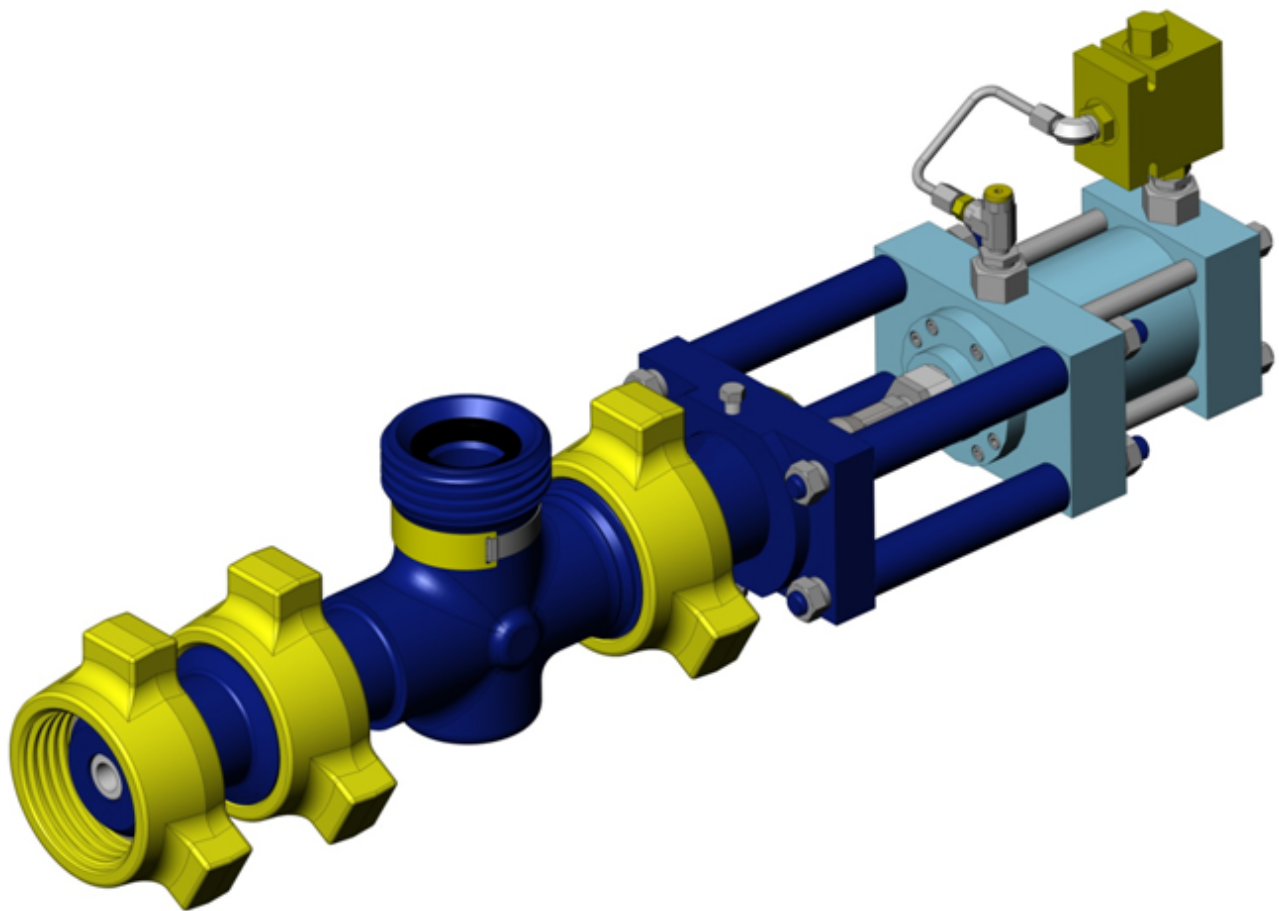




Technical Manual

MSI Hydraulic Adjustable Choke



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Revision B

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WARNINGS

The MSI Hydraulic Adjustable Choke is used in high-pressure and high flow well service applications. High pressure equipment, if not used and maintained properly, can cause serious injury or death and damage to equipment and property. Not taking proper precautions and failing to perform routine maintenance and inspections can also contribute to loss of well control, and such loss could cause serious injury or death and damage to equipment and property.

