Clark Pump Rebuild Manual

Full Process of Rebuild

Last Updated 2024

Applies to the following products:	7%, 10%, and 20% Clark Pumps

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Welcome

This guide will walk a technician or end user through the rebuilding of a Clark Pump

During the remanufacturing process we will replace all degradable parts, such as O-rings, springs, and seals, as well as any parts that show damage or wear.

The Clark Pump has been consistently refined and improved over the years, so during remanufacturing we will also bring older pumps up to current standards, wherever possible. We replace PET end caps (units made between 2006 and 2009) , which have a limited lifespan, with Delrin.

The photos and part numbers referenced in this guide are for a 7% Clark Pump, with key measurements and tolerances given for 10% and 20% displacements. The process and many of the part numbers are identical for 10% and 20% models. A few key parts will of course be different, but these differences should obvious with the parts in front of you. A brief appendix shows key differences and part numbers for the 20% Clark Pump.

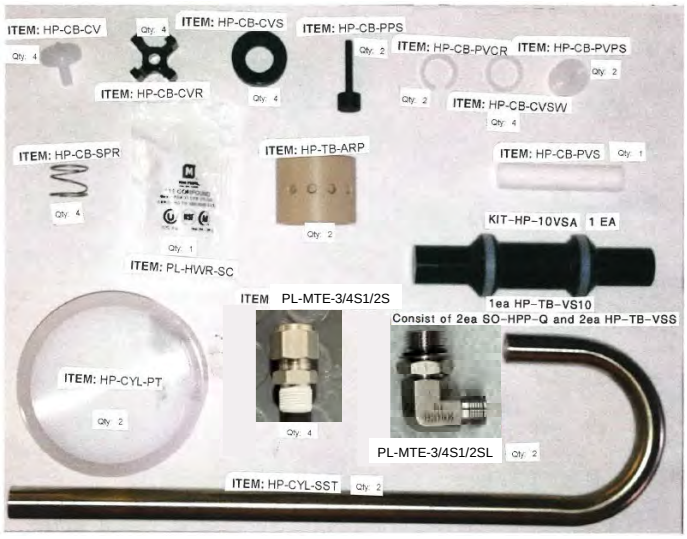
Only a handful of 15% Clark Pumps were built. Rebuilding them is straightforward, and Katadyn maintains an inventory of replacement parts, but we recommend consulting with Katadyn, or returning the unit to Katadyn for remanufacturing.

Clark Pump Rebuild Kits

Clark Pump Rebuild Kit

KIT-HP-7UD | KIT-HP-10UD | KIT-HP-20UD

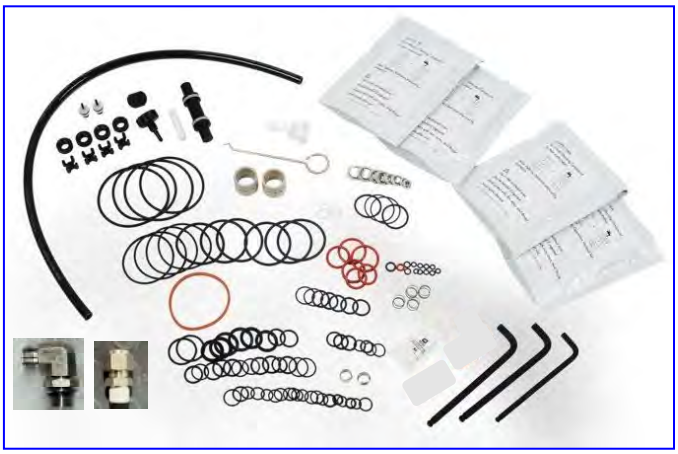
This kit contains all the parts required for a factory rebuild and is designed for service partners to rebuild the Clark Pump in their shop. The kit includes all the internal parts within the Clark Pump except the spacer rings and top end Spool Pistons. This kit has a photographic parts map where the parts can be laid out parts next to their corresponding part numbers. It also includes decals for the cylinders and top end. It does not contain instructions or tools. *thumbnail of complete rebuild parts map.



Offshore Kits

KIT-OFFSH for a 7% or 10% | **KIT-OFFSH1** for a 20%

The Offshore Kit includes a seal and O-ring kit, annular rings, reversing valve spool, a section of nylon high pressure tubing, high pressure fittings, acid and alkaline membrane cleaning solutions, Alan Wrenches, an O-ring Pick, an Annular Ring tool and the Clark Pump rebuild instruction manual. This kit does not include a piston rod(s) or cylinder pistons.



Seal & O-ring Kit - If a full rebuild is not required

KIT-HP-S&O for a 7% and 10% | **KIT-HP-S&OH** for a 20%

If a Clark Pump does not have a history of underperforming but is leaking or has seals older than 5 years, a Seal & O-ring Kit is recommended. For the mechanically-minded individual, this kit replaces all seals in the Clark Pump. This Kit also comes with Parker tube fitting grab rings and O-rings, Filter Housing O-rings, Sea Strainer Seals and a 6-gram packet of Silicone Grease.

Parts and Tool Kits

We also offer two tool kits for the Clark Pump; the **Clark Pump Rebuild Tool Set** and the **Clark Pump Tool Kit-Lite**. The Lite Tool Kit has all the specialty tools that might not be found in your average tool box, while the Clark Pump Rebuild Tool Set contains these tools along with allen and open-ended wrenches, an easy out (extractor) and a spanner wrench. Below is the itemized list of each kit.

Clark Pump Rebuild Tool Set **KIT-TL-CPRBTS**

No.	Description	Qty
KIT-TL-CPRBTS	CLARK PUMP REBUILD TOOL SET	1
HDW-TL-1/4A	1/4" ALLEN WRENCH	1
HDW-TL-5/16A	5/16" ALLEN WRENCH	2
HDW-TL-AR	SPECTRA ANNULAR RING REMOVER	1
HDW-TLCVT	CHECK VALVE SEAT REMOVAL TOOL	1
HDW-TLCYLT	SPANNER WRENCH FOR CP & 2.5"PV RING	1
HDW-TLORT	O-RING PICK	1
HDW-TLPST	PUMP SHAFT INSERTION TOOL	1
HDW-TLPST7	PUMP SHAFT INSERTING TOOL 7%	1
HDW-TLPVOT	PILOT VALVE ORING TOOL	1
HDW-TL-HEMPLER5	HEMOSTAT PLIERS 5-1/2" SS	1
HDW-TL-1316&78W	13/16" & 7/8" OPEN END WRENCH THIN	2

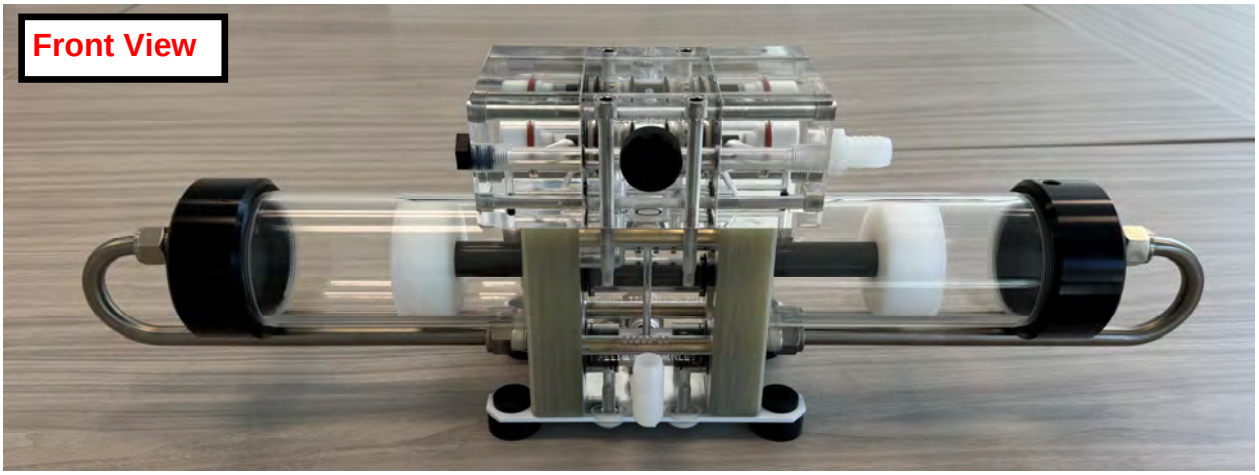
Clark Pump Tool Kit Lite **KIT-TL-CPRBTKL**

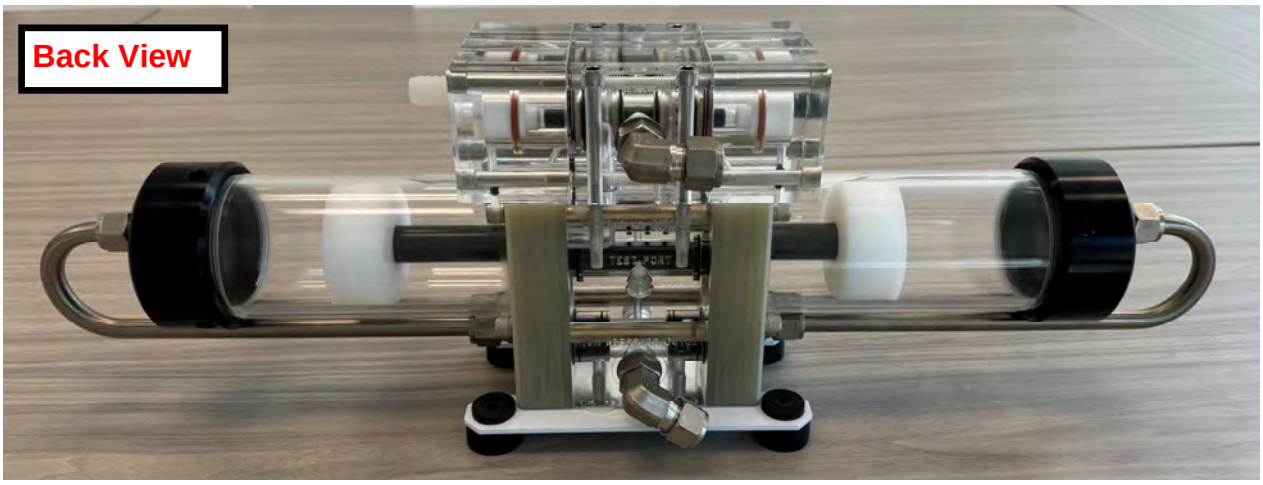
No.	Description	Qty
KIT-TL-CPRBTKL	CLARK PUMP TOOL KIT-LITE	1
HDW-TLPVOT	PILOT VALVE O-RING TOOL	1
HDW-TLPST	PUMP SHAFT INSERTION TOOL	1
HDW-TLPST7	PUMP SHAFT INSERTING TOOL 7%	1
HDW-TL-AR	SPECTRA ANNULARING REMOVER	1
HDW-TL-HEMPLER5	HEMOSTAT PLIERS 5-1/2" SS	1
HDW-TLORT	O-RING PICK	1

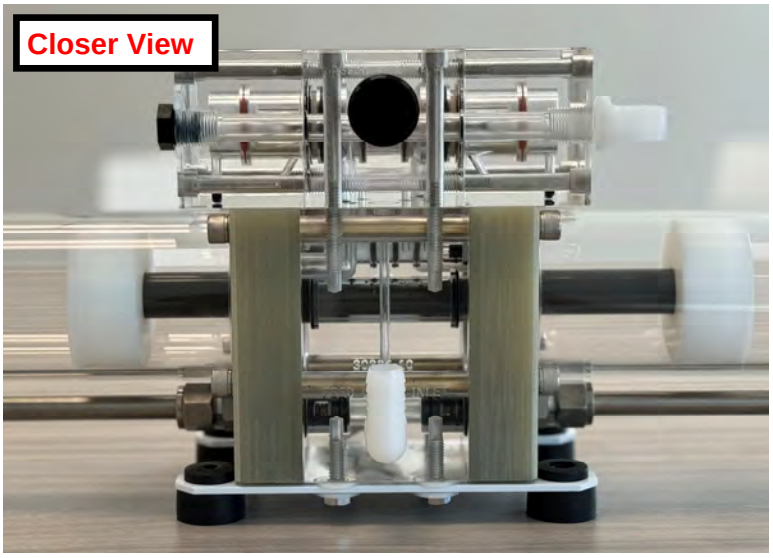
Scan to see Clark Pump tools

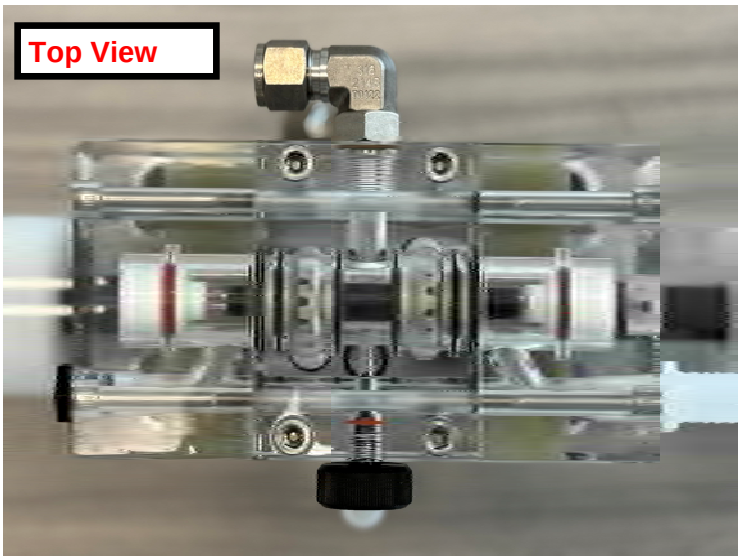
youtube.com/watch?v=lfjZkp5HQ9I&list=PLJ7D5RAA4OpHlD0GTAkuSD8Pm6zlZLW3S&index=3

Transparent Images of Clark Pump









Recommended Tools:	7/8, 13/16, and15/16-inch end wrenches
Small flashlight	Piston assembly tool, including base, cylinder, and horn
Small drill bit	Annular ring installation tool
Dental pick	Socket wrench with 1/4” Allen wrench and 1/2” sockets
Piston rod installation tool (a section of 7% piston rod with a rounded end)	Mar-proof hammer
Forceps	Ring wrench
Wire cutter	
Silicone oil	
Mechanical press	
1/4-inch Allen wrench or drill attachment	
Two 5/16-inch Allen wrenches	

