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Service Bulletin SB1140-M1
PH-2, 7.00" & 8.00" Bore PH-3 Series Hydraulic Cylinders
Issued: August, 2012
Supersedes: None

PH-2, 7.00" & 8.00" Bore PH-3 Series Hydraulic Cylinders

Parts Identification, Maintenance Instructions & Seal Kits

Service Assemblies and Seal Kits

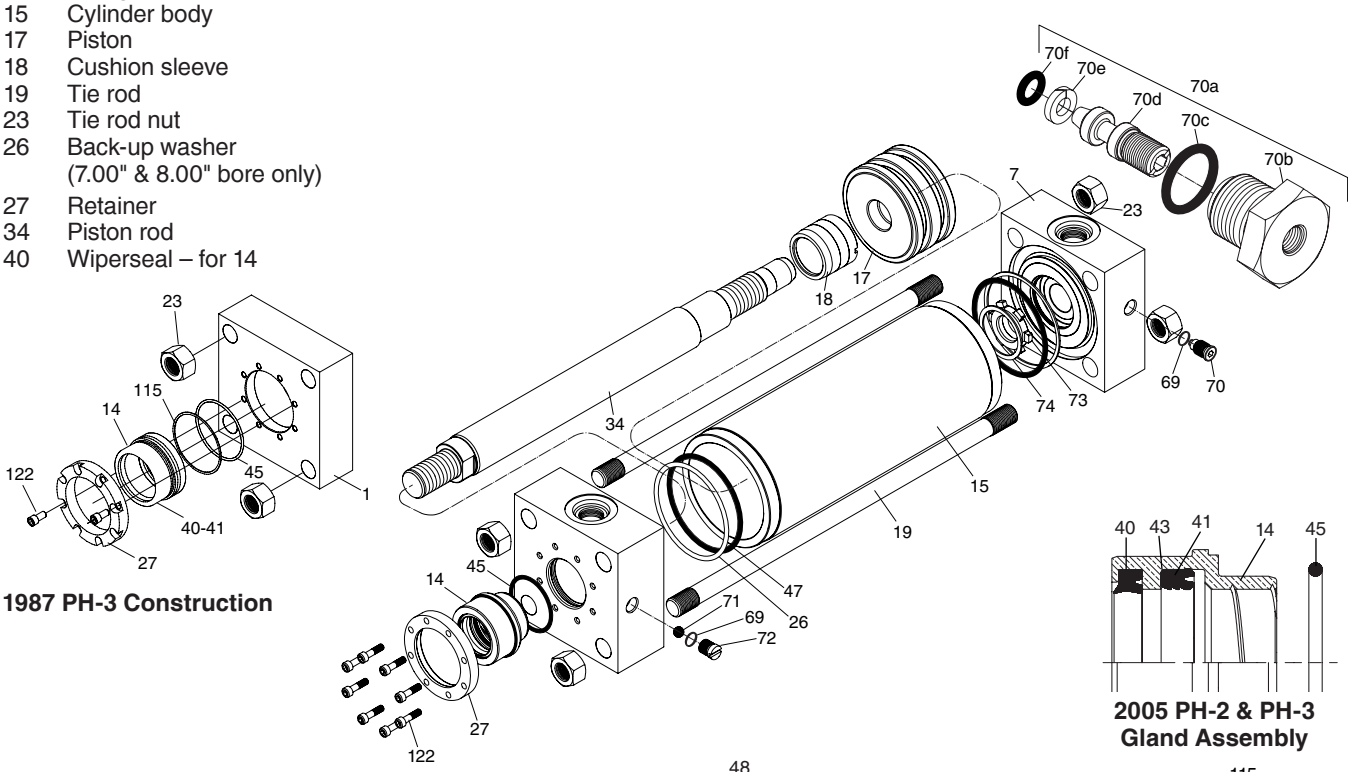
Service Assemblies and Seal Kits for Schrader Bellows hydraulic cylinders simplify the ordering and maintenance processes. They contain sub-assemblies which are ready for installation, and are supplied with full instructions. When ordering Service Assemblies and Seal Kits, please refer to the identification plate on the cylinder body, and supply the following information:

