

⚠ WARNING

- Read and follow all instructions carefully.
- Disconnect and lock-out power before installation and maintenance. Working on or near energized equipment can result in severe injury or death.
- Do not operate equipment without guards in place. Exposed equipment can result in severe injury or death.

⚠ CAUTION

- Periodic inspections should be performed. Failure to perform proper maintenance can result in premature product failure and personal injury.

Hydraulic Hub Installation and Removal

Introduction

Proper hub installation is critical to transmitting torque in a consistent and reliable manner.

The number of methods used to hydraulically mount hubs on shafts is as numerous as the equipment manufacturers in the industry. Each OEM has their own design philosophy regarding the placement of o-rings, type of hydraulic fittings and installation equipment.

This manual does not presume to dictate, override or contradict methods as may be defined by the OEM.

This manual is dedicated to providing guidelines to ensure that sufficient care is taken to provide the precise fit required between shaft and hub. Those guidelines presented herein which relate to equipment designed and provided by Kop-Flex are to be considered firm. Any deviations to the procedures, which apply to the use of this equipment, should first be discussed with Kop-Flex Engineering.

Several configurations of hub to shaft mounting will be encountered in the field. These configurations relate to the location of the o-rings on the hub and shaft and the means used to introduce dilation pressure. Figure 1A shows the o-ring arrangement where one o-ring groove is located on the shaft and the second on the hub, as well as dilation pressure introduced through a radially directed passage and circumferential groove. Figure 1B shows both o-rings located in the hub as well as pressure introduced through an axially directed passage and cross-drilled hole to a circumferential groove. Note that there are a variety of conventions regarding the design of o-ring arrangements and the pressure port locations. These also include configurations where no o-rings are used. The figures in this instruction manual are provided for reference only. Consult the coupling general arrangement drawing for specific applications.

The "pull-up" discussed herein is the predetermined axial movement of the hub relative to shaft permitted by the dilation of the hub. The value of this pull-up for specific installations may be found in the coupling general arrangement.

The units of measure presented in this manual are in PSI (lb/in²) and kPa (kiloPascal) all other data introduced shall have their units of measure converted accordingly.

1.0 Scope

This document provides a general guideline for hydraulic installation and/or removal of keyless, taper bored coupling hubs.

2.0 Initial Inspection

2.1 Precautions – High pressure hydraulic systems can be dangerous. Take every precaution to avoid injury.

- Carefully check equipment set up prior to pressurizing
- Use only equipment with suitable pressure ratings
- Check all fittings, plugs, and connections for proper assembly and tightness.
- Do not exceed pressure limits specified

2.2 Cleaning – The success of hydraulic mounting coupling hubs is highly dependent on the condition of the contacting surfaces. Both the hub bore and the shaft end must be clean and free from burrs; the smallest particle trapped between the shaft and the bore can cock the hub enough to make the fit up unsuitable for use. Any nicks, scratches and edges on mating surfaces must be polished smooth. Care must be taken to:

- not produce flat spots.
- clean shaft end and hub bore with mineral spirits.
- examine and clean all o-ring grooves.

2.3 Proper Contact – "Tapered bores shall be checked by using the plug gage from a matched plug and ring gage set furnished by the purchaser. A light coat of bluing shall be used for the check. Tapered bores for keyless hydraulically fitted hubs shall have at least an 85% blued fit (surface contact) to the taper gage." The preceding quote is excerpted from API Standard 671 3rd Edition dated October 1998. If less than the required 85% contact is found and it can be attributed directly to nicks and scratches, the hub bore or shaft may be lightly stoned or polished to remove high spots and checked again. If minimum contact of 85% is still not achieved, the shaft and the hub should be independently lapped using a ring and plug lapping tool set to ensure 85% contact. Lapping of hub to shaft is not recommended due to the possibility of forming a "step" on each mating surface at the point of initial engagement.

3.0 Initial Hub Mounting and Setup

- 3.1 Establish the Initial (zero) Position – Without o-rings and back up rings in the shaft or hub, set the hub on the shaft and with hand pressure only, push hub into full engagement with the shaft. This location is the initial position for starting axial pull up.
- 3.2 Establish the Installed (pulled-up) position – The hub must be advanced up the shaft by the amount and within the tolerance specified on the coupling general arrangement drawing. The difference between the initial position and the installed position is commonly referred to as the hub "pull-up."
- For an approximate reference point, blue the end of the shaft and scribe a line at the initial position as shown in Figure 1(A).
 - For an accurate reference point, use a depth micrometer to measure the distance from the end of the shaft to the face of the hub. Record this dimension for future reference.