Consumables:
Silicone grease (Molykote 111)
Silicone oil
Teflon tape

Scan QR code to see Clark Pump Tools

youtube.com/watch?v=lfjZkp5HQ9I&list=PLJ7D5RAA4OpHlD0GTAkuSD8Pm6zlZLW3S&index=3

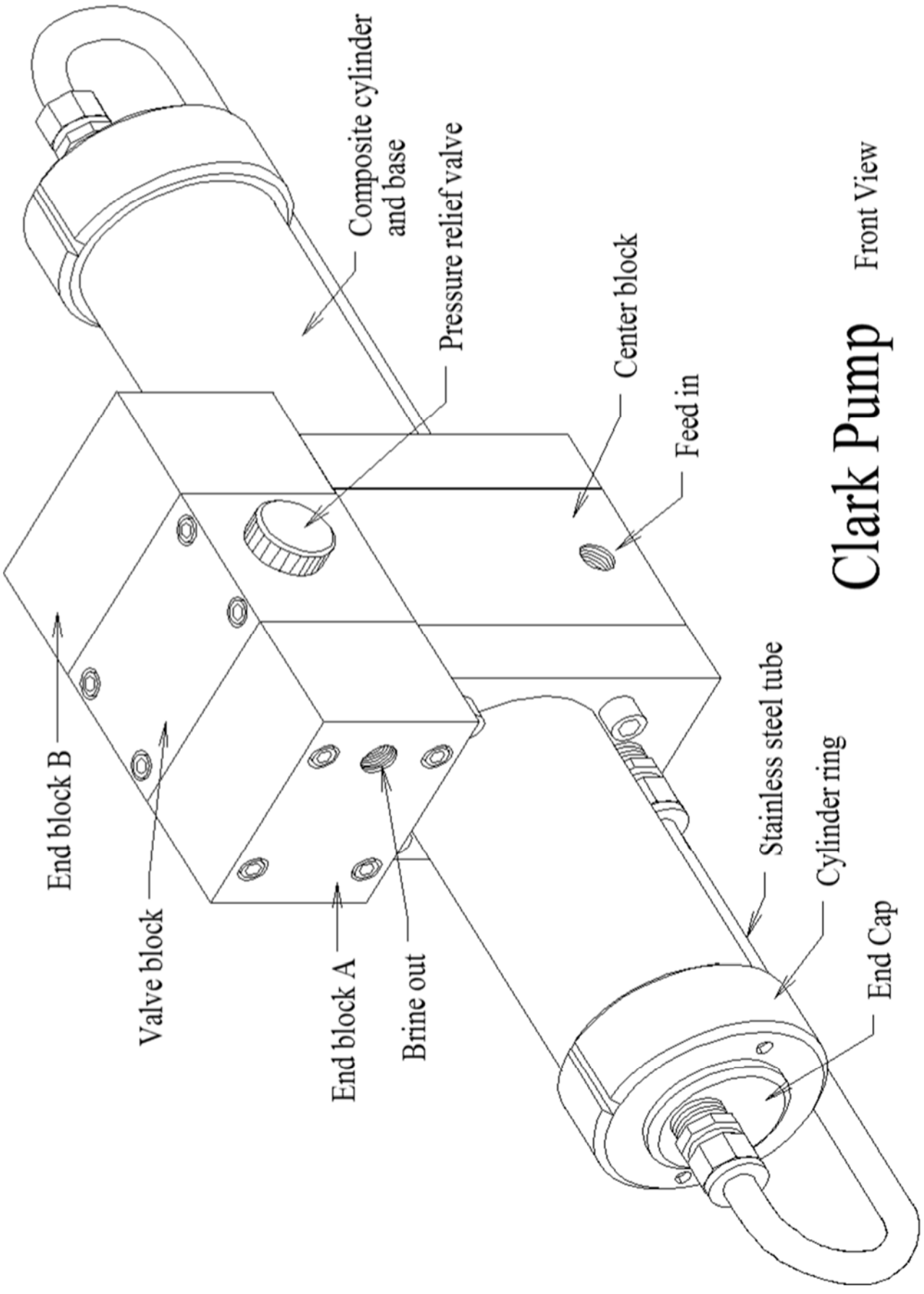
Outline

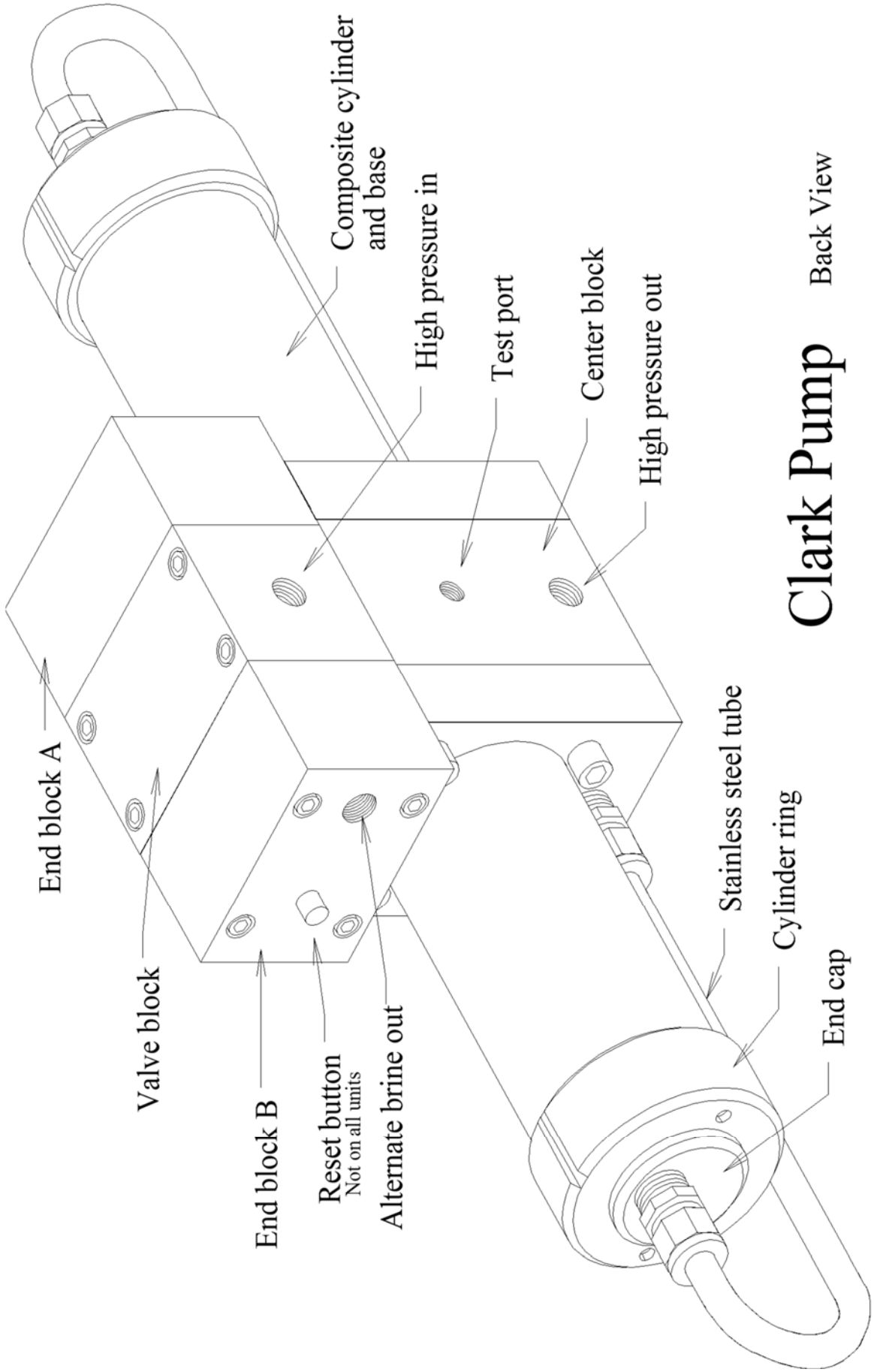
1. Disassemble Clark Pump
2. Assemble center block with rod.
3. Assemble valve block, with annular rings and spool assembly.
4. Assemble end blocks.
5. Join end blocks to valve block to complete top end. Attach top end to center block.
6. Assemble cylinders and attach to center block.

Note: This manual covers the assembly of Clark Pumps with three different displacements—7%, 10%, and 20%—but most of the process is the same for all three displacements. The 7% and 10% pumps are identical except for the center block, rod, and rod seals: The 10% pump's rod is larger in diameter, so the center block and seals must be larger to fit the rod.

The 20% Clark Pump has two 10% rods, side by side, and a center block to accommodate them, so the rods and seals are the same as in a 10% Clark Pump. The 20% pump's pistons are made of Delrin, with replaceable seals, instead of the Nylon one-piece piston used on the 7% and 10% pumps. Also, the end blocks on the 20% pump have a 1" bore instead of a 1-1/4" bore, and 1" spool pistons and spool piston seals.

The differences between the three pump displacements, and corresponding parts, are noted throughout this guide.


Clark Pump
Front View
Composite cylinder and base
Pressure relief valve
Center block
Feed in
End block B
Valve block
End block A
Brine out
Stainless steel tube
Cylinder ring
End Cap


Clark Pump
Back View
Composite cylinder and base
High pressure in
Test port
Center block
High pressure out
End block A
Valve block
End block B
Reset button
Not on all units
Alternate brine out
Stainless steel tube
Cylinder ring
End cap

Clark Pump Quick Assembly Cheat Sheets

CENTER BLOCK

Pull Center Block

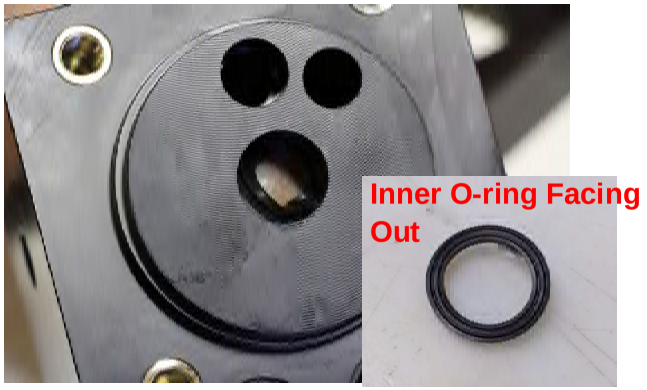
HP-CB-7

HP-CB-10

HP-CB-20

Press in Inserts

HP-CB-INS x4



Install Piston Rod Seals

7%: S0-HPP-PR7 x2

10%: S0-HPP-PR10 x2

20%: S0-HPP-PR10 x4

Install 4 Seals

SO-HPP-PV x4

Install Pilot Valve Spool

HP-CB-PVS x1

SO-HPP-PS x2

HP-CB-PVPS x2

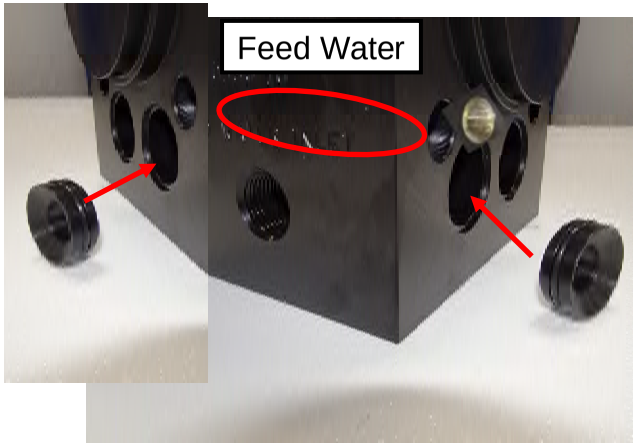
HP-CB-PPS x2

HP-CB-PVCR x2

Roll O-Rings on Seats

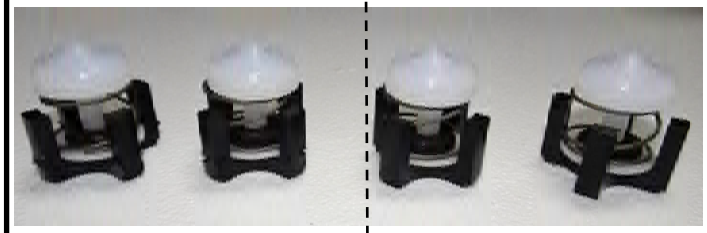
HP-CB-CVS x4

SO-HPP-CVS x4



Install 2 Seats on “FEED WATER INLET” Side

NOTCH 2X



Install on INELT side side

HP-CB-CV3 x4

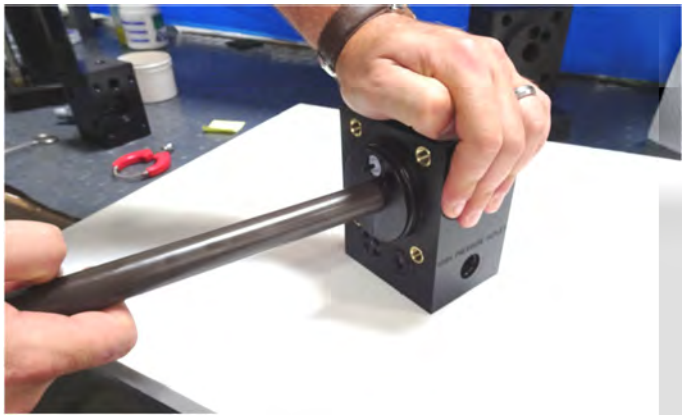
HP-CB-CVSW x4

Install on other

HP-CB-SPR x4

HP-CB-CV x4

CENTER BLOCK CONT.

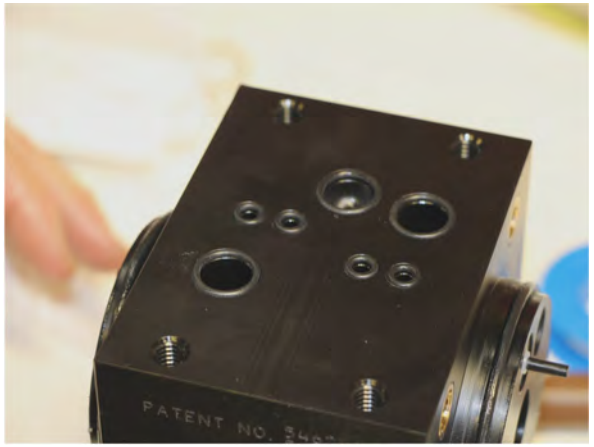


Use Oil and Tool to Install Piston Rod

7%: HP-CYL-3/4R x1

10% HP-CYL-7/8R x1

20% HP-CYL-7/8R x2



Use Grease and Install Sealing O-Rings

SO-HPP-CVP1 x4

SO-HPP-ECCB

SO-HPP-PLP –as needed

SO-HPP-VP -as needed

CYLINDER ASSEMBLY

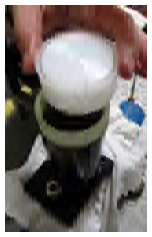
Apply Stickers

HP-CYL-CCA x2

Assemble and Teflon Tape 4 Straight Fittings

PL-MTS-3/8X1/2S x4

Install Pistons



7% and 10%
Install from top

HP-CYL-PT x2

20%
Install from bottom

HP-CYL-PT20 x2 *SO-HPP-PT20 x2*
HP-CYL-PTS20 x2 *HP-CYL-PTB20 x4*

Install End Cap O-Ring

HP-CYL-EC x2
SO-HPP-ECCB x2

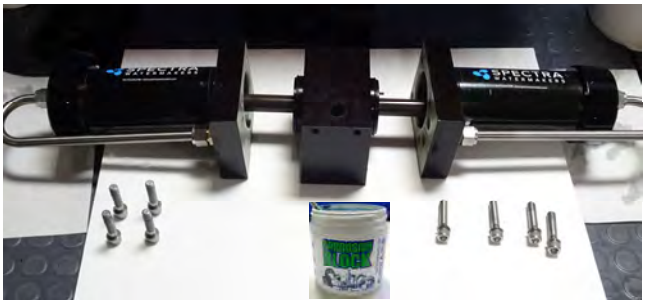
Green Pad
J-Tube ends

HP-CYL-SST x2

CYLINDER ASSEMBLY

Assembly Steps:

1) Tighten Bottom Base Fitting
2) Fit End Cap
3) Grease & Hand Tighten Aluminum Ring.
   HP-CYL-R x2
4) Tighten Top Base Fitting
5) Align End Cap Fitting
6) Tighten Aluminum Ring with Wrench
7) Set J-Tube, Tap with Mallet
8) Scissor Tighten Bottom Fitting
9) Scissor Tighten Top Fitting



Fit 8 Washers on 8 Greased Bolts and Fasten with Drill With Highest Torque Setting

HD-CPS-3/824175 x8 *HD-WSH3/8x5/8S x8*

Hand Tighten

LOADED VALVE BODY

Grease O-Ring and Threads of Pressure Relief Valve. Screw in

HP-TB-VB x1

SO-HPP-RV x1 *HP-TB-BV x1*

Install 4 Annular Ring O-Rings

SO-HPP-AR1 x4

Spray O-Rings with Soapy Water and press in Annular Rings with Tool.

HP-TB-ARP x2

Press Reversing Valve Spool through Valve Body

10% & 7%: KIT-HP-VS10 x1

20%: KIT-HP-VS20 x1

On each side, Grease and Install

2 Small and 1 Large Sealing O-rings

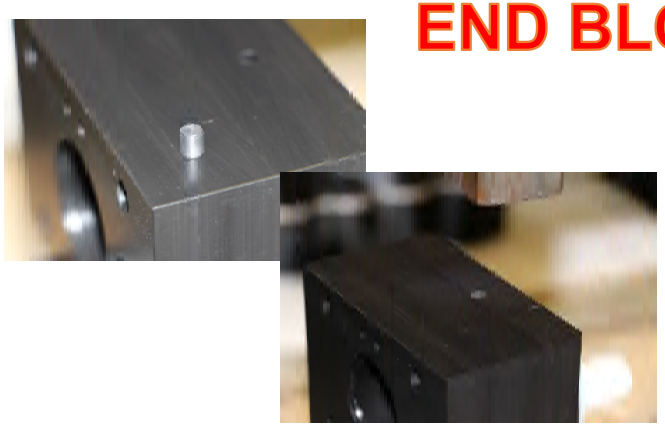
(Same Ones from the Top of the Center Block)

Grease (to stick) and Install Valve Bore O-ring & Spacer Ring

HP-TB-SR x2

SO-HPP-VB x2

END BLOCK & FINAL ASSEMBLY



Press Machine Plug into End Block A & B

HP-TB-EBP x2

10% & 7%: HP-TB-VEB-A1 & HP-TB-VEB-B1

Install O-Ring in Each

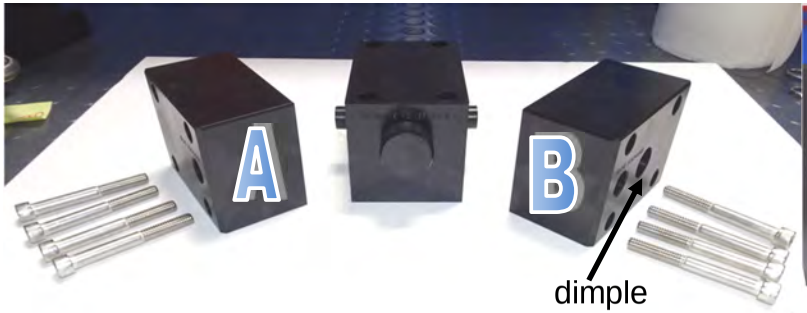
7 & 10%: SO-HPP-SP x2

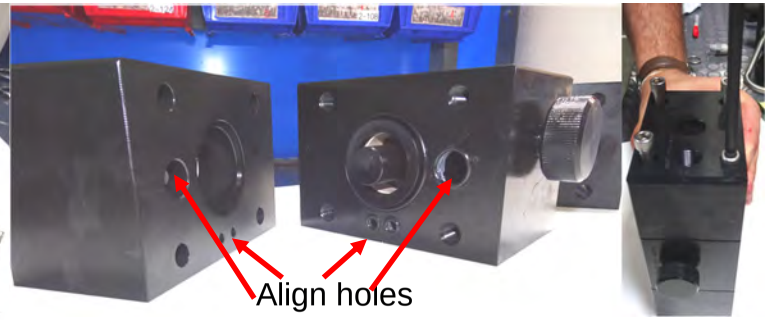
20%: SO-HPP-SP1 x2

Bottom Out Spool Piston in Each

7 & 10%: HP-TB-VSP x2

20%: HP-TB-VSP1 x2





Use 8 shorter screws to connect top end blocks

HD-CPS-5/162.75 x8

Use 4 longer screws to connect top end to Center Block

HD-CPS-5/16X3 x4

Hand Tight

Components

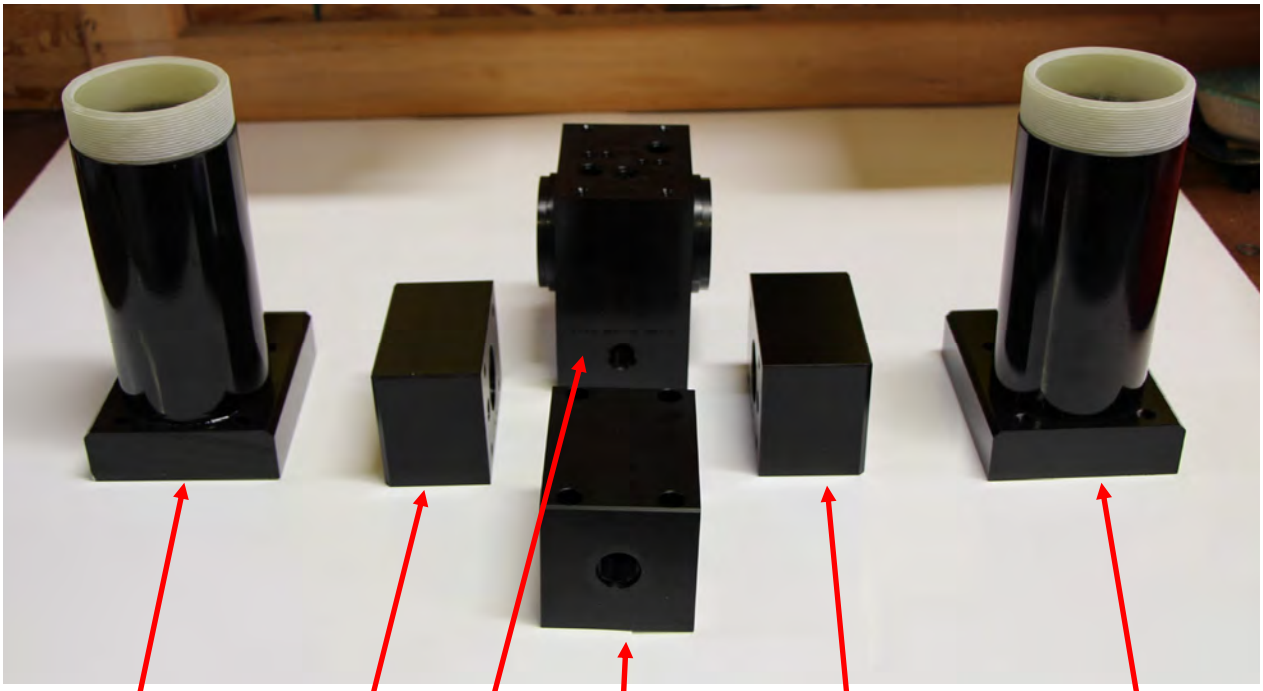
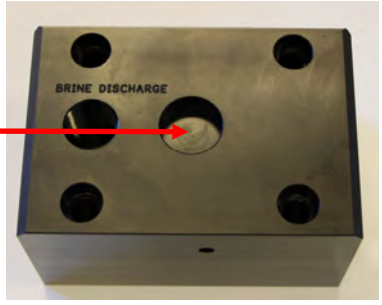


Photo Identification of Major Components:

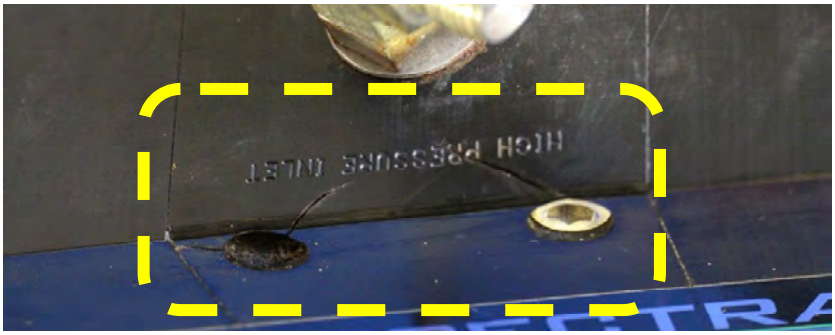
- The two composite cylinders and bases are identical and interchangeable.
- The valve block is inscribed with “High Pressure Inlet” on one side; “Pressure Relief Valve” on the other.
- End Block A and End Block B are mirror images, and both are inscribed with “Brine Discharge.” End Block B has an additional indentation, which is absent on End Block A:

Indentation in End Block B



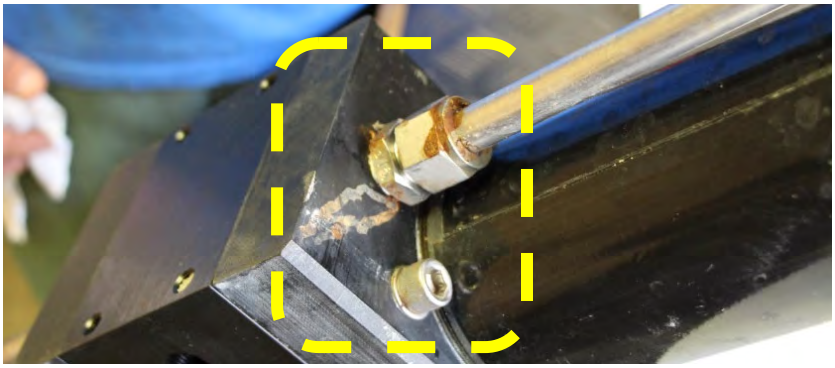
Disassembly Process

Clark Pump



1.1 Dissemble Clark Pump

- Before disassembling, check the Clark Pump for damage and defects. This valve block is cracked from over tightening its mounting screws, and will need to be replaced.