Serial Number - Bore - Stroke - Model Number[3] - Fluid Type

Key to Part Numbers

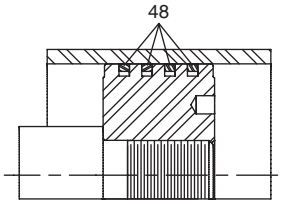
1 Head
7 Cap
14 Rod gland
15 Cylinder body
17 Piston
18 Cushion sleeve
19 Tie rod
23 Tie rod nut
26 Back-up washer (7.00" & 8.00" bore only)
27 Retainer
34 Piston rod
40 Wiperseal – for 14
41 Lipseal – for 14
42 Lipseal, Piston
43 Back-up washer, gland lipseal 41 (not hydraulic Class 1 seals)
44 Back-up washer, piston lipseal
45 O-ring – gland/head
47 O-ring – cylinder body
48 Cast iron rings
69 O-ring – needle valve and check valve screws
70[1] Needle valve, cushion adjustment
70a[1] Needle valve, cushion adjustment – cartridge type
70b Cartridge screw
70c O-ring – cartridge screw
70d Needle screw
70e Back-up washer – needle screw
70f O-ring – needle screw
71 Ball – cushion check valve
72 Cushion check valve screw
73 Floating cushion bushing
74 Retaining ring for cushion bushing
115 Back-up washer, rod gland to head o-ring
119[2] Hi-Load Piston seal
120[2] Energizing ring for Hi-Load seal
121 Wear ring for Hi-Load piston
122 Retainer Bolt

[1] In some cases, the adjusting screw is installed in a cartridge.
[2] 7.00" & 8.00" Bore cylinders have only one Hi-Load piston seal and energizing ring.
[3] See page 2 for model number changes to 2005 PH-2 & PH-3.

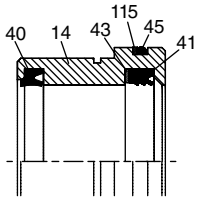


1987 PH-3 Construction

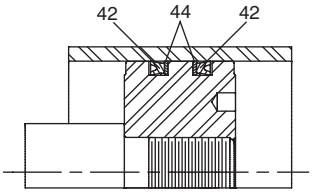
2005 PH-2 & PH-3 Gland Assembly



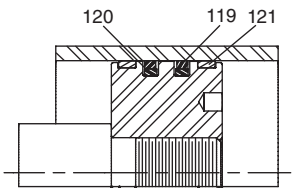
Ring Type Piston



1987 PH-2 & PH-3 Gland Assembly



Lipseal Piston



Hi-Load Piston

Operating Fluids and Temperature Ranges

The table shows the main types of fluid used with hydraulic cylinders. If the operating conditions of the particular application cannot be met by the seal classes described, please consult the factory and supply application details.

Class No	Typical Fluids	Temperature Range
1 Nitrile & Polyurethane	Air, Nitrogen, Hydraulic Oil, Mil-H-5606 Oil	-10°F (-23°C) to +165°F (+74°C)
2 Nitrile	Water, Water Glycol, H.W.C.F. Water-in-Oil Emulsion - Houghto-Safe 271, 620, 5040 Mobil Pyrogard D, Shell Irus 905, Ucon Hydrolube J-4	-10°F (-23°C) to +165°F (+74°C)
5 Fluorocarbon	High Temperature Houghto-Safe 1010, 10551 1120, Fyrquel 150, 220, 300, 550 Mobil Pyrogard 42, 43, 53, 55 Note: Fluorocarbon seals are not suitable for use with Skydrol fluid, but can be used with hydraulic oil if desired.	-10°F (-23°C) to +250°F (+121°C) (Class 5 seals may be operated up to +400°F [+204°C] with reduced service life)

Service Kit Numbers

Schrader Bellows PH-2 and PH-3 were originally introduced in 1987. In July 2005, the PH-2 and PH-3 rod gland and retainer design were revised to improve performance and service-ability. This change resulted in two different style rod gland and rod seal kits; one for the 1987 version and another for the July 2005 version. The July 2005 PH-2 and PH-3 model code was revised with a new Bore and Rod Diameter code that will identify the new design.