There are two popular methods for establishing pull-up distance:

- 3.2.1 Dial Indicator Method – Locate a stable, flat stationary surface in proximity to the hub end upon which a magnetic base dial indicator can be mounted (reference Figure 1(A)). Set up the indicator to measure axial movement of the hub which will provide a direct and accurate reading of the desired pull-up.
- 3.2.2 Stop Ring Method – In this method a gap, corresponding to pull-up, is established between the end of the hub and a stop ring mounted on the shaft (reference Figure 1(B)). In this instance, feeler gages are used to accurately establish the pull-up distance. The stop ring or split collar (whichever may be used) should never be relied upon to act as a positive stop because mounting tool forces may exceed the resistive force of the ring. Therefore, the stop ring should only be looked upon and used as a gauging fixture. Note: It is the company's recommendation that both of the above methods should be used when setting pull-up, if possible (sections 3.2.1 and 3.2.2).

3.3 O-rings and Backup Rings (if applicable)

3.3.1 Installing O-rings and Backup Rings - If the tapered shaft and/or the hub is equipped with o-ring grooves (which is the most common design for hydraulically installed hubs), they must be installed now. After initial position is established remove the hub and install the proper o-rings and backup rings. The o-ring is nested on the concave side of the backup ring with the backup ring located on the anti-pressure side of the o-ring. It is imperative that the o-rings and backup rings be kept clean and are lubricated before installation. Lubricate with the hydraulic fluid used to pressurize the hub. Note that most hydraulically installed tapered hub to shaft fits are designed to have an o-ring and backup ring installed together in each groove. However, some shaft ends are designed to use only an o-ring (without the backup ring), while others are designed for neither an o-ring or a back-up ring at all. The latter is more commonly seen in the hydraulic "removal only" designs (i.e. heat mounted applications). Consult with your equipment shaft manufacturer for the o-ring details of your specific application. **Do not use vaseline glycerine or any viscous lubricants.**

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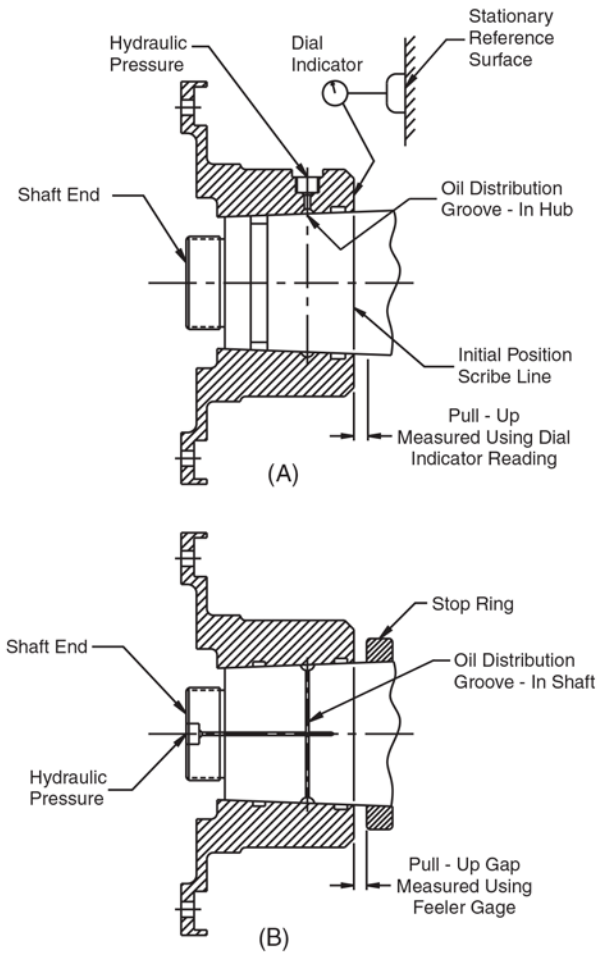


Figure 1

When installed, if an overlap exists at the split joint of the backup ring, the ends may be dressed to fit.

3.3.3 Recheck Start Position – Refer to Section 3.2. Recheck the reference point by remeasuring the distance from the end of the shaft to the face of the hub. This should be the same as the measurement taken previously. If necessary, adjust location with a soft mallet or use the axial pusher in section 3.6 to reposition the hub to the initial (zero) position from before and re-zero the indicators for the original initial (zero) position of section 3.1.