1.2

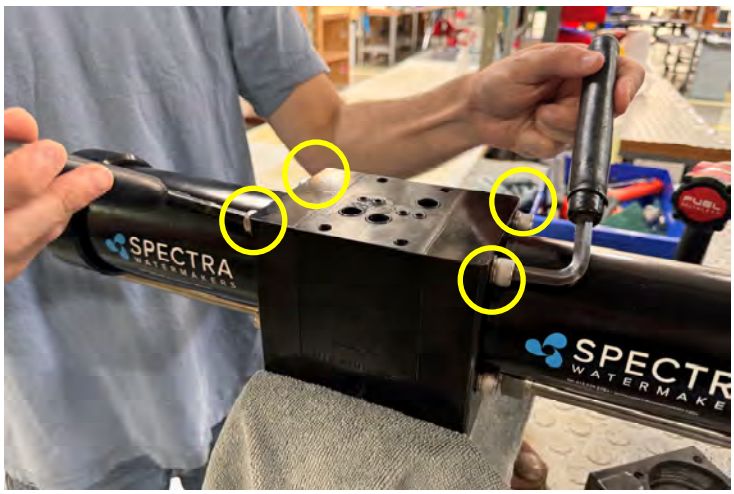
- This cylinder base fitting shows evidence of prolonged leaking. This fitting and the J tube may need to be replaced.

1.3

- Begin by **removing** all the external elbows, the test port plug, and the pressure relief valve. The two high pressure stainless steel elbows.

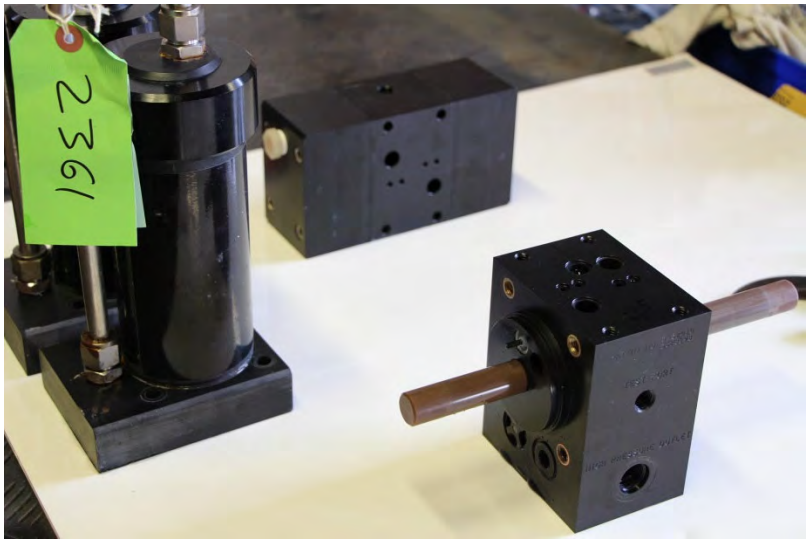
1.1

- Remove the valve block assembly from the center block by removing the four mounting bolts.



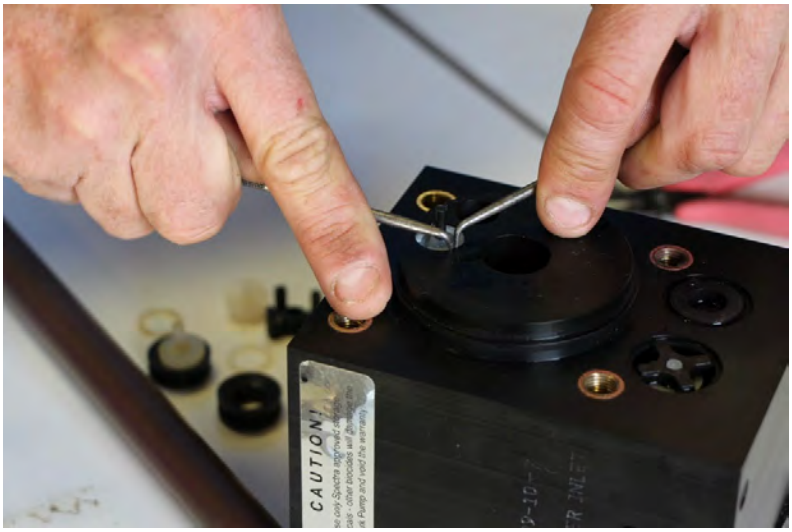
1.2

- Remove the cylinders from the center block using two 5/16-inch Allen wrenches.



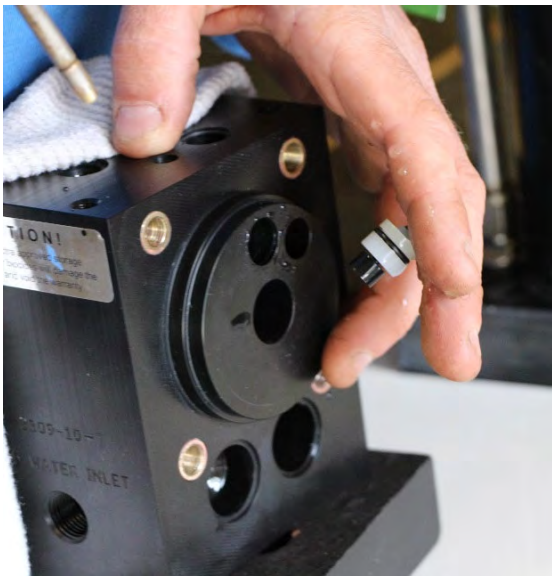
1.3

- Wipe down each component and inspect carefully for cracks especially around the fittings as disassembly continues.



1.4

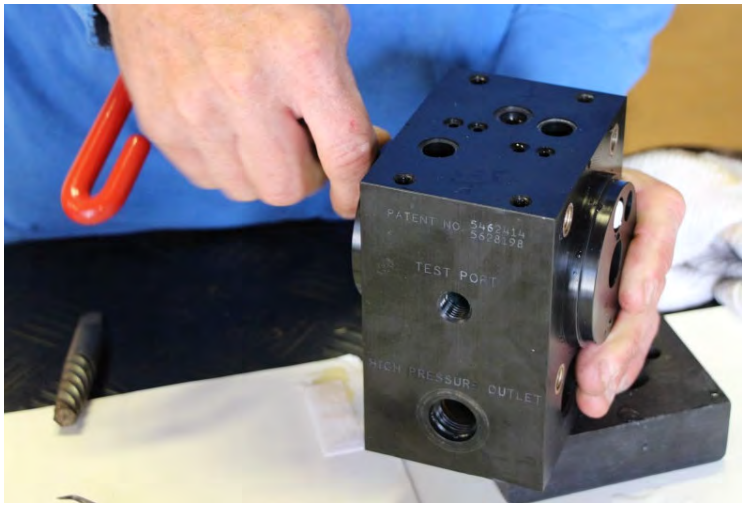
- The pin valve retaining washers are split nylon washers (like a circlip) and can be removed from the center block using two O-ring picks, or an O-ring pick and a small screwdriver to pry the clip out of the groove.



1.5

- Remove the pin valve assemblies by gripping with a pair of pliers. Alternatively, they can be blown out of the center block using compressed air. Place a rag over the back side of the center block to keep the other pin valve in place. Plug the hole shown with your thumb while injecting air into the other.

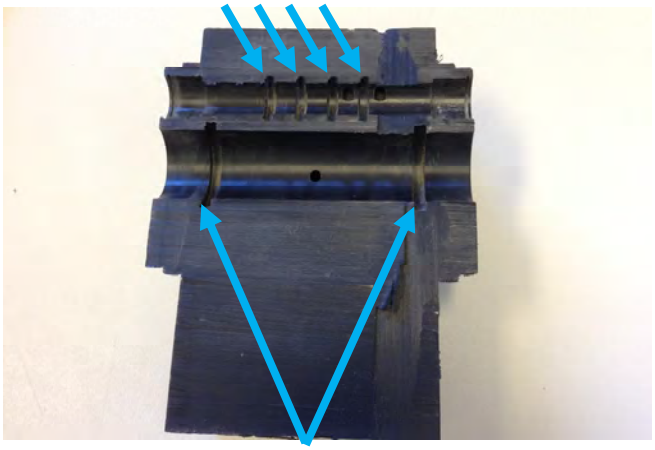
Note: Removing with pliers will likely damage the pin, only remove with pliers if you intend to replace the pin.



1.6

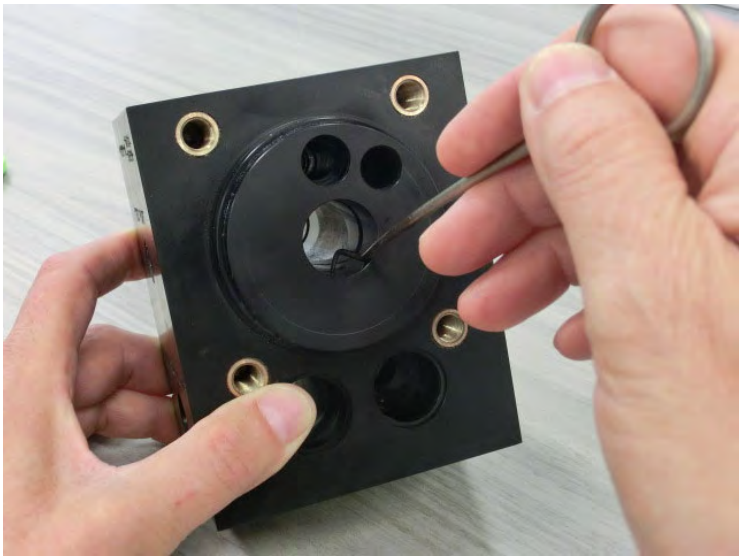
- The pilot valve spool, and the pin valve assembly on the other side, can now be pushed out with an appropriate tool. The pin valve assemblies should be discarded and replaced.

O-ring Groves



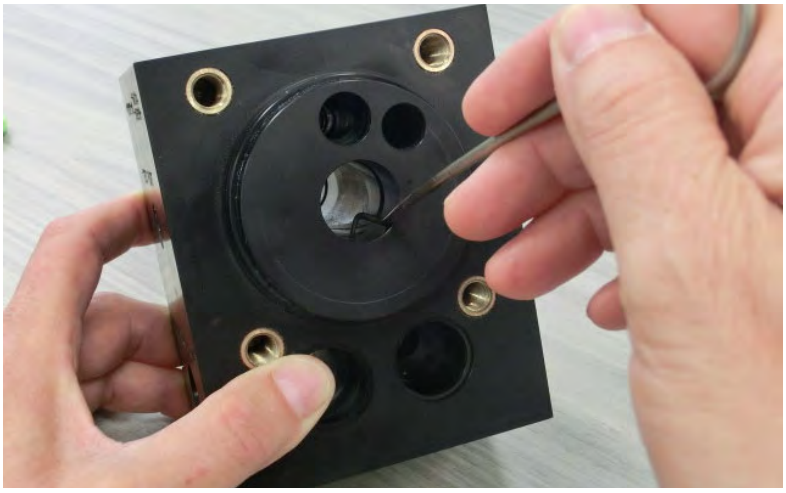
1.7

- This cutaway view shows the races for both the piston rod lip seals, and the pilot valve spool O-rings.



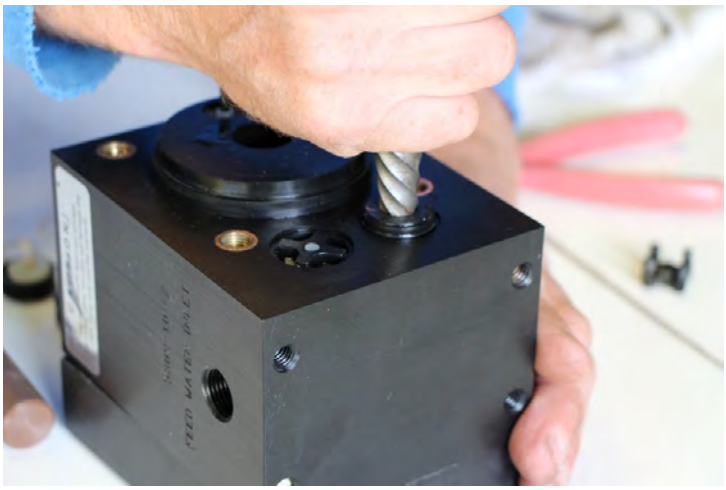
1.8

- Remove the piston rod lip seals with forceps or a dental pick. Take care not to scratch the block or O-ring groove.



1.9

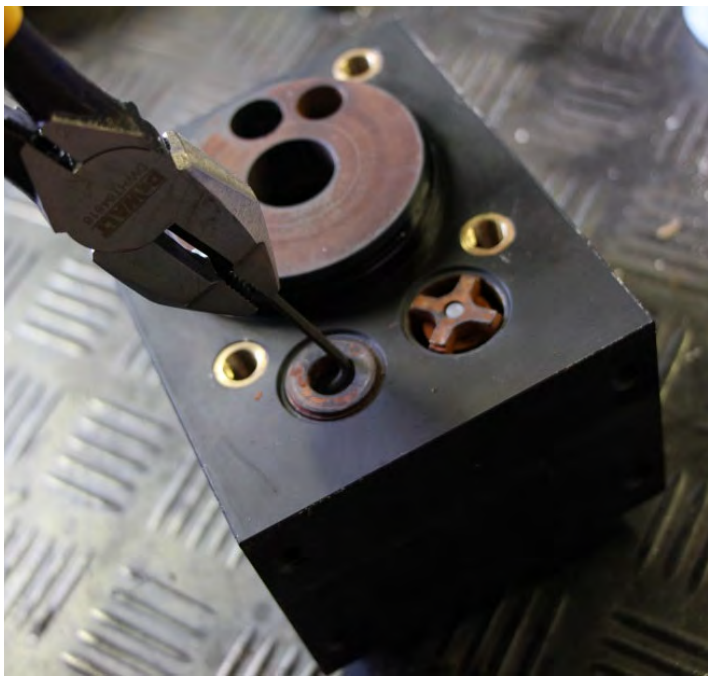
- Likewise, remove pilot valve spool O -rings from the pilot valve bore.
- The easiest way is to stab the O-ring and then pry it out.
- Be careful to not push all the way through the O-ring so you don't damage the O-ring groove.



1.10

- A #6 Easy-Out may be used to remove the valve seats. This may damage the seats, and they may need to be replaced.

Note: On fairly good condition pumps, the seats on the outlet side can often be left in place

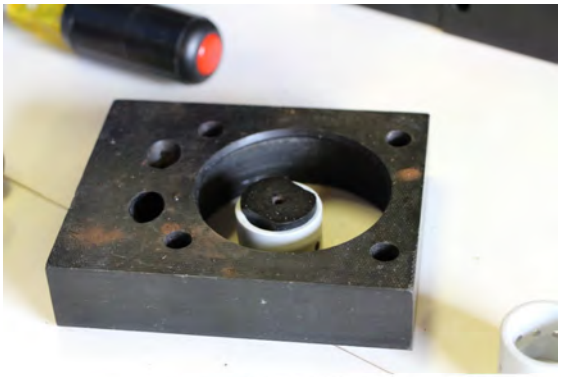


1.11

- Alternatively valve seats can be removed with a small Allen wrench and pliers, taking care not to score the side of the valve port.

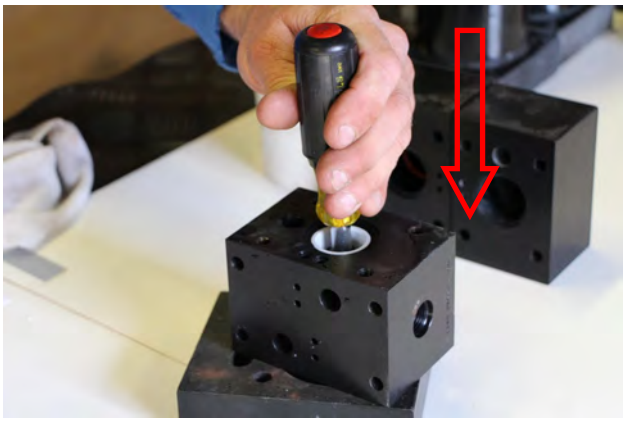
1.12

- On some older units the check valve springs were white nylon. These can be discarded and replaced with stainless springs included in the kit.



1.13

- Using the annular ring removal tool (shown, part number HDW-TL-AR) press out the annular rings from the valve block, slid it into place between the two annular rings (inside the block) and then push the ring out.
- Used annular rings should be replaced, but if they are not cracked (between the holes) you can save them as spares.