Cylinders ordered after July 19, 2005 and later can be identified by a revised Bore and Rod Diameter code format. See the example shown (or refer to Catalog SB0106-4 or later) and compare to the cylinder label model number. Cylinders ordered prior to July 19, 2005 have an alpha numeric Bore and Rod Diameter code formatted with 1 letter followed by 2 numbers, e.g. C11 for 2.50" bore with 1.000" rod. From July 19 to the present, the code is formatted as 2 letters followed by 1 number, e.g. CA1 for 2.50" bore with 1.000" rod.

Model Number Examples:

Prior to July 19, 2005 — PH**C11**0823 w/ 6" stroke

July 19, 2005 to present — PH**CA1**0823 w/ 6" stroke

2005 PH-2 Rod Gland and Rod Seal Kits

Rod Ø (1.50 - 6.00 Bore Sizes)	Standard Seals		Fluorocarbon Seals	
	Rod Gland Cartridge Kits	Rod Seal Kits	Rod Gland Cartridge Kits	Rod Seal Kits
0.625	A63230A08	A63230C08	A63230B08	A63230D08
1.000	A63230A10	A63230C10	A63230B10	A63230D10
1.375	A63230A13	A63230C13	A63230B13	A63230D13
1.750	A63230A14	A63230C14	A63230B14	A63230D14
2.000	A63230A20	A63230C20	A63230B20	A63230D20
2.500	A63230A25	A63230C25	A63230B25	A63230D25
3.000	A63230A30	A63230C30	A63230B30	A63230D30
3.500	A63230A35	A63230C35	A63230B35	A63230D35
4.000	A63230A40	A63230C40	A63230B40	A63230D40

2005 PH-3 Rod Gland and Rod Seal Kits

Rod Ø (7.00 - 8.00 Bore Sizes)	Standard Seals		Fluorocarbon Seals	
	Rod Gland Cartridge Kits	Rod Seal Kits	Rod Gland Cartridge Kits	Rod Seal Kits
3.000	A63230A30	A63230C30	A63230B30	A63230D30
3.500	A63230A35	A63230C35	A63230B35	A63230D35
4.000	A63230A40	A63230C40	A63230B40	A63230D40
5.000	A63230A50	A63230C50	A63230B50	A63230D50
5.500	A63230A55	A63230C55	A63230B55	A63230D55

Contents and Part Numbers of Seal Kits For Rod Glands (See key to part numbers on page 1)

Rod Gland Kits – Contain items 14, 40, 41, 45, 115 (1987 PH-2 & PH-3 only), (43 class 2 & 5 only except 0.625" & 1.000" rod in 2005 PH-2 & PH-3.)

Rod Seal Kits – Contain items 40, 41, 45, 115 (1987 PH-2 & PH-3 only), (43 class 2 & 5 only except 0.625" & 1.000" rod in 2005 PH-2 & PH-3.)

1987 PH-2 Rod Gland and Rod Seal Kits

Rod Ø (1.50 - 6.00 Bore Sizes)	Standard Seals		Fluorocarbon Seals	
	Rod Gland Cartridge Kits	Rod Seal Kits	Rod Gland Cartridge Kits	Rod Seal Kits
0.625	A63230108	A63230308	A63230208	A63230408
1.000	A63230110	A63230310	A63230210	A63230410
1.375	A63230113	A63230313	A63230213	A63230413
1.750	A63230114	A63230314	A63230214	A63230414
2.000	A63230120	A63230320	A63230220	A63230420
2.500	A63230125	A63230325	A63230225	A63230425
3.000	A63230130	A63230330	A63230230	A63230430
3.500	A63230135	A63230335	A63230235	A63230435
4.000	A63230140	A63230340	A63230240	A63230440

1987 PH-3 Rod Gland and Rod Seal Kits

Rod Ø (7.00 - 8.00 Bore Sizes)	Standard Seals		Fluorocarbon Seals	
	Rod Gland Cartridge Kits	Rod Seal Kits	Rod Gland Cartridge Kits	Rod Seal Kits
3.000	A63230130	A63230330	A63230230	A63230430
3.500	A63230135	A63230335	A63230235	A63230435
4.000	A63230140	A63230340	A63230240	A63230440
5.000	A63230150	A63230350	A63230250	A63230450
5.500	A63230155	A63230355	A63230255	A63230455

Contents and Part Numbers of Seal Kits For Rod Glands
(See key to part numbers on page 1)

Rod Gland Kits – Contain items 14, 40, 41, 45, 115 (1987 PH-2 & PH-3 only), (43 class 2 & 5 only except 0.625" & 1.000" rod in 2005 PH-2 & PH-3.)