3.3.2 Remounting the Hub on the Shaft – With o-rings and backup rings installed (if applicable), reposition the hub on the shaft. When moving the hub over the shaft, take particular care that o-rings and backup rings are properly seated and not pinched or damaged. With o-rings now in place, the hub will usually be prevented from reaching its initial position. This is a normal condition and not to be viewed as a problem. If this condition occurs the accepted method of moving the hub up the taper is to use a lead hammer. Several blows of the hammer will seat the rings and allow the hub to move to the initial scribe line (starting position).

3.4 Mounting of the Pusher Assembly

The pusher assembly shown in Figure 2 is designed and constructed to match the machine shaft end. Its stroke will accommodate the full pull-up of the coupling hub onto the shaft. The maximum stroke of the pusher is marked on its outside diameter. Check that the stroke of the pusher exceeds the hub pull-up value shown on the coupling general arrangement drawing.

3.4.1 Once the starting position has been verified, thread the pusher assembly onto the shaft and lightly seat it using a spanner wrench. Figure 2 shows a typical pusher assembly mounted on the shaft end with the hub in its starting position. As previously recommended, both the dial indicator and stop ring methods are depicted to monitor the hub pull-up.

3.5 Assemble the Hydraulic Installation Kit

The Hydraulic Installation Kit shown in Figure 3 is comprised of two hydraulic pumps, their gauges, associated valving and hoses all mounted on a welded tube frame to form an integral, readily movable sled. The two pumps are manually operated providing independent sources of both high pressure (35,000 PSI/240,000kPa) and low pressure (10,000PSI/70,000kPa) fluid.

3.5.1 Pump and Hose Assembly – Operation /Handling

- Remove plugs from each "tee" at the pump.
- Remove plugs from one end of each hose and attach one hose to each pump.
- Both hoses supplied are suitable for high-pressure use and are therefore interchangeable.
- Mount hub and pusher assembly onto shaft end per the instructions contained in this manual in Sections 3.3 and 3.4.
- Remove plug from hose attached to low pressure pump.
- Remove the bottom plug from the pusher assembly and attach the hose from the low pressure pump.
- Loosen the upper plug on the pusher assembly to bleed air from the system.
- Close the valve on the low-pressure pump and operate pump until hydraulic fluid flows freely from the bleed plug. Collect the bleed fluid and discard. Close the bleed plug when there are no longer air bubbles in the in the bleeder fluid.
- The low-pressure pump may now be operated to provide hub advancing pressure to the pusher assembly. Recheck the fluid level in the pump to avoid the possibility of introducing air into the line during installation.
- Install a high-pressure fitting into either the shaft end or outside diameter of the hub depending on machinery design.
- Remove plug from end of hose from the high-pressure pump. Attach hose to the fitting only finger tight then back-off to bleed the line.

- Close valve on high-pressure pump and operate the pump until fluid flows freely from the hose connection. It may take considerable pumping. Collect bleed fluid and discard. Recheck the fluid level in the pump to avoid the possibility of introducing air into the lines during installation.
- Carefully recheck and tighten all fittings and plugs.
- Note: Save all removed plugs for reuse.

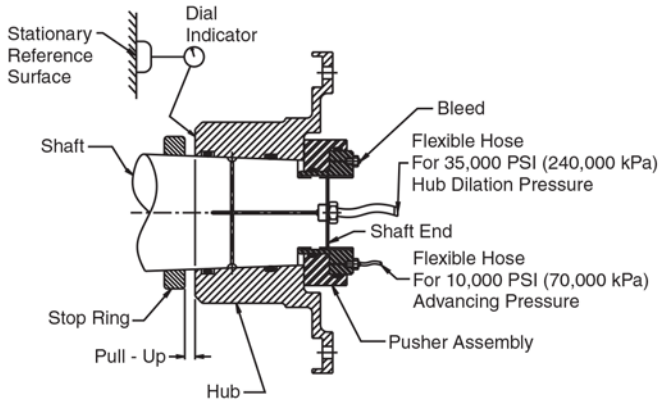
Note: Packaged with each installation kit are the instruction manuals published by the pump manufacturer. These manuals are to be considered part of this manual. Kop-Flex strongly advises that all manuals be read before operating the equipment.