1.14

- Without the tool, you can tap the ring out the other side of this valve block using a nut driver or a small socket.
- The annular ring is held in place with an o-ring so it should not take much force to remove it.

1.15

- Using two wrenches, loosen the compression nut on the end cap.

1.16

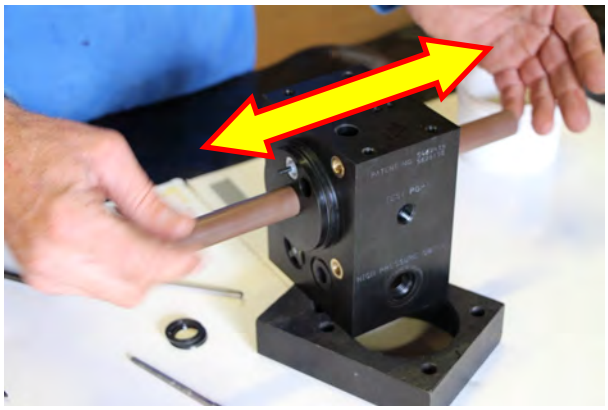
- Loosen the compression nut on the base and remove the stainless steel tube.
- Remove the compression fittings from the bases and end caps.

1.17

- Using a ring wrench or strap wrench, remove the cylinder ring and end cap.
- If it is difficult to remove, heating the aluminum ring using a hair dryer (150°F, 65°C) will help loosen it. Heat the ring until you can leave your hand on it for 2 seconds (<150^{o}F, 65^{o}C).

1.18

- Check the piston rod for scoring. It should be smooth and straight.

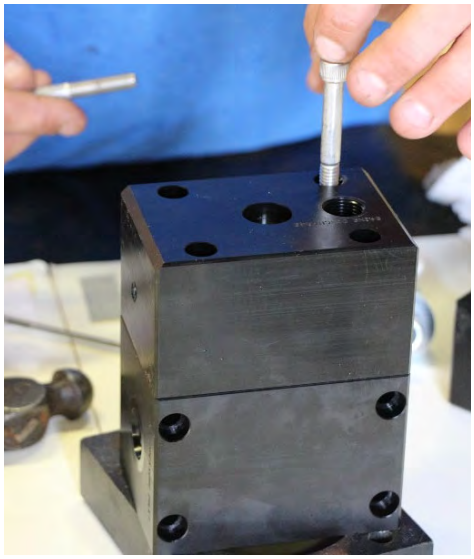


1.19

- With the piston rod lip seals removed, the piston rod should have clearance in the center block bore and slide back and forth with no resistance.
- If there is any resistance, the center block will need to be honed or bored, and/or the rod replaced.

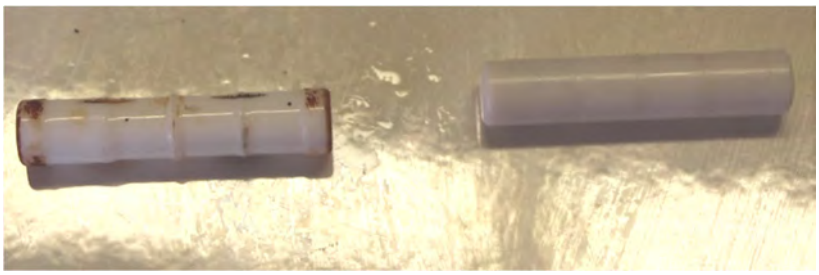
1.20

- If the bronze inserts are protruding slightly, they should be shortened so the base of the cylinders touch the center block when bolted into place.
- NOTE: It’s ok for these inserts to be inset into the block up to 1/8” (3mm), they should not extend beyond the surface of the block.



1.21

- Likewise, bolts can become corroded over time so clean them and make sure they fit in the blocks, clean the threads and lubricate with silicone grease.



1.22

- Inspect the pilot valve spool for wear. If it is in good condition, it can be reused.
- The pilot valve spool on the right is used, but still in good condition. If you can feel any ridges, like the one shown on the left (an extreme example) it must be replaced.

1.23

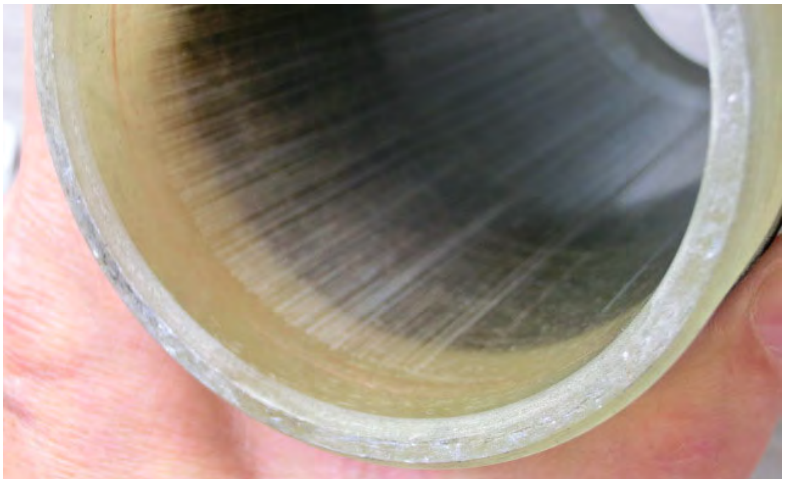
- If the spool valve seals are smooth and do not show any scoring they can be reused. When in doubt replace the spool valve. The spool on top is for a 15 or a 20% pump and the one on the bottom is for a 7 or 10% pump.

1.24

- Clean up the cylinder rings so they are ready to be reinstalled.

1.25

- Inspect cylinders for wear and deep grooves (this one retains a smooth finish and is in good shape).

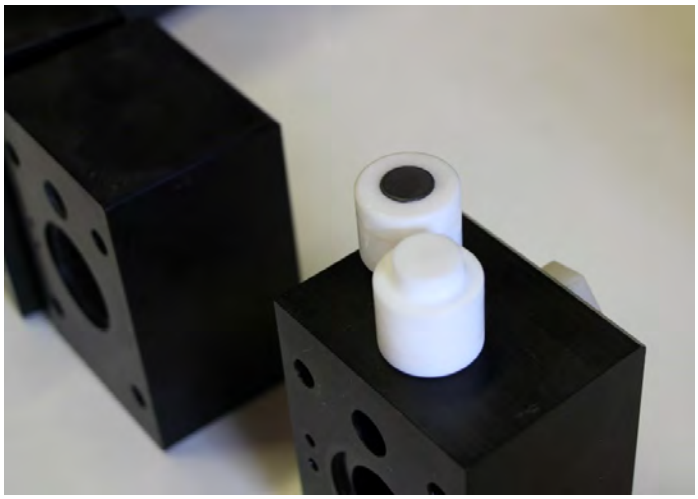


1.26

- This cylinder has pronounced grooves. Any grooves you can feel with your fingernail need to be addressed. A ball hone as shown in the next step works well for minor scoring.

1.27

- Minor grooves can be carefully removed with a wet 2-3/4-inch hone. In a pinch you can use sand paper to smooth down the ridges, it's not a permanent solution but it will work for awhile.



1.28

- Check spool pistons for excessive wear. If in good condition, they can be reused. If your system is still using a stroke sensor be sure to reuse the piston with the magnet.

1.29

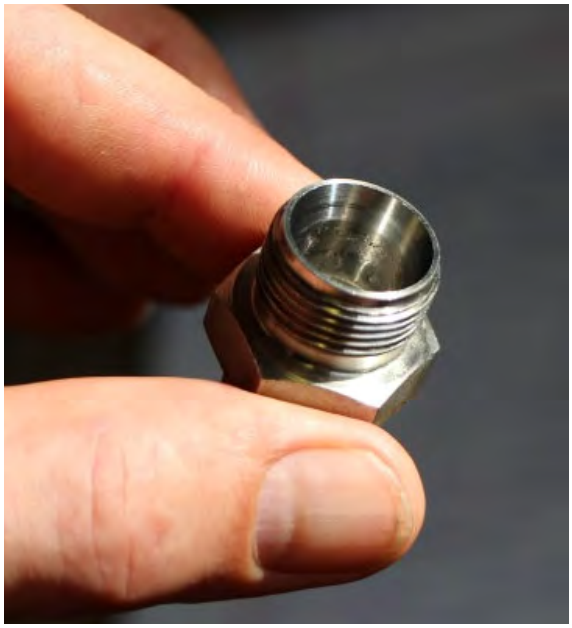
- Inspect pistons for wear and snug fit in the cylinders. If pistons remain in good condition, and still seal snugly in the cylinder, they can be reused. Again using the new parts is always a good idea and then you can save the old parts for spares.

1.30

- Only reuse J tubes and fittings that show no signs of pitting or leakage. This ferrule is pitted and won't reseal again.

1.31

- Note that you can see the sealing surface where the ferrule contacts the fitting. This compression fitting is pitted, and must be discarded.



1.32

- This compression fitting still looks good.

1.33

- Fittings can be reused in fiberglass base of the cylinders, if in excellent condition.

1.34

- On even a fairly routine rebuild, many parts should be discarded and replaced.

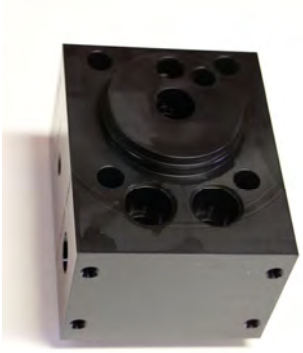
Rebuild Process

Clark Pump

2. Center Block Assembly

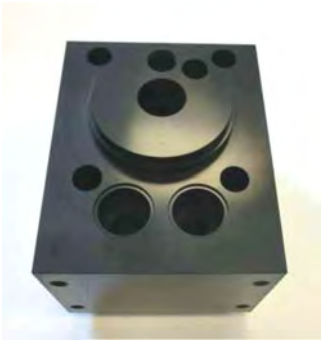
7% Center Block

(part number **HP-CB-CB7**):



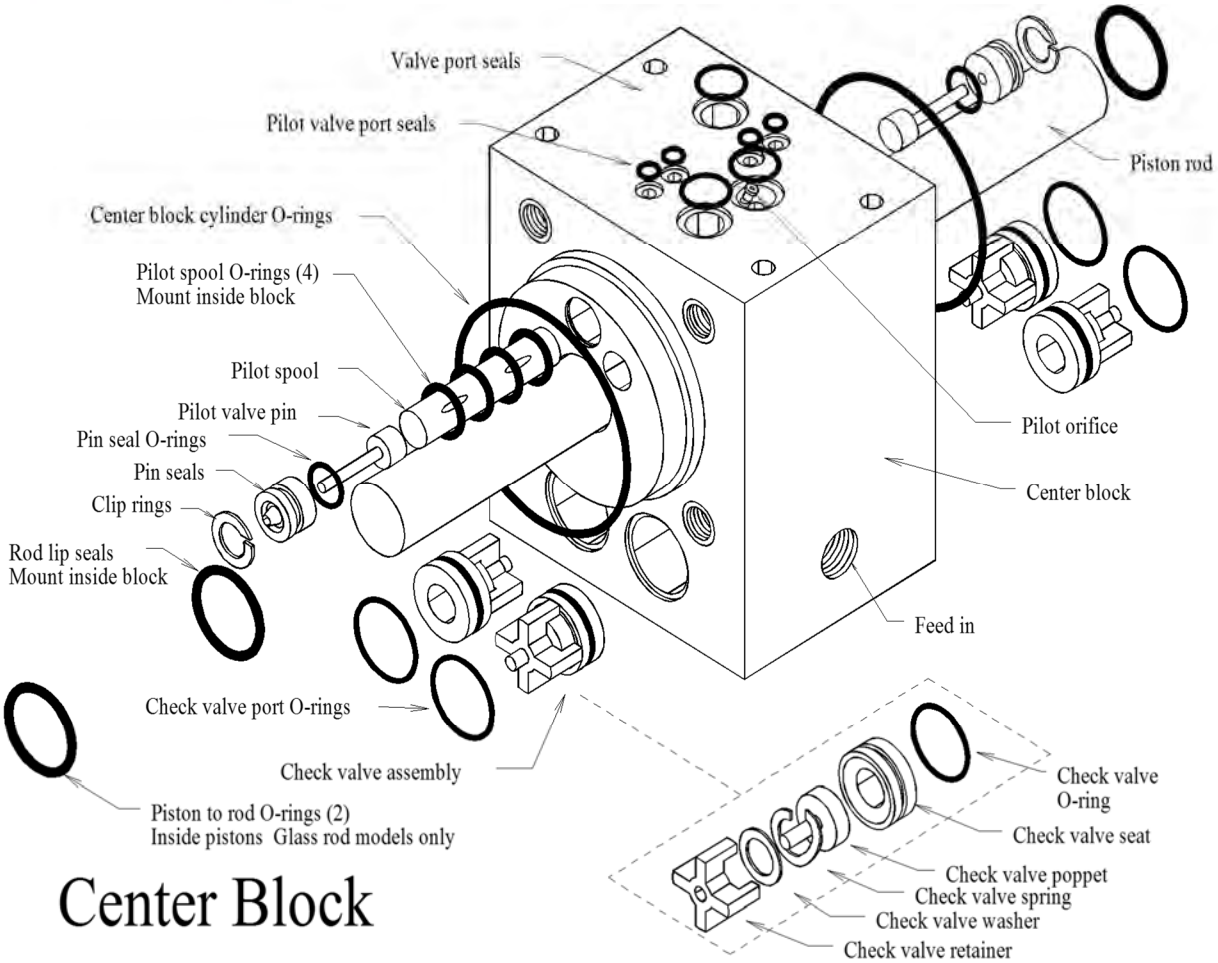
10% Center Block

(part number **HP-CB-CB10**)



20% Center Block

(part number **HP-CB-CB20**)



Center Block

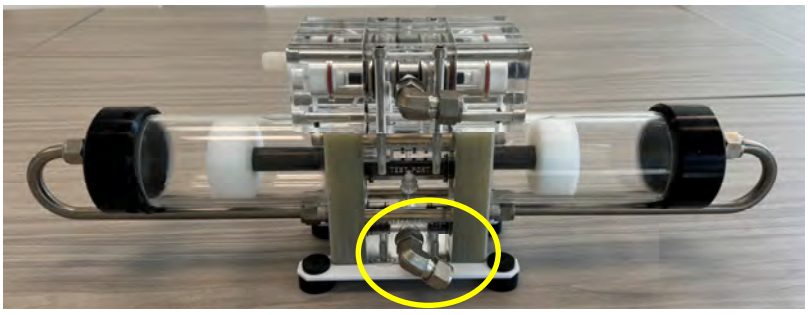
2.1

- Place O-ring (**SO-FT-STF**) over threads on a stainless steel elbow **(PL-MTE-3/4S1/2SL).**
- Take care not to cut the O-ring on the threads.
- Lightly coat threads with silicone grease (We use Molykote 111).

PL-MTE-3/4S1/2SL

2.2

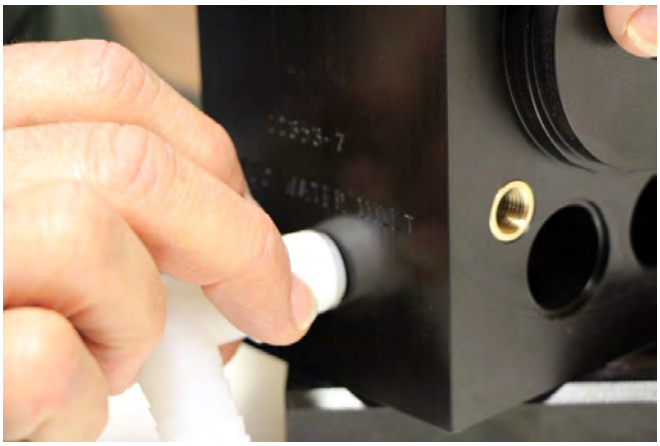
- Screw the stainless steel elbow into the center block's high pressure **outlet**.
- Leave the elbow loose, because it will be reoriented and tightened later, during testing.
- **Alternatively, you may leave this fitting uninstalled and add once pump is assembled further.**



Center Block

2.3

- When applying Teflon tape to fittings do not wrap the first two threads which will make it easier to start the fitting in the threaded hole. Wrap six turns of Teflon tape around the threads of a 3/8” x 5/8” Nylon elbow (PL-HBE-3/8x5/8) and apply a small amount of silicon grease to the threads to lubricate for installation. For 20% Clark Pumps, see note in next step.



2.4

- Screw the Nylon elbow into Feed Water Inlet. Leave the elbow finger tight, as it will be reoriented and tightened later, during testing. Note: On 20% Clark Pumps instead of the Nylon elbow, this will be another stainless elbow (**PL-MTE-3/4S1/2SL**) with an O-ring (**SO-FT-STF**, just like the two fittings installed in the previous steps).

2.5

- **Again, these exterior fittings (seen above in figure 2.4) can be left uninstalled until further along with assembly, if desired.**

Center Block

Note:

7% SO-HPP-PR7 x2

10% SO-HPP-PR10 x2

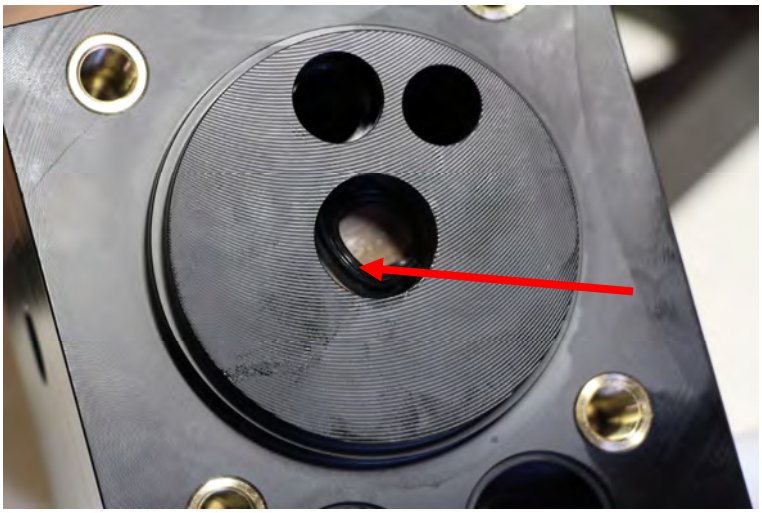
20% SO-HPP-PR10 x4

Outward face, showing right O-ring

2.6

- The lip seals must face out, and the O-ring within the lip seal must stay in place.