The MSI hydraulic adjustable choke is designed to decrease pressure in a fluid flow situation, as a result, the velocity of the fluid stream increases drastically. Abrasive particles in the high velocity flow stream can cause excessive and premature erosion to the choke components. The downstream side of the choke though is protected by long wearing carbide thus reducing this wear. Therefore it is critical for safety and performance to ensure the choke is installed such that the direction of flow is away from the bonnet on adjustable chokes. Improperly flowing through the choke may cause damage and void the warranty. It is not recommended.

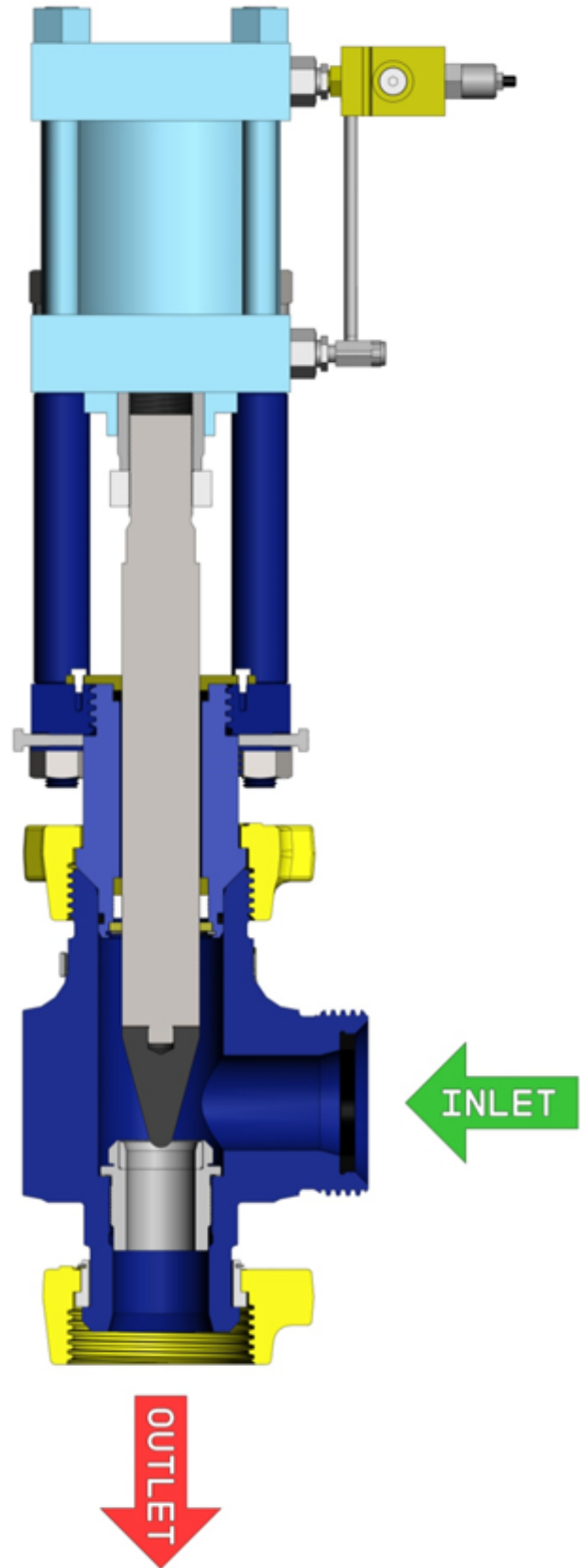
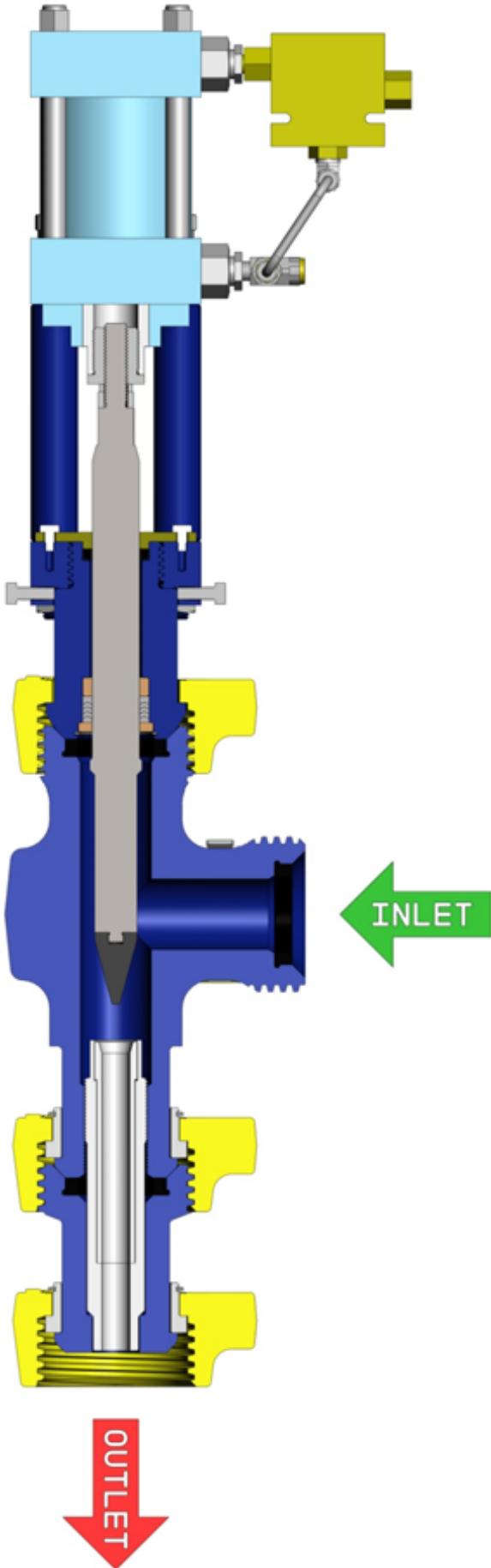
ALL OPERATORS AND MAINTENANCE PERSONNEL SHOULD BE THOROUGHLY TRAINED IN THE SAFE OPERATION, MAINTENANCE, AND INSPECTION OF THIS EQUIPMENT.