Rod Seal Kits – Contain items 40, 41, 45, 115 (1987 PH-2 & PH-3 only), (43 class 2 & 5 only except 0.625" & 1.000" rod in 2005 PH-2 & PH-3.)

Piston Seal and Body Seal Kits — All PH-2 Versions

PH-2 Bore Ø	Standard Seals				Fluorocarbon Seals			
	Body Seal Kits	Piston Lipseal Kits	Piston Ring Kits	Hi-Load Piston Kits	Body Seal Kits	Piston Lipseal Kits	Piston Ring Kits	Hi-Load Piston Kits
1.50	A63215010	A63211507	A63211508	A63211560	A63221520	A63221507	A63221508	A63221560
2.00	A63220010	A63212007	A63212008	A63212060	A63222020	A63222007	A63222008	A63222060
2.50	A63225010	A63212507	A63212508	A63212560	A63222520	A63222507	A63222508	A63222560
3.25	A63232011	A63213207	A63213208	A63213260	A63223230	A63223207	A63223208	A63223260
4.00	A63240011	A63214007	A63214008	A63214060	A63224030	A63224007	A63224008	A63224060
5.00	A63250011	A63215007	A63215008	A63215060	A63225030	A63225007	A63225008	A63225060
6.00	A63260011	A63216007	A63216008	A63216060	A63226030	A63226007	A63226008	A63226060

Piston Seal and Body Seal Kits — All PH-3 Versions

PH-3 Bore Ø	Standard Seals				Fluorocarbon Seals			
	Body Seal Kits	Piston Lipseal Kits	Piston Ring Kits	Hi-Load Piston Kits	Body Seal Kits	Piston Lipseal Kits	Piston Ring Kits	Hi-Load Piston Kits
7.00	A63307031	A63307011	A63307001	A63307021	A63307035	A63307015	A63307005	A63307025
8.00	A63308031	A63308011	A63308001	A63308021	A63308035	A63308015	A63308005	A63308025

Contents and Part Numbers of Seal Kits For Pistons & Bodies
(See key to part numbers on page 1)

Piston Lipseal Kits – (Includes Cylinder Body End Seals) Contain two each of items 47, 42, & 44 (26 7.00" & 8.00" bore only).

Piston Ring Kits – (Includes Cylinder Body End Seals) Contain two each of item 47, (26 7.00" & 8.00" bore only) & four each of item 48.

Hi-Load Piston Seal Kits – (Includes Cylinder Body End Seals): Contains two each of items 47, 119, 120 & 121 (26 7.00" & 8.00" bore only).

Cylinder Body End Seal Kits - Contains two each of item 47 (26 7.00" & 8.00" bore only).

Cylinder Modifications or Repairs

Cylinders as shipped from the factory are not to be disassembled and or modified. If cylinders require modifications, these modifications must be done at company locations or by The Company's certified facilities. The Industrial Cylinder Division Engineering Department must be notified in the event of a mechanical fracture or permanent deformation of any cylinder component (excluding seals). This includes a broken piston rod, tie rod, mounting accessory or any other cylinder component. The notification should include all operation and application details. This information will be used to provide an engineered repair that will prevent recurrence of the failure.

It is allowed to disassemble cylinders for the purpose of replacing seals or seal assemblies. However, this work must be done by strictly following all the instructions provided in this bulletin.

Although Schrader Bellows Hydraulic Cylinders are designed to make on-site maintenance or repairs as easy as possible, some operations can only be carried out in our factory. It is standard policy to fit a cylinder returned to the factory for repair with those replacement parts which are necessary to return it to 'as good as new' condition. Should the condition of the returned cylinder be such that repair would be uneconomical, you will be notified.