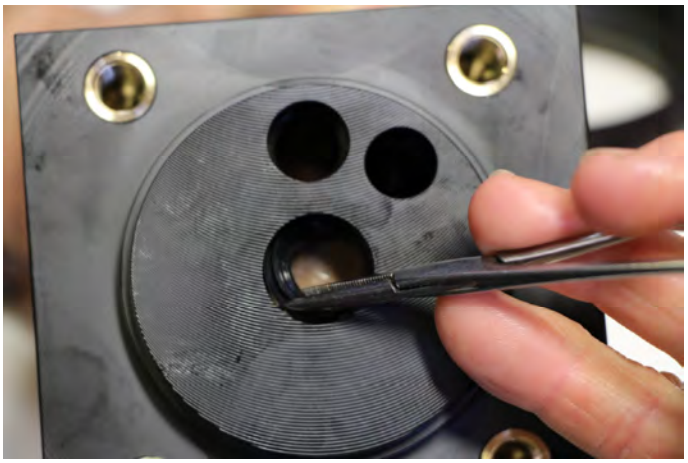
SO-HPP-PR10/PR7



2.7

- The two piston rod lip seals go in the large (3/4-inch or 7/8-inch) center block bore. Begin by inspecting the grooves in the bore for debris from manufacturing, as any contamination can interfere with the seals.
- Remove the debris with a dental pick or compressed air.
- Place lip seal in valve bore, facing out.

Center Block

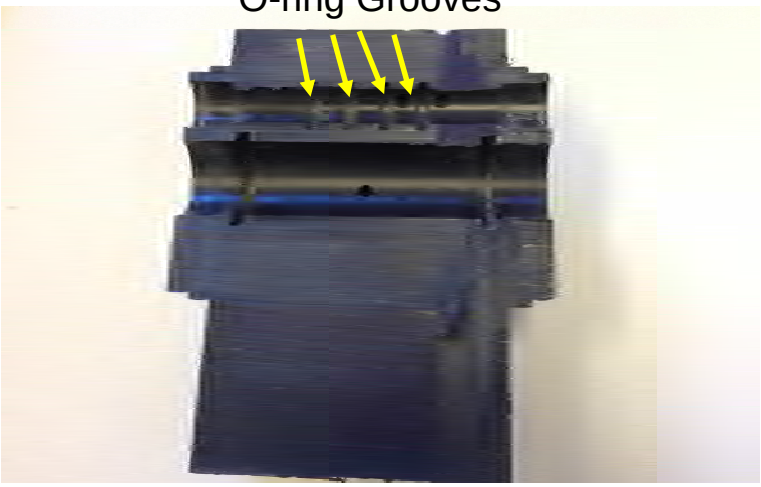


2.8

- Use forceps or a small stick to position the lip seal in groove. Repeat on other side of the center block.
- Feel around the periphery of both seals with your finger to smooth and check for lumps or twists.
- If the seal will not smooth out by pushing it into place with your finger then remove it and try again.

Note: In this cutaway view you can see the grooves for the O-rings in the following steps

O-ring Grooves



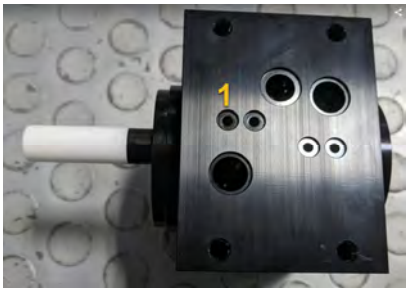
2.9

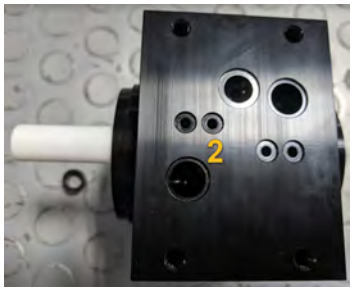
- Check all upper ports for obstructions and debris.

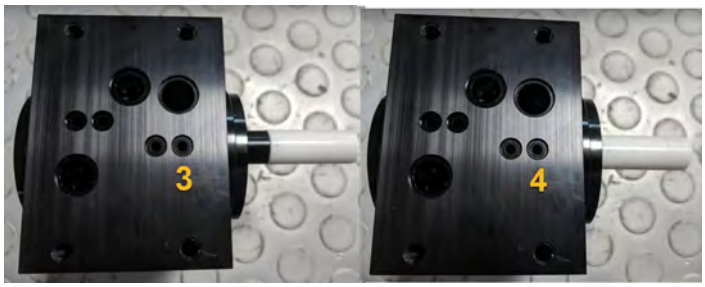
Center Block

2.10

- Use pilot valve O-ring tool (**HDW-TL-PVOT**) as a guide to install the pilot valve spool seals.
- If you do not have the tool, use the spool itself or a similar sized object, to act as a “backboard” for installation of the seals

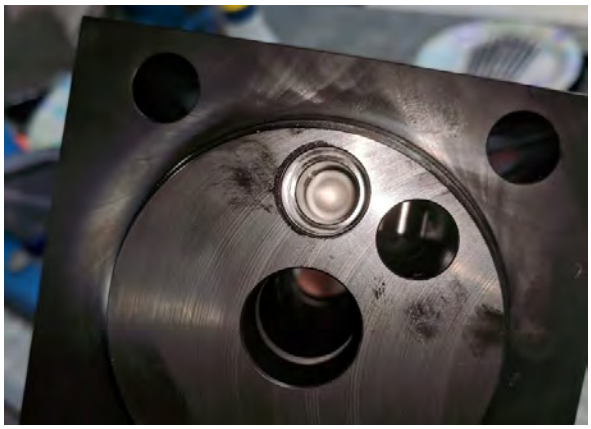






2.11

- Do one side at a time using spacer ring first on each side.



2.12

- Move pilot valve tool or pilot spool through bore until it is even with the groove for the seal.

Center Block

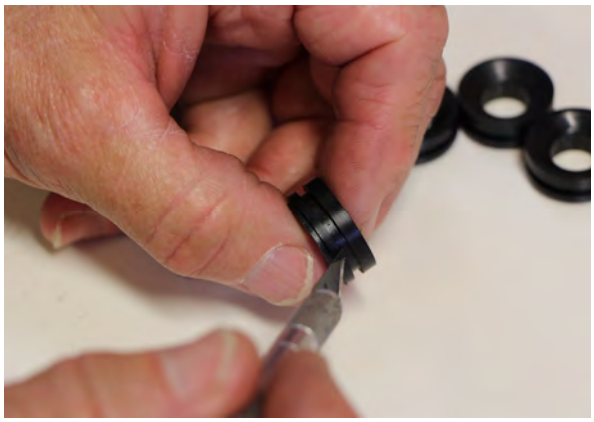
2.13

- Using forceps, insert the O-ring (**SO-HPP-PV**) and maneuver into groove. Repeat for all four O-rings, then inspect for even seating.

Note: This is the most difficult part of assembling the Clark Pump, and requires patience and dexterity.

2.14

- Inspect four (4) check valve seats (**HP-CB-CVS**) for aberrations, and remove as necessary with an X-Acto knife.



2.15

- Likewise, check the outer grooves.

Center Block

2.16

- Roll all (4) check valve seat seals (**SO-HPP-CVS**) onto the check valve seats.

4X SO-HPP-CVS

2.17

- Insert two (2) check valve seats into the check valve bores on the INLET SIDE (the side of the center block that says “Feed Water Inlet” and now has the Nylon elbow).

Note: Save two (2) check valve seats for **Step 1.24**.

2.18

- With a constant, even pressure, use your finger or the piston rod to push in the check valve seats until bottomed out.

Center Block

2.19

- Check valve seat in place.

2.20

- Check for aberrations in manufacturing on the four (4) check valve retainers (**HP-CB-CVR**), especially additional material on the ends of the legs. Trim as necessary with an X-Acto knife.

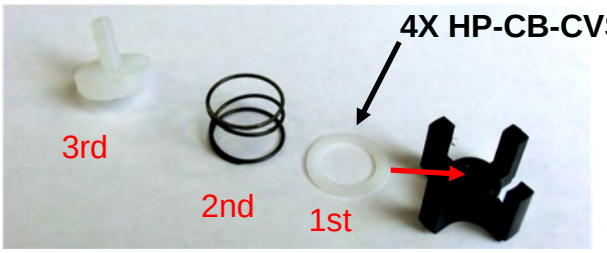
2.21

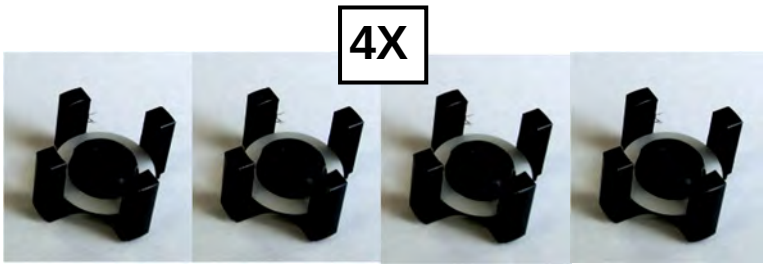
- The **(2) check valve retainers** for the inlet side must be notched with clippers to ensure a secure fit in the check valve bores, otherwise they will pop out of their bores during assembly.

Center Block

2.22

- **Notch** the top of each leg of the check valve retainer legs, leaving pronounced burrs.

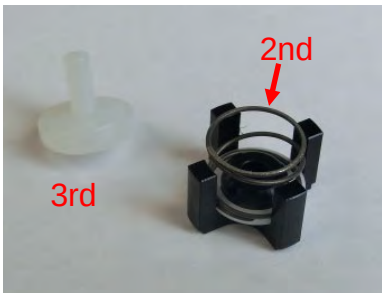




2.23

- Place four (4) Nylon Check Valve washers (**HP-CB-CVSW**) on all four (4) check valve retainers.

4X HP-CB-CVSW

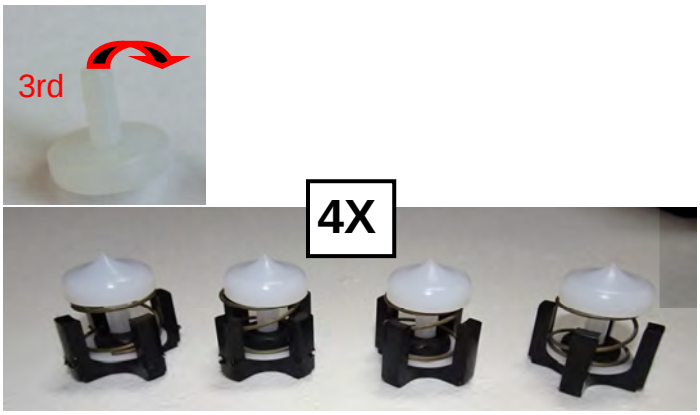


2.24

- Place four (4) check valve springs (**HP-CB-SPR**) on top of the check valve washers.

4X HP-CB-SPR

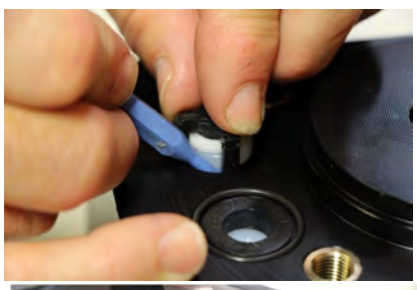
Center Block

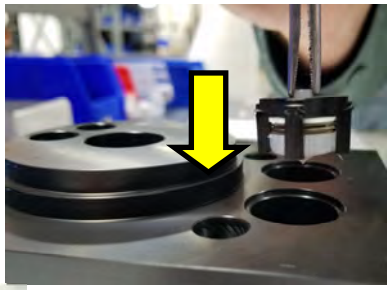


2.25

- Insert four (4) check valves (**HP-CB-CV**) into check valve retainers and check for free movement.

4x HP-CB-CV





2.26

- Insert the 2X Check Valve assemblies **with notched** legs to the **Inlet side.**
- Hold the valve in compression with the dental pick while sliding the assembly into place. It may be necessary to wiggle the valve a little to get the cage pushed into place.
- Alternatively, you can carefully assemble it upside down.

2X Notched Legs

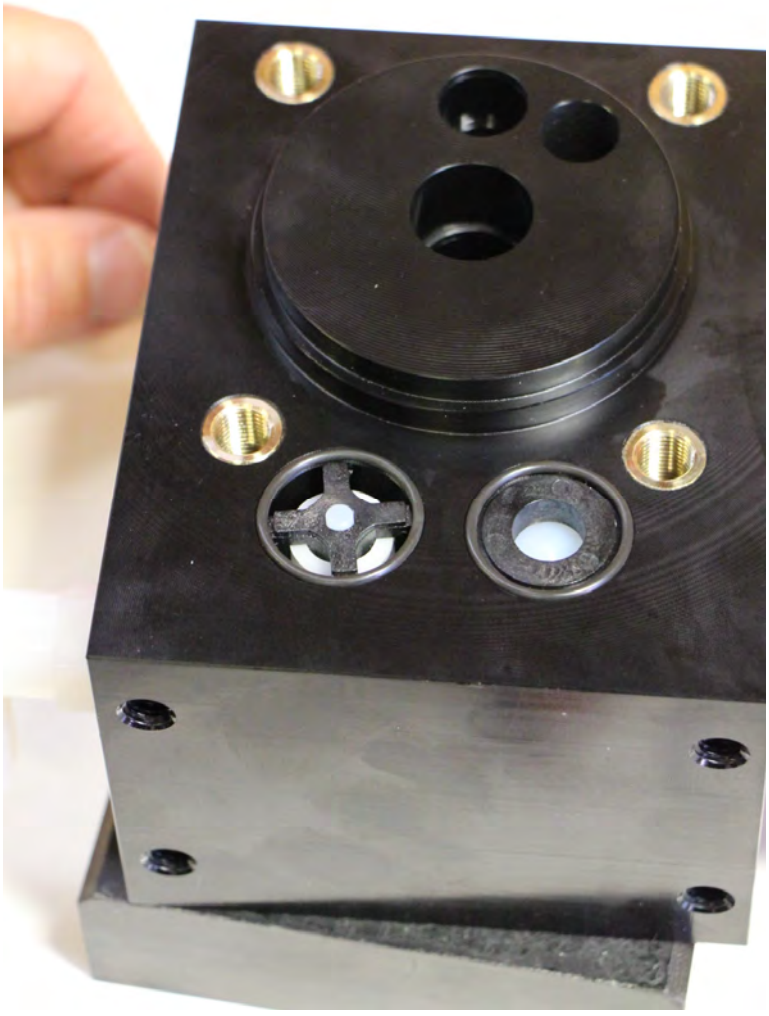
2.27

- Insert the **remaining** 2X check valve seats into the bores on the **Outlet side** of the center block.
- To ease installation, loop the valve seat over the forceps, face down, then grip one of the legs of the valve retainer.
- Hold the valve down with the forceps as you press in the valve seat. Once installed, press on the valve to check for free operation (springing).

Center Block

2.28

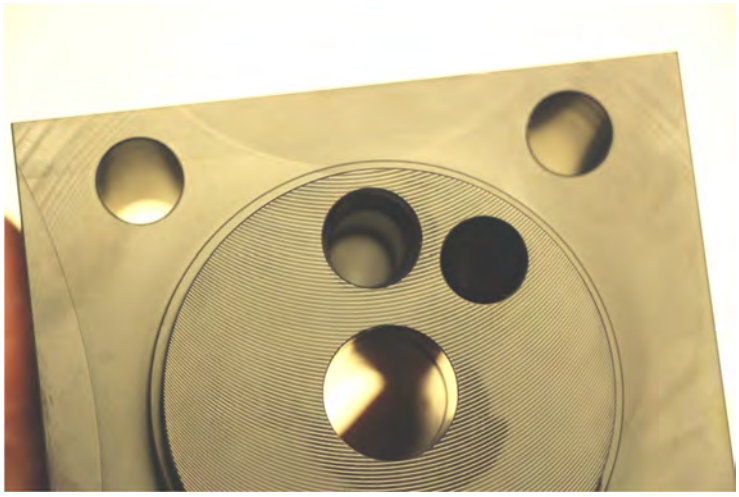
- Place new O-rings (**SO-HPP-CVP1**) over all four valve ports.
- If the O-rings don't stay in place, gently stretch them for a better fit.
- A small amount of silicone grease will help hold the O-rings in place during assembly.



2.29

- Center block with valve assemblies and outer valve seals in place.
- If valve assemblies pop out, you can use a rubber band to hold in place until ready to join to cylinders

Center Block



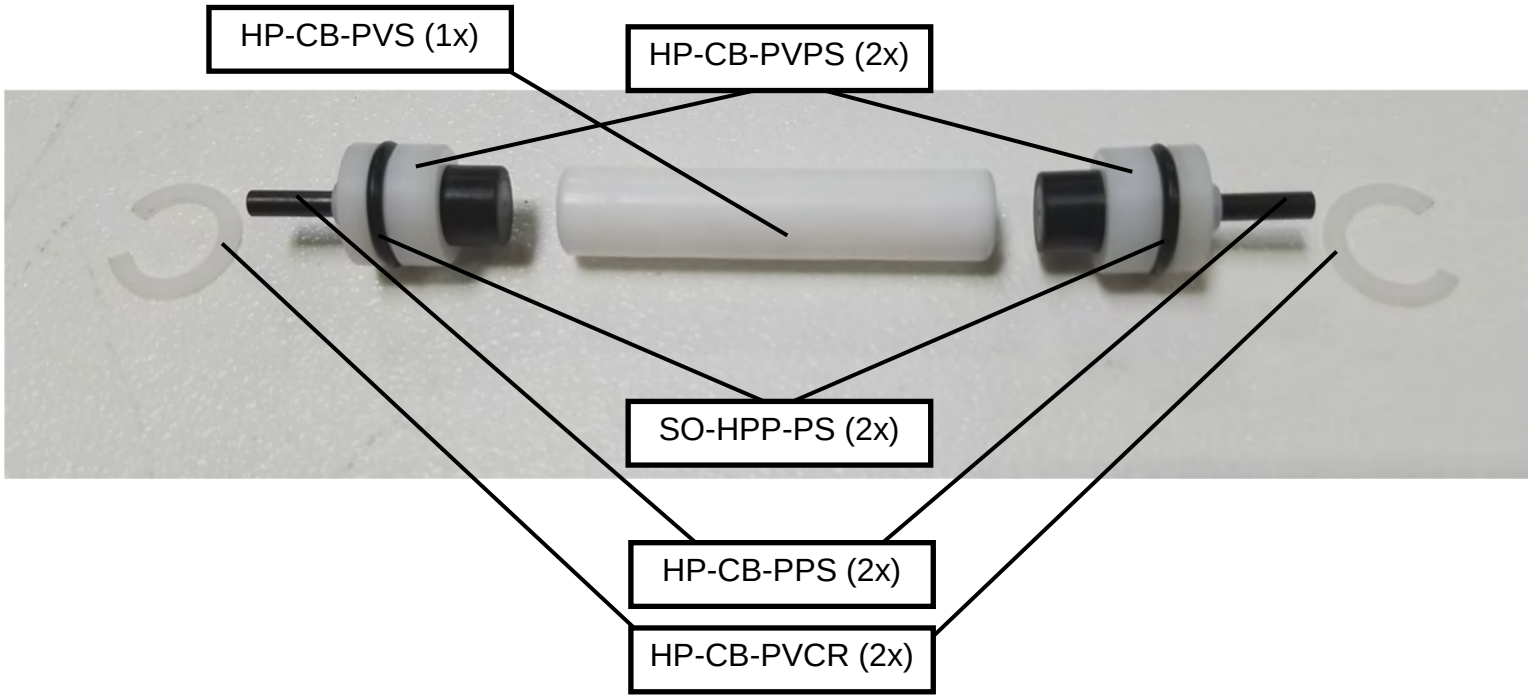
2.30

- Return to the upper port where you installed the 4 small seals

2.31

- After confirming all four seals are in place, lubricate the pilot valve spool with silicone grease and insert it into the pilot valve bore, where it will stay.