3.6 Hub Installation

3.6.1 Recheck hub starting position and dial indicator adjustment (reference Section 3.3.3).

3.6.2 Expanding the Hub – To expand the hub, use the high- pressure pump and slowly increase pressure to approximately 12,000PSI/82740kPa. To prevent the hub from moving down the shaft as the expanding pressure builds up, use the low pressure pump to develop sufficient pusher-piston force to maintain the hub at its zero starting position. Although no positive action is suggested to bleed the cavity formed by the shaft, hub and o-rings, some bleeding may occur and be observed. The degree of bleeding will vary from installation to installation and be a function of equipment arrangement and tolerance. As stated in the previous paragraph, it is important that the hub be maintained at its zero starting position as the initial expanding pressure is developed. Continue applying pressure using both pumps until conditions are stable then start the advancing procedure. Stabilized expanding pressure should be in the range of 12,000 to 15,000PSI (82,740 to 103,420kPa).

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Note: Location of hub dilation pressure inlet, oil distribution groove and o-ring arrangement varies as shown in Figure 1.

Figure 2

Hydraulic Hub Installation and Removal

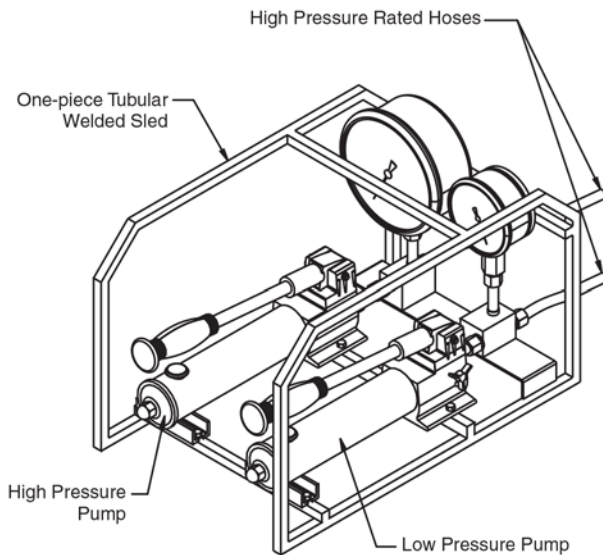


Figure 3

If the hub to shaft design is of the style where no o-rings are used, the axial (low pressure) pump is used to push the hub onto the shaft slightly, before developing any pressure in the radial expansion (high pressure) pump. Further bleeding of the high pressure pump may be accomplished by allowing air to be pushed out of the large end of the tapered bore and applying pressure to the axial pump only after oil is visible at the large end of the taper fit.

3.6.3 Advancing the Hub – Using only the low pressure pump, slowly advance the hub on the shaft, continually monitoring hub movement with the dial indicator. As the hub advances, pressure in the high pressure pump may be noted to build without activating the high pressure pump. This hub pressure may reach a level of 27,500PSI (189,000kPa). Should this pressure exceed 28,000PSI (193,060kPa), bleed off oil at the pressure release valve of the high pressure pump until the pressure drops to 25,000PSI (172,375kPa) before proceeding with the advancement. Should advancement alone not produce the hub pressures as noted above, use both the high pressure and low pressure pumps accordingly to advance the hub to the pull-up position. Always observe the high pressure and low pressure limits. Should the pressure at the low pressure pump reach its limit, remove the hub following the instructions of Section 5.0 and inspect bore and shaft for damage and possible causes of the hang-up.

3.6.4 Seating the Hub – When the specified pull-up has been reached, begin releasing the dilation pressure from the high pressure pump very slowly to zero and disconnect the hose from the hub. Maintain pressure on the pusher-piston holding the hub in its pulled-up position. After waiting a minimum period of one (1) hour to allow the hydraulic oil to drain from the interface, release pressure at the low-pressure pump very slowly. During this period of relaxing pressure observe the dial indicator for movement.

If any movement is noted, stop releasing the pressure and hold for an appropriate period of time (approximately fifteen (15) minutes) then start releasing pressure again. When all movement has ceased, the pusher-piston assembly may be disconnected from the hub.

Note: The waiting periods referred to in the previous sections are to be considered nominal at an ambient temperature of approximately 70° F. Because fluid flow is a function of fluid viscosity and in turn a function of fluid temperature. The lower the ambient temperature, the longer the expected waiting period. For example, at 30° F the fluid viscosity is 4 to 5 times that at 70° F and resultant flow time is approximately 5 times as long. At temperatures of 10° F or lower, it is recommended that kerosene be used as the expanding fluid because of its low viscosity. Kerosene is compatible with the Kop-Flex Installation Kit providing the hydraulic fluids are first removed from the pumps and hoses.

3.6.5 Verifying Pull-Up – Check that all pressures are zero.

Disconnect hose and fittings and remove pusher-assembly from the shaft end. Measure the distance from the shaft end to the hub face with depth micrometers and compare to the initial reading obtained in Section 3.2. Record the final pull-up dimension.