The piston is sealed and securely locked to the piston rod with anaerobic adhesive. This threaded connection is ONLY to be diassembled or reassembled by factory trained personnel.

⚠ **WARNING**: Some cylinders contain heavily loaded springs. Improper disassembly of these cylinders can cause severe bodily injury or death. Always disassemble a cylinder containing a spring by following the instructions in Bulletin 0805-G-TSD-1.

After the cylinder has been disassembled, carefully remove the seals that will be replaced to avoid damaging groove surfaces. Carefully clean all parts.

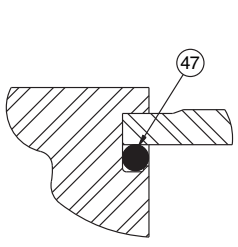
Seals will be easier to install if they are lubricated. Always lubricate seals and other components of a hydraulic cylinder with the operating fluid. Cylinders fitted with Class 3 seals (EPR) cannot be lubricated or operated with petroleum based products.

Servicing Piston Seals

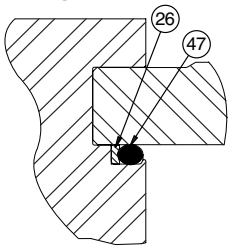
The cylinder bore and piston must be closely examined for signs of scoring. If either the cylinder body or piston is damaged they must be replaced.

When a cylinder is overhauled, a new set of piston seals is required. It is also recommended that the cylinder be reassembled with new cylinder body O-rings. All piston seal kits contain piston seals as well as two cylinder body O-rings (47) and for 7 and 8 inch bore hydraulic cylinders, their mating back-up washers (26).

Body End O-Rings



1.50- 6.00" Bore



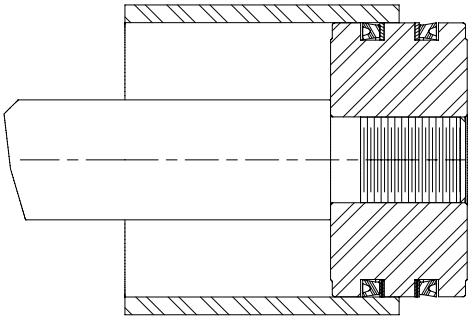
7.00" & 8.00" Bore

Lipseal Piston

Kits for Lipseal pistons contain two lipseals (42) and two back-up washers (44).

Apply lubricant to the piston OD and all grooves. Install one piston seal in the groove nearest the rod. The two 'lips' of this Lipseal should face toward the rod end of the piston. Install the back-up washer in the same groove opposite the 'lips' of the seal. Lubricate the cylinder body ID and insert the piston – cap end first – into the cylinder body as shown.

Next, turn the cylinder body on its side and push the piston through the body just far enough to expose the groove for the second seal. Now, install the second Lipseal and back-up washer in the exposed groove with the two 'lips' facing away from the rod. Then pull the piston into the cylinder body.



Hi-Load Piston

Kits for Hi-Load pistons contain two sets of seals for 1.50" - 6.00" bore cylinders and one set of seals for 7.00" - 8.00" bore cylinders. Each seal set includes one filled PTFE sealing ring (119) and an elastomeric energizing ring (120). The kit also contains two wear rings (121). Install the inner energizing ring(s) in the seal groove(s).

Install the wear rings in the two grooves on each end of the piston. Stretch the PTFE seal ring(s) by hand until it fits over the wear ring. Push the outer ring(s) over the wear ring and into the seal groove(s). With the outer ring(s) in the groove(s), compress them with a ring compressor. Alternatively, the PTFE rings can be compressed using a large hose clamp over thin shim stock. In all cases, take care not to damage the sealing ring(s). Keep the sealing ring(s) compressed for some time before inserting the piston into the body. A starting sleeve having an ID the same size as the cylinder bore, and tapered at one end, will aid the installation process.

Cast Iron Piston Rings

Kits for cast iron piston rings contain four rings (48). Iron piston rings seldom need replacement. If the rings show no signs of damage or abnormal wear, they may be reused. To install piston rings, collapse the rings one at a time while inserting the piston into the cylinder body, using a light oil to aid this process.