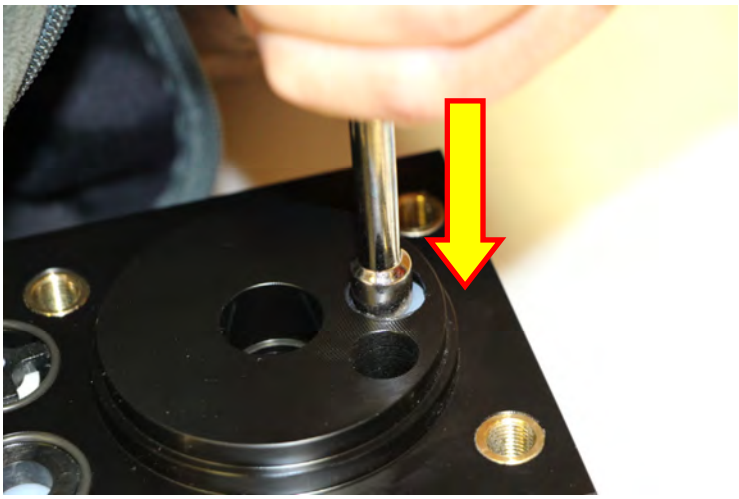
Center Block



2.32

- Put two O-rings (**SO-HPP-PS**) around two pilot valve pin seals (**HP-CB-PVPS**), seating them into the grooves.
- Insert the pilot valve pins (**HP-CB-PPS**) into the pilot valve pin seals.
- Apply a layer of silicone grease to the outside of the pilot valve pin seal, and insert into the pilot valve bore.

Center Block



2.33

- Press pilot valve pin assembly into place using nut driver or similar tool, taking care not to damage the pin. Repeat on opposite side.

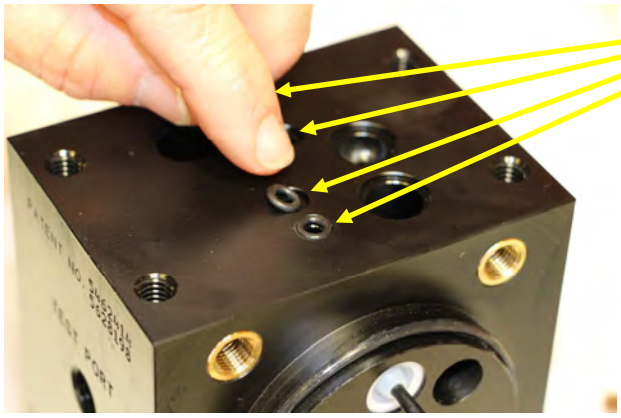
2.34

- Insert the split washer (**HP-CB-PVCR**) into the groove over the pin seal.
- If necessary, fabricate check valve retaining washers by cutting approximately 1/4” out of Nylon washers (**HP-CB-CVSW**).
- Ensure smooth and even seating by rotating the check valve retaining washer in its groove with an O-ring pick.

Center Block

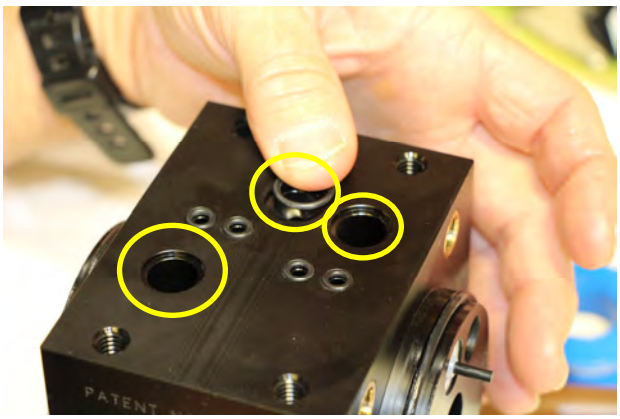
3.1

- Lubricate two (2) center block seals (**SO-HPP-ECCB**) with silicone grease and position around faces on both sides of the center block.



3.2

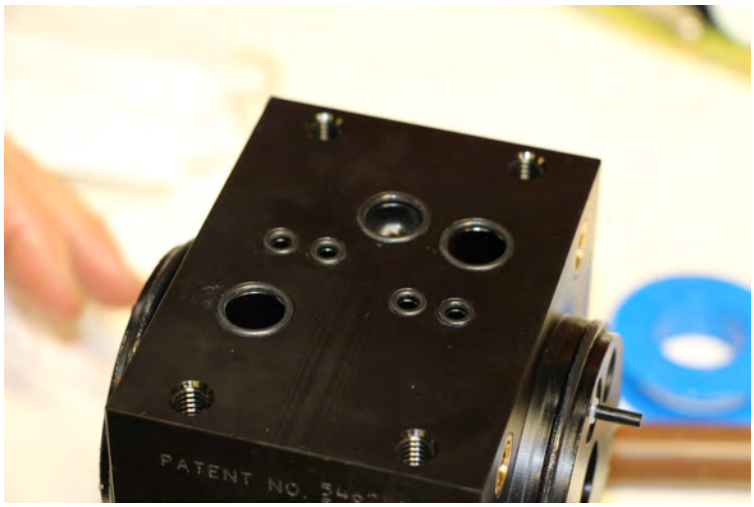
- Place (4) pilot port seals (**SO-HPP-PLP**) over the four pilot ports.
- A small amount of silicone grease will help hold the O-rings in place during assembly.



2.37

- Place the (3) valve port seals (**SO-HPP-VP**) over the three valve ports.
- A small amount of silicone grease will help hold the O-rings in place during assembly.

Center Block



2.38

- All upper seals shown in place:

Note:

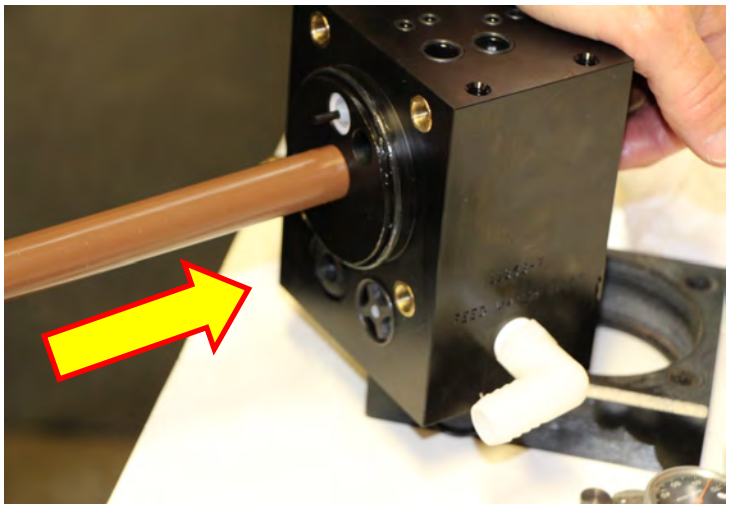
7% HP-CYL-3/4R x1

10% HP-CYL-7/8 x1

20% HP-CYL-7/8R x2

2.39

- Use the piston rod installation tool to aid insertion of the piston rod.
- Without the installation tool the seals could be damaged by the piston rod.
- If you do not have the tool, ensure the rod is well lubricated.



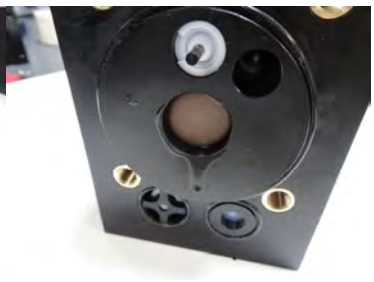
2.40

- Lubricate the piston rod (**HP-CYL-PT**) with silicone oil or grease. Carefully twist and insert the rod the piston rod bore, past the seals, taking care not to damage or dislodge the seals.

Center Block

2.41

- Push the installation tool out of the far side of the center block. Check for smooth movement of the piston rod in the piston rod bore. It will require a little force to move the rod, this is normal.



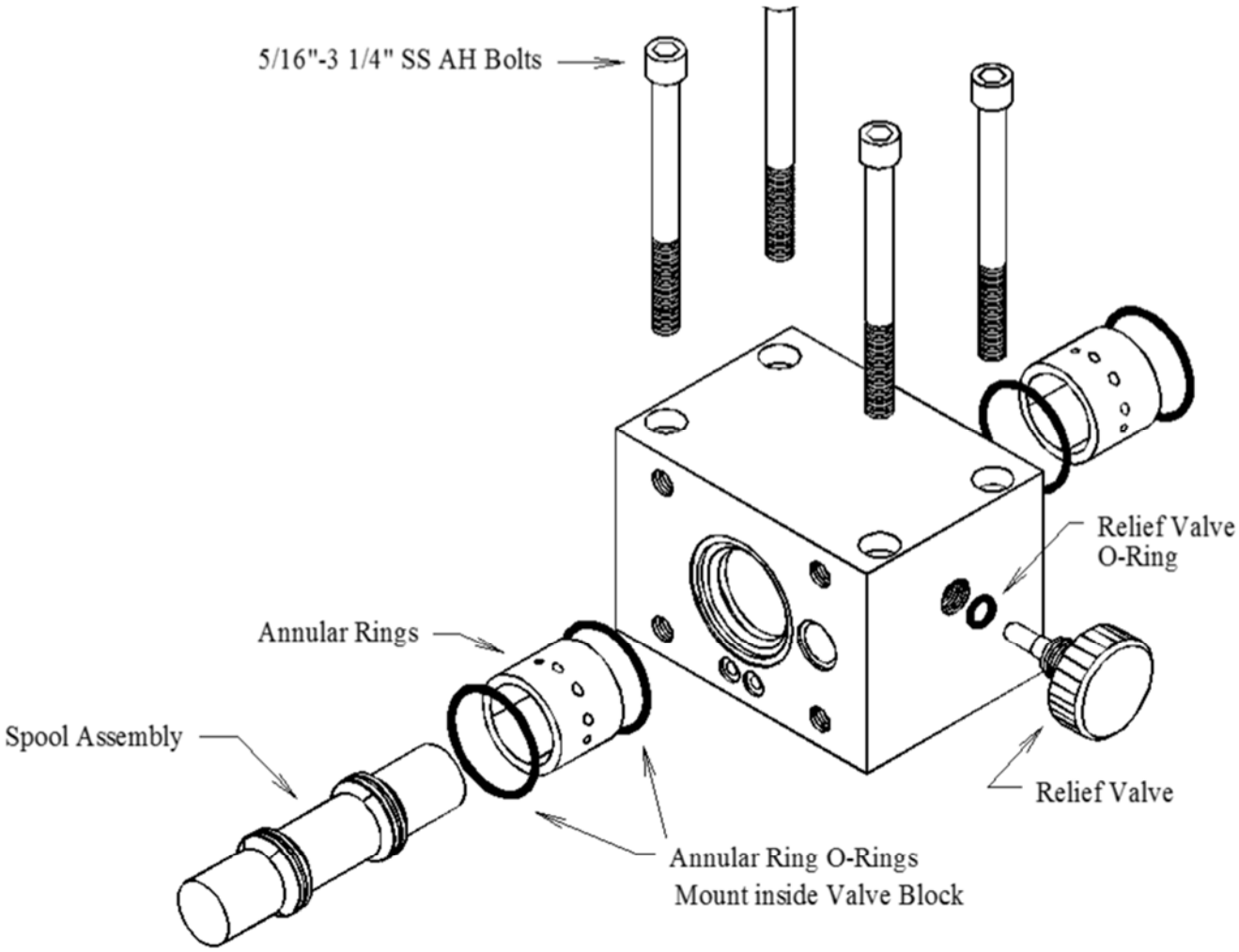
7% center block

20% center block

2.42

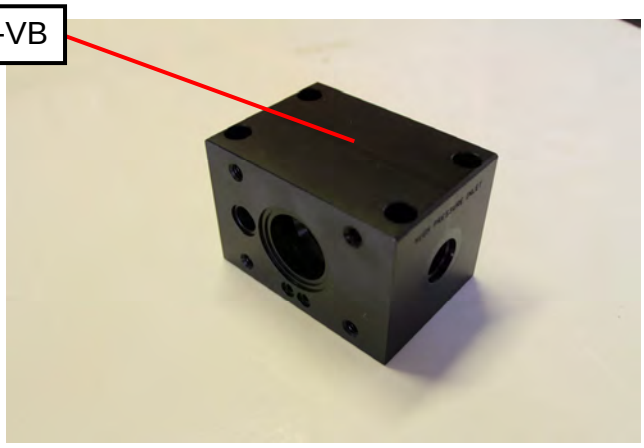
This completes the center block assembly.

3. Valve Block Assembly



Valve Block

HP-TB-VB

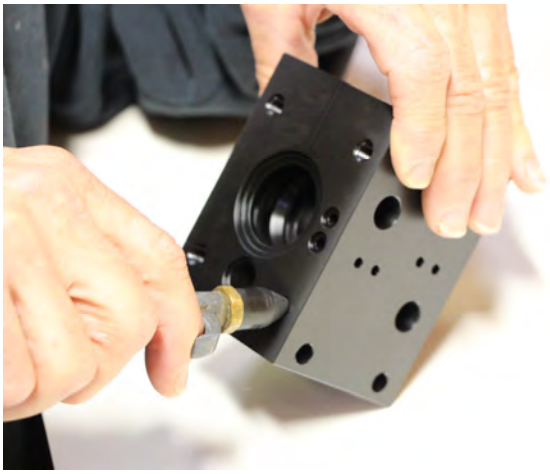


The valve body is inscribed with “pressure relief valve” on one side, and “high pressure inlet” on the other. All models use the same valve block.

Valve Block

3.1

- Check for defects in manufacturing, burrs, or shavings.



3.2

- Blow out any detritus (debris) with compressed air.

3.3

- Fit the small orange O-ring (**SO-HPP -RV**) to the relief valve (**HP-TB-BV**) and liberally apply silicone grease on the threads.

Valve Block

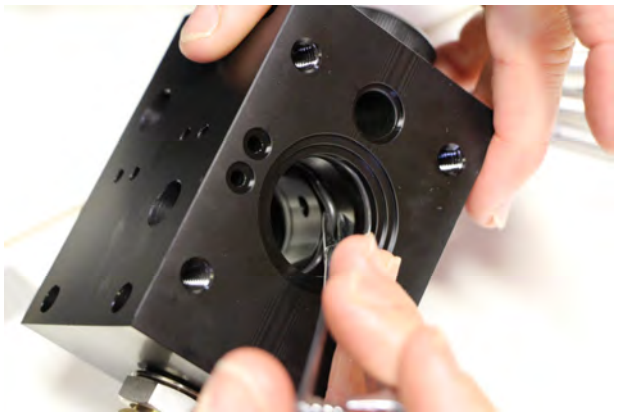
3.4

- Screw the relief valve into the Pressure Relief Valve port.

3.5

- Seat the four annular ring O-rings (**SO-HPP-AR**) in the four grooves along the large bore in the valve block.

4X SO-HPP-AR



3.6

- Forceps will aid installation of the two inner annular ring O-rings.

Valve Block

3.7

- Inspect two (2) annular rings (**HP-TB-ARP**), and seat the annular ring installation tool in one of the annular rings.

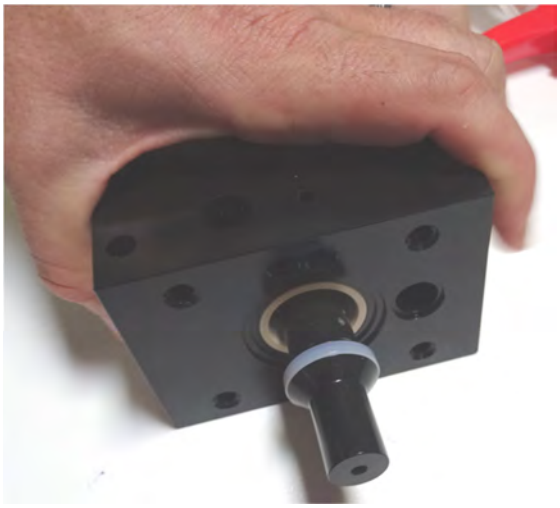
3.8

- To prepare for installation, lubricate both the annular rings and the valve block with soapy water.

3.9

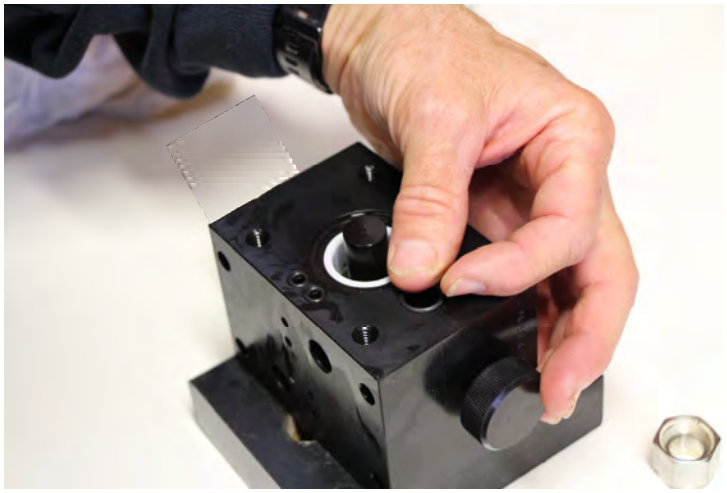
- Place the valve block under a mechanical press. Using the annular ring installation tool, press the annular ring into the valve block until bottomed out. Repeat on both sides of the valve block.
- If you do not have a press or the install tool, you can use an old ring as a tool to help push until bottomed out, by hand or carefully tap with a mallet/hammer

Valve Block



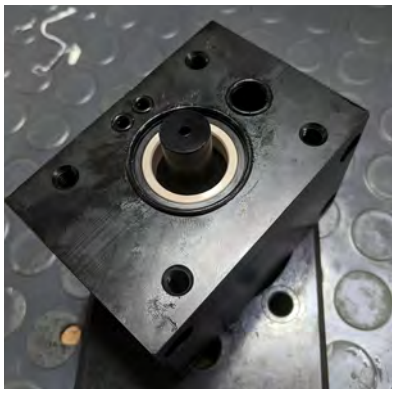
3.10

- Lubricate the annular rings with soapy water, then press the reversing valve spool assembly into the valve block.



3.11

- Place pilot port O-rings (**SO-HPP-PLP**) and brine port O-rings (**SO-HPP-VP**) on both sides of the valve block.