3.6.5.1 Insufficient Pull-up – If pull-up is less than specified repeat procedures outlined in Sections 3.6.1. through 3.6.5.

3.6.5.2 Excessive Pull-up – If pull-up is greater than specified reconnect high pressure hose and fittings to the hub and reinstall the pusher-piston with its associated hose and fittings. Pressurize the pusher-piston assembly to the level of pressure used for assembly. Pressurize the hub to approximately 22,000PSI (151,685kPa) then slowly release the pusher-piston pressure. As the pusher-piston pressure starts to drop, the hub should start to move down the taper. If the hub does not move, increase dilation pressure and again slowly reduce pusher-piston pressure. Repeat this procedure in very small increments of pressure because only a small amount of movement will most likely be required.

Note: Deviations to the specified pull-up may sometimes be considered to accommodate minor variations in BSE or Flange to Flange distance. This option should only be considered after consultation with the machinery manufacturer.

3.6.6 Securing the Hub – Install the retaining nut (if applicable) on the end of the shaft and tighten. Do not over tighten. Secure the retaining nut using the means provided or recommended by the machinery manufacturer (i.e. set screws, staking, etc.). This concludes the hub installation procedures.

4.0 Pusher Assembly

- 4.1 Retraction – After hub installation is complete, the pusher assembly piston is extended and must be retracted prior to reuse. This is accomplished by mechanically squeezing the assembly using a C-clamp or other similar device. Extracted fluid may be retained by attaching the hose and pump to the assembly and opening the pressure release valve on the pump.
- 4.2 Storage – When the pusher assembly is no longer required it is to be stored extended, full of oil, with the steel plugs in place and tightened. In this condition the assembly is ready for use when required for hub removal.

5.0 Hub Removal Procedure

5.1 Preparation

- 5.1.1 Clean the hub prior to removing the retaining nut (if applicable) from the shaft end. It is imperative that all surfaces, recesses, holes and transition areas between components be free of dirt and all foreign material.
- 5.1.2 Remove the retaining nut from the end of the shaft and secure the dial indicator to measure hub movement.
- 5.1.3 Connect the high-pressure pump and hose to the O.D. of the hub or shaft end making sure the pusher assembly is in the extended position of its stroke. Screw the pusher assembly onto the shaft end until it contacts the hub and then back off one full turn. It is permissible to insert teflon washers in the gap between the hub face and the pusher face to soften the impact loads associated with the hub “popping” off the shaft as it expands.
- 5.1.4 Connect the low-pressure pump and hose to the pusher assembly. Pump the pusher assembly until it just touches the end of the coupling hub. Bleed the high and low pressure lines as described in section 3.5. Pressure will develop when the piston makes contact with the hub. Note that the piston stroke should be positioned so that there is sufficient allowance for the pusher to retract the full amount of the hub pull-up as the hub is allowed to be “pushed” back off the shaft by radial pressure.

5.2 Removal

- 5.2.1 Using the high-pressure pump, slowly increase pressure to expand the hub until the hub moves axially. During the pump- up, the pressure may remain constant (at approximately 15,000 PSI for most tapered, keyless fits) for many pump strokes as fluid is spread between the contact surface. As pressure builds, do not exceed the pressure ratings. If this pressure level is reached before the hub starts to move, lightly tap hub with a wooden mallet. Once movement is observed, it is only necessary to reduce the axial force imposed by the pusher assembly to complete withdrawal. This is accomplished by slowly opening the valve on the low-pressure pump while the internal pump remains pressurized. Close valve when hub has moved its full pull- up amount and no longer exerts pressure on either pump. If the hub does not withdraw as the low pressure valve is opened, close the valve and repeat the procedures of this section.

WARNING! Keep clear of hub and mounting tools when pressurizing because hub usually moves off taper with a sudden jump and high axial force. A loud “popping” sound is normal as the hub initially “breaks free.”

- 5.2.2 Check that all lines are depressurized. Remove pusher assembly and disconnect high-pressure pump. The hub can now be easily removed from the shaft end.

5.3 Inspection

Examine coupling hub o-rings (if applicable). Even small cuts and abrasions will warrant replacement. Backup rings however can sustain moderate damage and still remain effective. If backup rings have only a corner pinched or extruded material does not protrude more than one thickness of the backup ring, then the backup ring may be reused without much risk of damage to the o-ring. If parts are readily available, it is always safest to replace both o-rings and backup rings.

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