Cylinder Assembly

The cylinder should be re-assembled as follows:

1) The back-up washers, where fitted, and then the body O-rings should be lightly lubricated and pressed into the grooves in the head and cap, without twisting. The cylinder body, with the piston and rod already fitted, can then be assembled to the cap by 'rocking' it down over the O-ring until the cylinder body is in contact with the cap. The head is then fitted over the piston rod and assembled to the cylinder body. Rock gently until the body and head are in metal-to-metal contact.
2) Lightly lubricate the gland seals.
3) Slide the gland over the piston rod end, taking care not to damage the seal lips. Slide the small circular or full square retainer over the gland. Orient holes in full square retainers over the tie rod holes in the head or line up holes in smaller retainers with threaded mounting holes. Assemble bolts that secure bolt-on retainers finger tight.
4) Ensuring that the head and cap are kept in alignment, refit the cylinder tie rods.

Note: Some cylinder configurations have tie rods threaded into a component other than tie rod nuts (e.g. head, cap, flange plate, etc). Before torquing the tie rods, use paint on the tie rods as an indicator that adequate thread engagement is achieved. Ensure that no unpainted thread is exposed at the connection to the mating component.

For both style retainers, torque tie rod nuts to values listed on page 6. **Torque tie rods gradually starting at one corner and work in a diagonal pattern to ensure evenness of tightening. DO NOT TORQUE ONE TIE ROD COMPLETELY AND THEN THE OTHERS.** Then, on cylinders with bolt-on retainers, torque bolts to the values listed on page 6.

Trunnion Mounts

Trunnion mount with trunnion in groove on cylinder body – Torque cap end tie rods to value listed in table, then torque head tie rods to the same value.

Trunnion mounts with trunnion located against a single shoulder on the cylinder body – Torque tie rods on the larger diameter side of the shoulder to approx. 10% of torque table value. Then torque the tie rods on the opposite end to the full table value.

Trunnion mounts located on a cylinder body without a shoulder – Assemble short set of tie rods first, using paint marks on the cylinder body as a location guide. Ensure the trunnion pins are square to the body. Install the longer tie rods and torque to values in the table.

Servicing Cushion Needle and Check Valves

Leakage from cushion adjusters or check valve screws indicates that the screw or cartridge-type assembly must be replaced. The replacement assembly includes a new O-ring.

Removal

The screw/cartridge assembly should be unscrewed and its mounting hole cleaned, paying close attention to the surface on which the O-ring sits.

Installation – Cushion Needle Valves

Where a cartridge-type adjuster is fitted, lightly lubricate the screw threads and torque to the figures shown in the table on page 6. With both types, the hex-headed screw may be adjusted to provide the required cushioning performance.

Installation – Check Valve

Ensure that the ball is correctly positioned. Screw-type adjusters should be screwed fully home, and then backed off by a full turn.

Servicing Cylinder Gland Seals

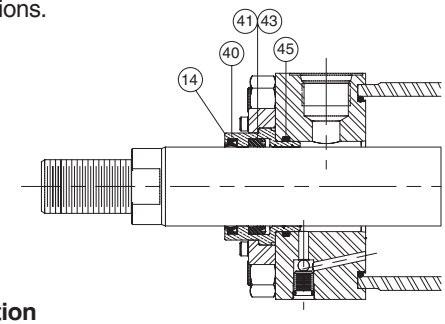
Fluid leakage from the piston rod at the gland normally indicates worn rod seals. The cylinder should, if possible, be removed for overhaul, or the piston rod disconnected.

Removal

1) Inspect the piston rod to make sure it is free from burrs or damage which would prevent the gland sliding off the rod.

The Schrader Bellows gland is a cartridge design consisting of a bronze gland (14), primary rod seal (41), back-up washer (43) for all hydraulic cylinder seal classes, and a double lip wiperseal (40). The PH-2 and PH-3 gland is usually held in place with a bolt-on retainer. However, some PH-2 Series mounting styles with oversize piston rod diameters will utilize a retainer plate held in place by tie rods.

2) Where the gland is secured by a circular retainer, undo the socket head cap screws and slide the gland and retainer off the piston rod.
3) Remove the seals using a sharp pointed instrument, taking care not to damage the gland. Clean and inspect the gland bore and seal grooves. If any wear is present replace with a Rod Gland Kit containing seals of the correct type for the conditions.