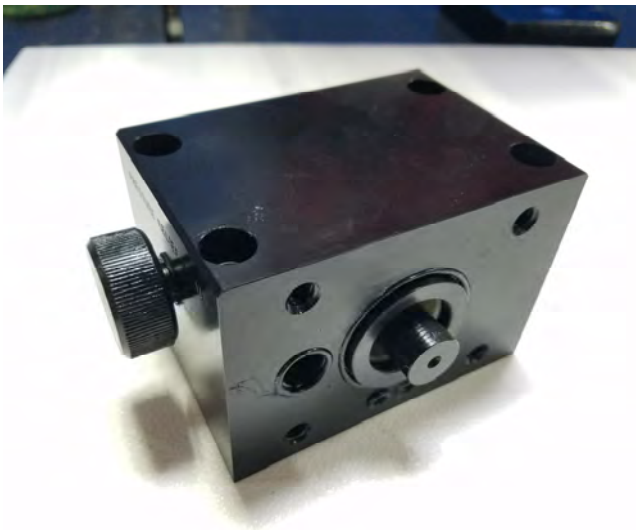
3.12

- Place Valve Bore Seal (**SO-HPP-VB**) on each side of valve body. Silicone grease may aid in getting the O-ring to stay in place.

Valve Block

3.13

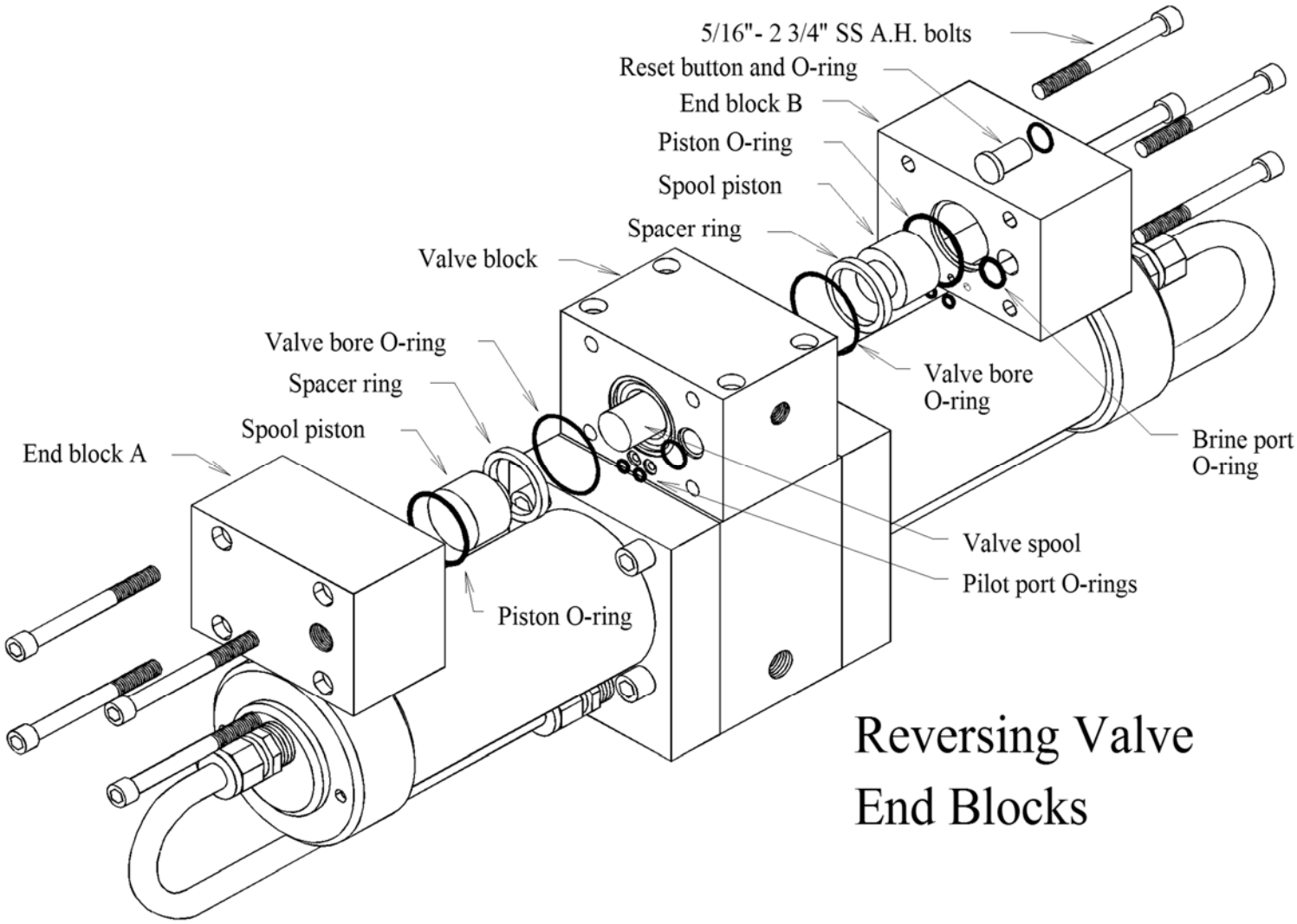
- Place Spacer ring (**HPP-TB-SR**) on each side of valve body so annular ring is covered.
- A small amount of silicone grease will help tack it in place.



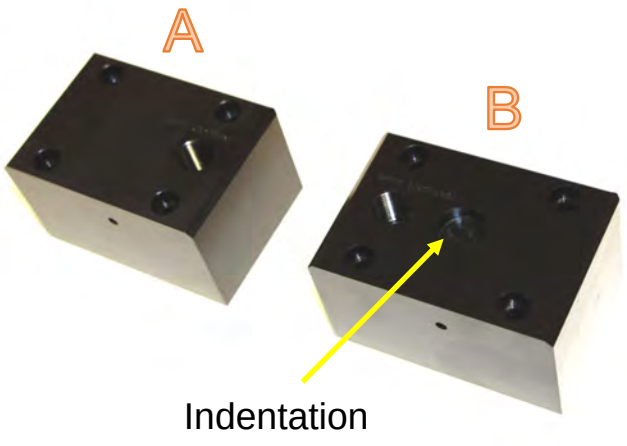
3.14

- Place four 5/16” x 3-1/4” stainless steel bolts (**HD-CPS-5/16x3**) in the mounting holes. This completes the valve block assembly.

4. Reversing Valve End Blocks



The A and B end blocks are mirror images. The B side has an indentation that the A side does not have.

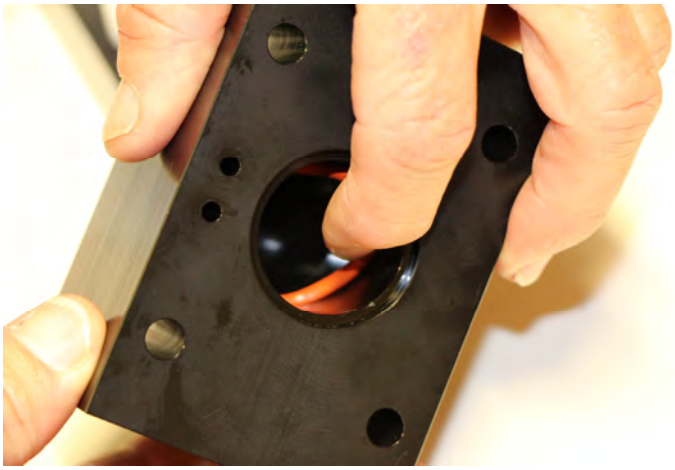


The 7% and 10% Clark Pumps end blocks have a 1-1/4” bore (**HP-TB-VEB-A1** and **HP-TB-VEB-B1**); 20% end blocks have a 1” bore (**HP-TB-VEB-A** and **HP-TB-VEB-B**).

Reversing Valve End Blocks

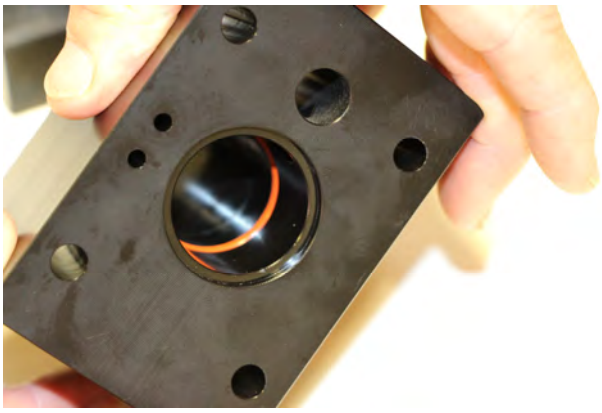
4.1

- Inspect both end blocks for debris and defects in manufacturing. Remove debris and blow out with compressed air as needed.



4.2

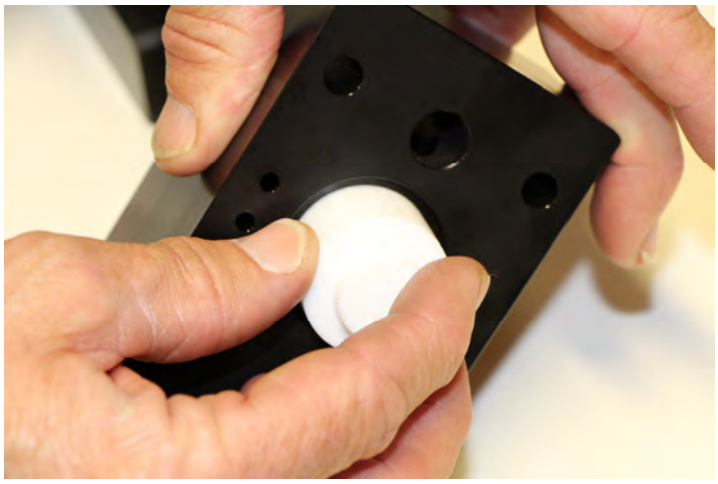
- Insert the orange spool piston O-rings (**SO-HPP-SP**) and seat them into their grooves. (on 20% pumps this O-ring part number **SO-HPP-SP1**)



4.6

- Piston O-ring in place

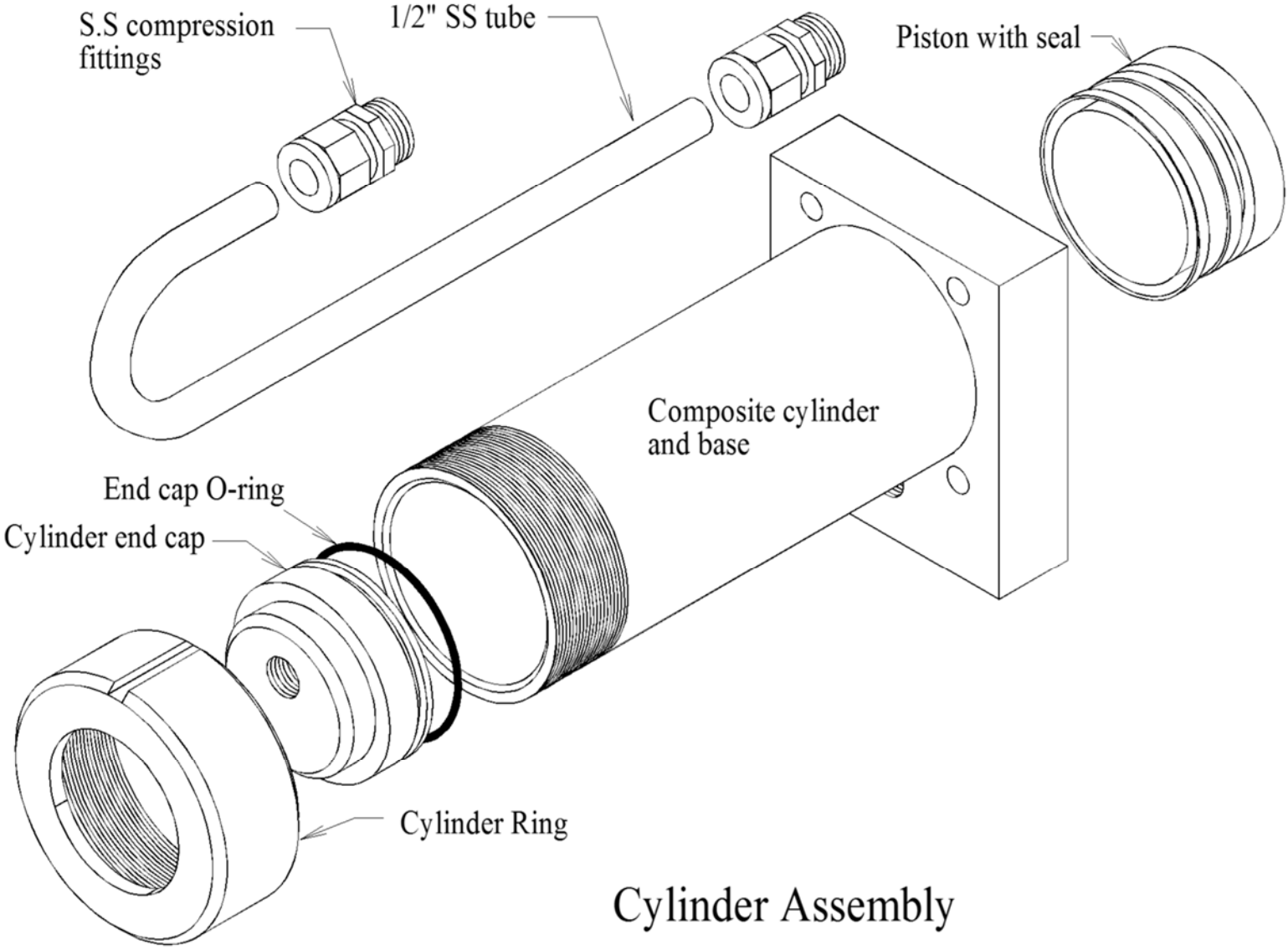
Reversing Valve End Blocks



4.7 (last step)

- Load the spool piston (**HP-TB-VSP**) into both end blocks. (On 20% pumps this is part number **HP-TB-VSP1.0**). **Press in until bottomed out.**

5. Cylinder Assembly

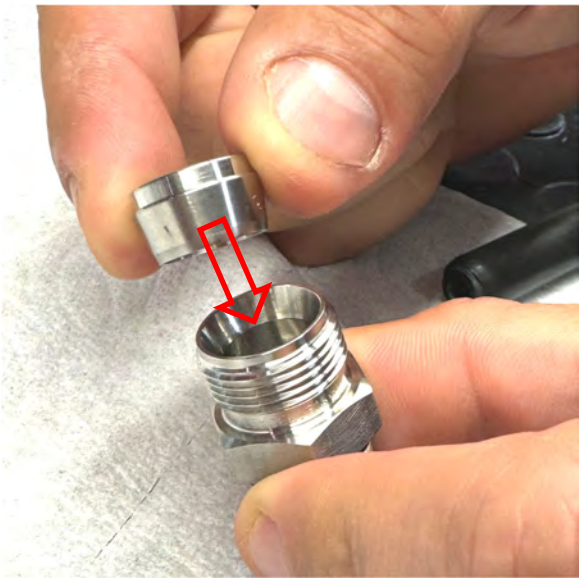


Cylinder Assembly

Cylinder Assembly

5.1

- Ensure internal cylinder walls are smooth
- Address with Ball Hone or sandpaper as referred to in disassembly steps

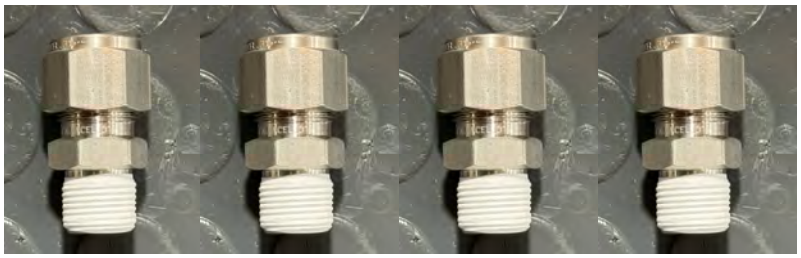


5.2

- Ensure steel ferrules (1 piece or 2 piece) are in nut, cone side down.
- Assemble four stainless steel compression fittings (**PL-MTS-3/8x1/2S**), two for each cylinder.
- Apply 5-8 Wraps of Teflon Tape to tapered threads.

Note: NPT threads rely on wedging and thread sealant. No O-Ring Needed.

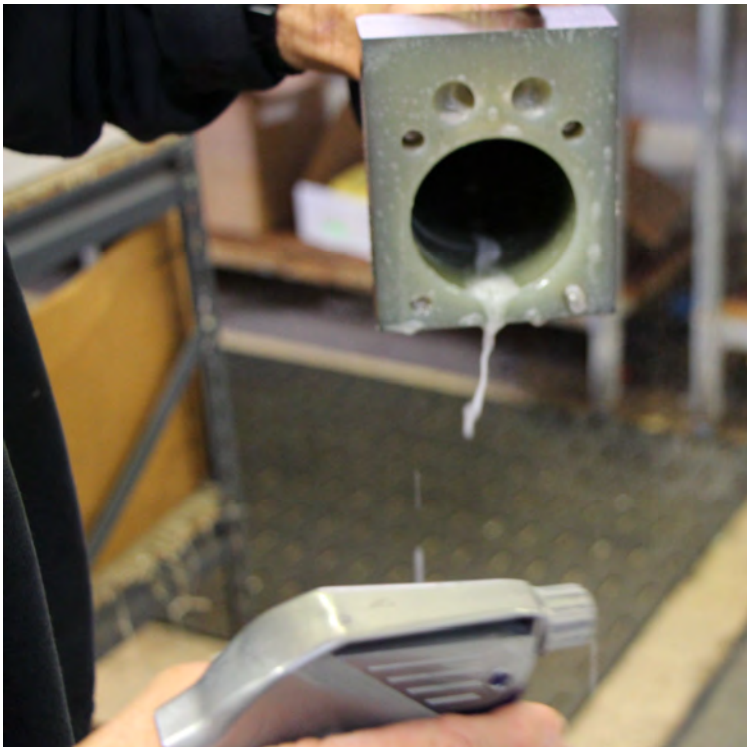
4X PL-MTS-3/8x1/2S



Cylinder Assembly

5.3

- Place the cylinder in a tight vice, taking care to pad the jaws to avoid scratching.
- Grease all threads with silicone grease, and hand-screw the fitting into base.
- Tighten fitting firmly to approximately a .060” clearance gap



5.5

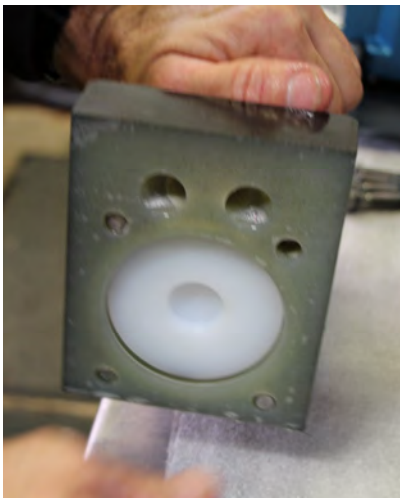
- Spray both pistons (**HP-CYL-PT**) and cylinders with soapy water.

Cylinder Assembly

5.6

- Insert the pistons (**HP-CYL-PT**) into the cylinders with the indentation facing downward.
- May be necessary to use a mallet handle to evenly push the pistons down toward the bottom of each cylinder.