Installation

Inspect the surface of the piston rod for damage which could cause early seal failure. When fitting the gland over the rod thread, a slight rotary motion will help prevent damage to the seals. In addition, shim stock or other thin, tough material can be wrapped around the threads to protect the seal lips.

1) Ensure that the kit contains seals of the correct type. Lubricate the gland and seals, and fit the wiper (40) into the groove closest to the outside face of the gland.
2) If a Class 1 material rod seal is being fitted to a standard gland, no back-up washer is necessary. A back-up washer (43) is included in seal kits for all other service classes. Install this in the rod seal groove, against the wall closest to the wiper. Install the lipseal (41) in the groove, **with the lips facing the pressure (cylinder) side of the gland.**
3) Slide the gland cartridge over the piston rod end thread and into the cylinder head. Place the retainer plate over the gland, install the mounting bolts and torque to the values listed on page 6. Note that some mounting styles with oversize piston rod diameters will utilize a retainer plate held in place by tie rods.
4) Each kit contains an O-ring (45) which seals the gland to the cylinder head. This O-ring is a static seal, and the original must be left in place unless it is faulty.

For cylinders that utilize a retainer plate held in place by tie rods, torque the rod nuts to values listed on page 6. **Torque tie rods gradually starting at one corner and work in a diagonal pattern to ensure evenness of tightening. DO NOT TORQUE ONE TIE ROD COMPLETELY AND THEN THE OTHERS.**

Rod seals are pressure activated and do not need adjustment.

Tie Rod Torque

An extreme pressure lubricant (such as molybdenum disulphide) should be used on tie rod threads and nut bearing surfaces to control friction and reduce tie rod twist.

Bore Size	Tie Rod Torque[1]	
1.50	18 - 19 lb-ft	24 - 25 N-m
2.00	45 - 49 lb-ft	61 - 67 N-m
2.50	45 - 49 lb-ft	61 - 67 N-m
3.25	120 - 124 lb-ft	163 - 169 N-m
4.00	131 - 135 lb-ft	178 - 184 N-m
5.00	312 - 316 lb-ft	423 - 429 N-m
6.00	528 - 544 lb-ft	716 - 738 N-m
7.00	800 - 816 lb-ft	1085 - 1107 N-m
8.00	1168 - 1184 lb-ft	1584 - 1606 N-m

[1] The tie rod torque values listed in this table are intended for PH-2 and PH-3 cylinders having a pressure envelope pressure rating of 3000 psi. Consult factory for tie rod torque of cylinders having a higher pressure rating.

Cartridge Cushion Adjuster Torque

Nominal Screw Size	Torque	
M8	6 - 7 lb-ft	9 - 10 N-m
M10	18 - 22 lb-ft	25 - 30 N-m
M14	44 - 48 lb-ft	60 - 65 N-m

Retainer Bolt Torque For Cylinders with Round Gland Retainers

Rod Dia.	Torque	
0.625	56 - 58 lb-in	6.3 - 6.6 N-m
1.000	56 - 58 lb-in	6.3 - 6.6 N-m
1.375	56 - 58 lb-in	6.3 - 6.6 N-m
1.750	56 - 58 lb-in	6.3 - 6.6 N-m
2.000	11 - 12 lb-ft	15 - 16 N-m
2.500	11 - 12 lb-ft	15 - 16 N-m
3.000	41 - 43 lb-ft	54 - 56 N-m
3.500	41 - 43 lb-ft	54 - 56 N-m
4.000	41 - 43 lb-ft	54 - 56 N-m
5.000	41 - 43 lb-ft	54 - 56 N-m
5.500	41 - 43 lb-ft	54 - 56 N-m

⚠ Warning

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from The Company, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application, including consequences of any failure and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

The product described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by The Company and its subsidiaries at any time without notice.

Offer of Sale

The items described in this document are hereby offered for sale by The Company, its subsidiaries or its authorized distributors. This offer and its acceptance are governed by provisions stated on a separate page of this catalog in the document entitled "Offer of Sale".

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