1X HP-CYL-PT



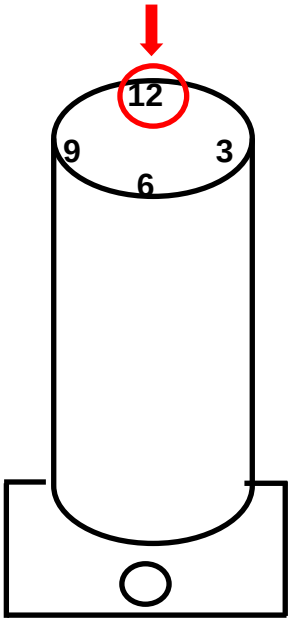
7% and 10% pumps

20% pump

5.7

- The indentation for the piston rod should be facing out.

Cylinder Assembly



5.8

- Apply silicone grease to the end cap O-ring (**SO-HPP-ECCB**) and place on the cylinder end cap (**HP-CYL-EC**).
- Apply slightly more silicone grease to the end cap once O-ring is in place.

5.9

- Insert the end cap with O-ring into the cylinder, keeping the threaded hole at **twelve o'clock**, opposite the fitting on the base.

5.10

- Apply a layer of silicone grease to the cylinder ring (**HP-CYL-R**).

1X HP-CYL-R

Cylinder Assembly

5.11

- Spray both the cylinder ring and the threads on the cylinder with soapy water, then screw the cylinder ring onto the cylinder.

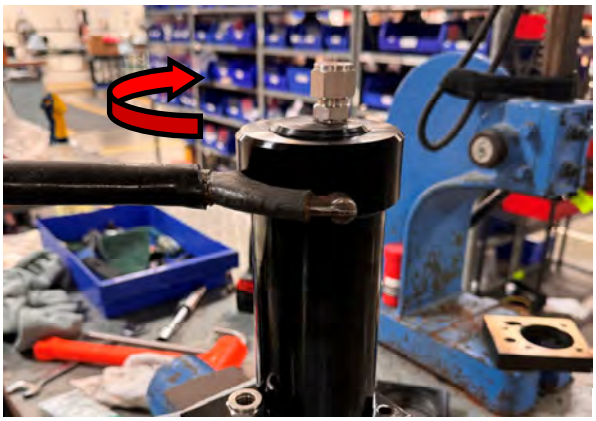
5.12

- Tighten cylinder ring with a spanner ring wrench, strap wrench, or by hand. The seal is with an O-ring so tighter is not better, it just makes it more difficult to undo the next time.

5.13

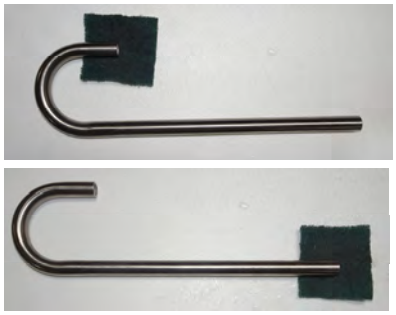
- Screw the other stainless steel fitting into the cylinder end cap with a 13/16” wrench.

Cylinder Assembly



5.14

- Tighten cylinder ring firmly with the spanner ring wrench/strap wrench/by hand.



5.15

- Use Scotch Brite or a similar mild abrasive to check the ends of both 1/2” Stainless steel tubing for imperfections that could cause a leak. Scuff ends to ensure a good seal.
- Coat both ends of the 1/2” stainless steel tubes (**HP-CYL-SST**) with silicone grease.

5.16

- Insert the end of the stainless steel tube into each fitting to align the ferrule.
- Snug the nut on the tube, then back off half a turn before removing the tube.
- Insert the J-tube into fittings, giving it a tap with a mar proof hammer to ensure complete seating. Tighten nuts finger tight, then tap again.

Cylinder Assembly

5.17

- Tighten the compression nut with a 7/8” wrench while holding the base nut in place with a thin 13/16” wrench. The compression nut must compress the ferrule around the tube and create a high pressure seal, approximately 3/4 turn beyond hand tight.
- Do not allow the fitting to spin while tightening the compression nut. The compression nut must compress the ferrule around the tube and create a high pressure seal which takes about 75 ft. lbs. of force.

5.18

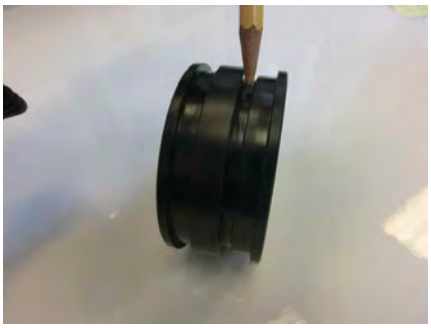
- Repeat previous step to tighten the top compression nut.

5.19

- The stainless steel tube should line up with the cylinder. If not, it can be tapped into place with a mar-proof hammer, even after the compression nuts are tight.

Cylinder Assembly

The following 3 steps are for preparation of the 20% piston only. The piston for the 7% and 10% Clark Pumps, shown on the next page, is one-piece Nylon and requires no assembly.



5.20

- **20% PUMPS ONLY:** Looking at the 20% piston (**HP-CYL-PT20**) you will see the deepest groove will receive an orange O-ring (**SO-HPP-PT20**).

5.21

- **20% PUMPS ONLY:** Over the orange O-ring, put a piston seal (**HP-CYL-PTS20**).

1X HP-CYL-PTS20

5.22

- **20% PUMPS ONLY:** In the two remaining grooves, place two piston bushings (**HP-CYL-PTB20**).

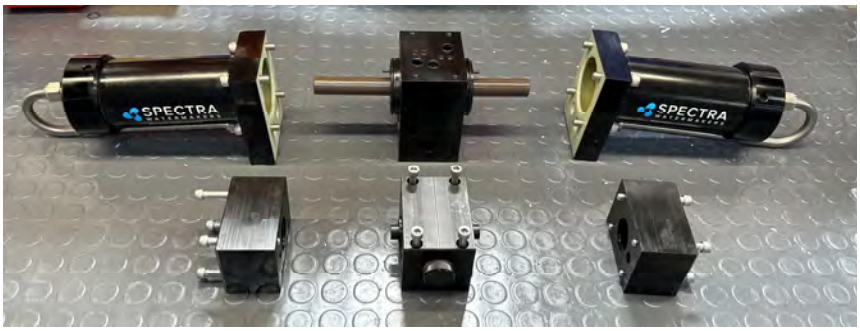
2X HP-CYL-PTB20

Final Pump Assembly

Clark Pump

Final Stage

Final Pump Assembly

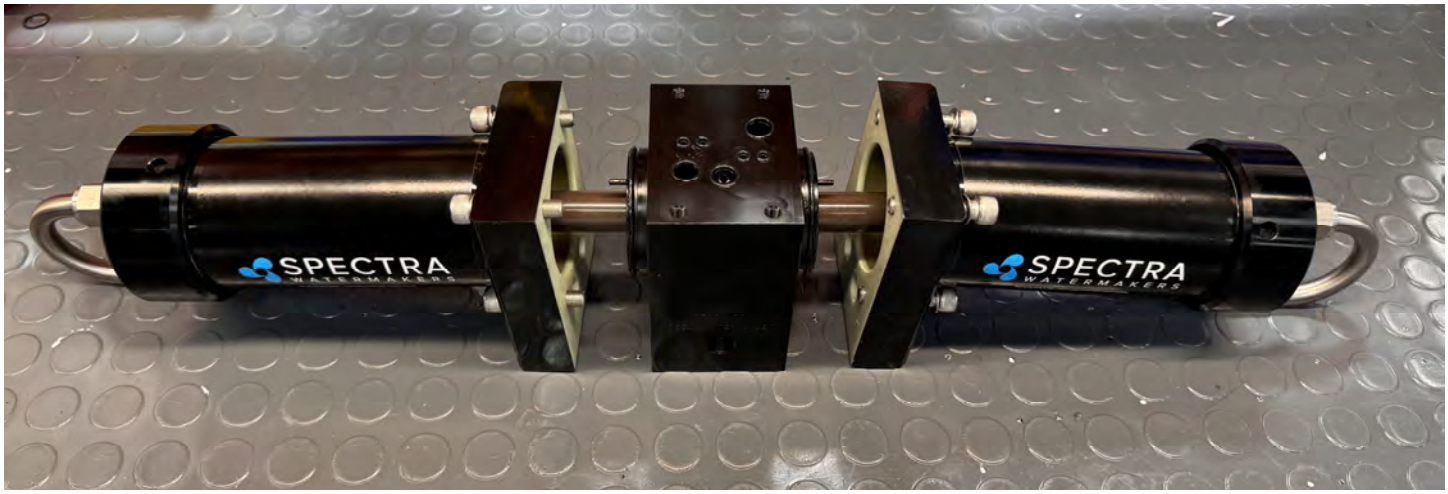


6.1

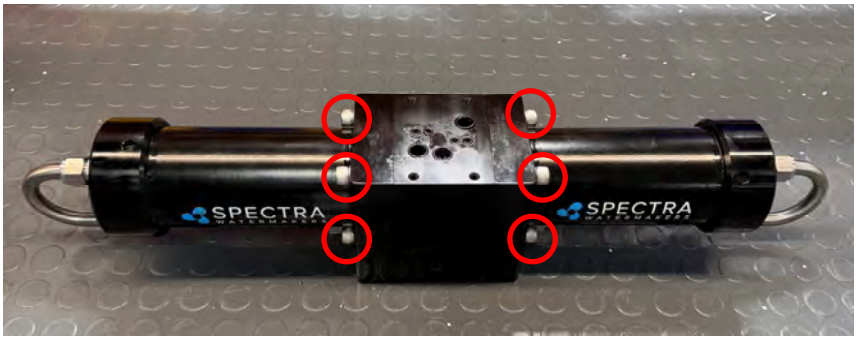
- Lay out all components made throughout this SOP.
- Ensure you have everything laid out as shown in image.

6.2 Attaching Cylinders to Center Block

- Set aside Valve Body and Valve Block A & B.
- Retrieve Center Block and Cylinders.
- Ensure all O-rings are in place Center Block.
- Grease threads of 8X 3/8” x 1-3/4” bolts (**HD-CPS-3/824175**) with anti-seize or bearing grease (if on hand) and add 8X washers (**HD-WSH-3/8x5/8S**).
- Seat the Cylinders and Center Block, ensuring the O-rings and valve assemblies stay in place on the Center Block.

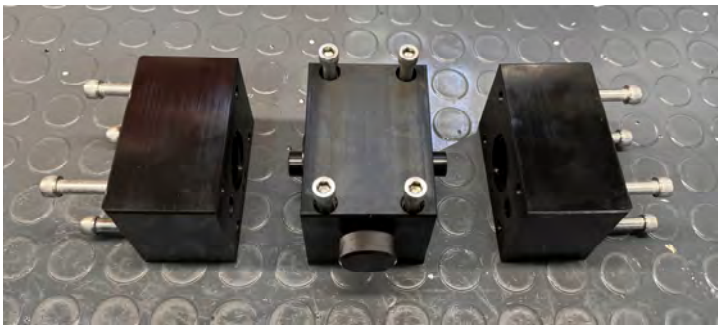


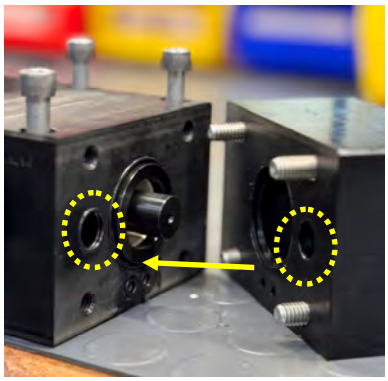
Final Pump Assembly



6.3

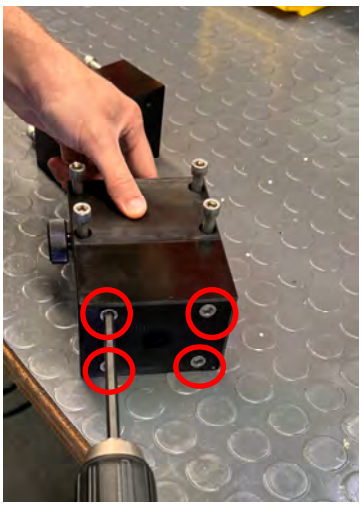
- Snug the 8X 3/8” x 1-3/4” bolts with washers.
- Use the gentlest setting on a power driver, as uneven tightening could dislodge the nickel-brass inserts in the center block.
- Final tightening will be by hand at end.

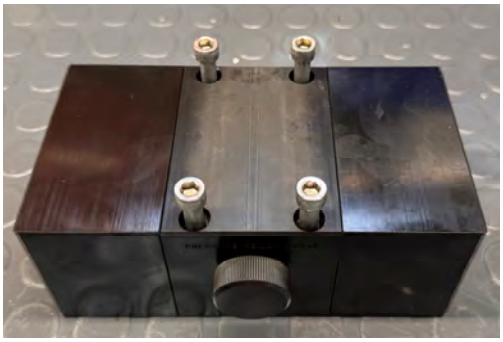




6.4 Attaching Valve Blocks A & B to Valve Body

- **Obtain** the Valve Body and Valve Blocks A & B.
- Check and make sure 8X O-rings and 2X plastic spacer O-rings are in place on the Valve Body.
- **Check to make sure the holes on A & B line up with the Valve Body.**

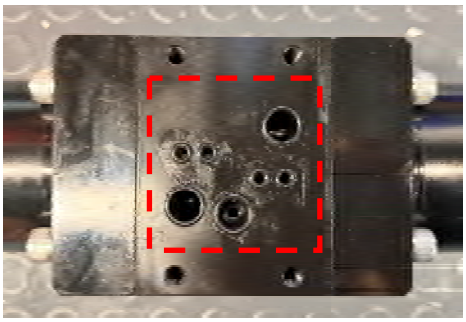


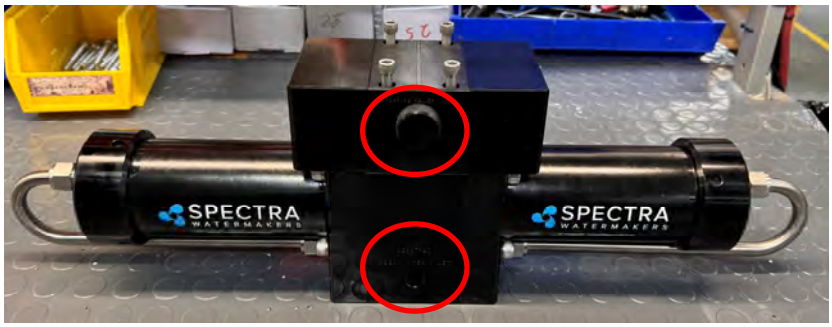


6.5

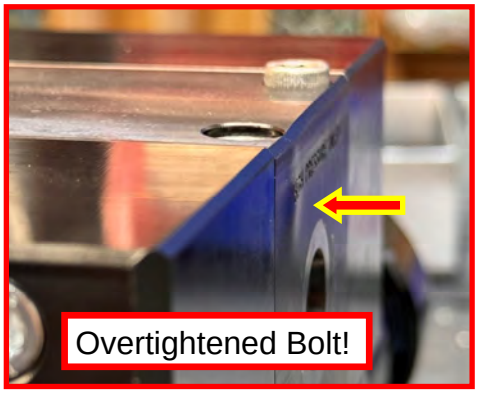
- Use the gentlest setting on a power driver to snug the 8X bolts on the Valve Blocks A & B.
- Final tightening will be done by hand at the end.

Final Pump Assembly





Example of a crack due to over tightening.



Overtightened Bolt!

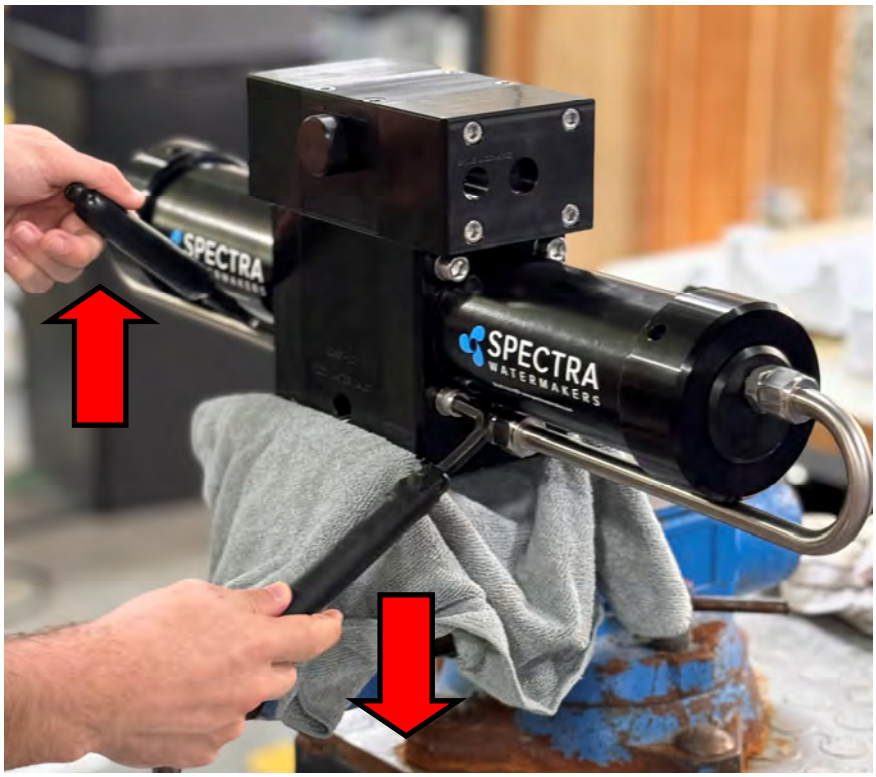
6.6 Attaching Assembled Top End to Body

- Make sure all 7X O-rings are seated in place on body.
- Place top end on body, making sure pressure relief valve is on the same side as feed water inlet.
- Use the gentlest setting on a power driver to snug the 4X bolts in an X pattern located on the top end.
- Final tightening will be done by hand at the end.
- It is critical not to overtighten as it is a metal bolt threading into plastic, Overtightening may cause bulging and damage to the body.
- See example of overtightened bolt.

6.7

- If you have access to a torque wrench, tighten to 7.5 feet/lbs to all 12X top end bolts using an X pattern.
- If you **do not** have a torque wrench, then tighten by hand. Using two fingers, get the bolts hand-tight.
- **If the plastic body is bulging, it is overtightened as per photo above in step 6.6.**

Final Pump Assembly



6.8 Final Tightening (Last Step)

- Lastly, place the newly assembled Clark Pump in a vice.
- Tighten the opposing cylinder bolts at the same time using two 5/16“ Allen wrenches.
- **Tighten gradually and repeatedly in an X pattern until all 8X bolts are very tight**, approximately 200 inch-pounds of torque.
- Again, uneven tightening could shift one of the bronze inserts.

Note: This can be tightened securely without damaging the system, as it involves metal-to-metal contact.

This concludes the Clark Pump rebuild process

Notes