This product is not designed to be used for fully stopping the flow of fluids. In systems where this is required proper isolation valves should be used in conjunction with the choke.

FLUID DIRECTION THROUGH CHOKE

3/4" & 1" MAXIMUM ORIFICE (2" IRON)

2" MAXIMUM ORIFICE (3" IRON)



GENERAL DESCRIPTION

1.1. Choke Description

Hydraulic adjustable chokes are used in many oilfield applications to control the rate of flow. Usually an adjustable choke is used as part of a manifold installed downstream of the wellhead. The choke is adjusted during flowback of the well to control downstream pressure and flow rates. The MSI hydraulic adjustable choke consists of three main sub-assemblies. These sub-assemblies are the bonnet assembly, tee, and nipple assemblies (for 2" iron only).

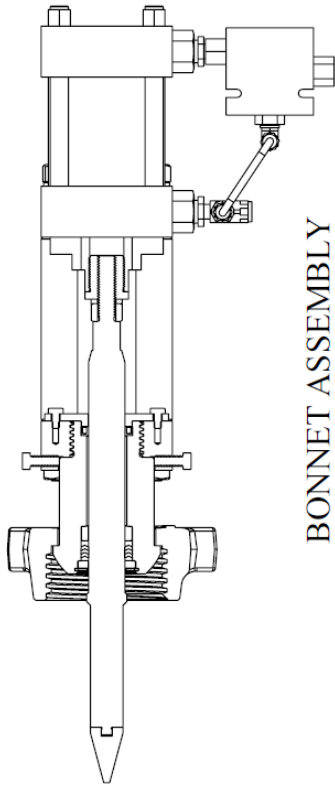
1.2. Choke Specifications

MSI chokes are available in ¾", 1", and 2" maximum orifice sizes. The components that comprise the choke are made from various materials. The bonnet, tee, and nipple are made from forged alloy steel. The stem is manufactured from stainless steel and utilizes a solid carbide tip. The choke seat is also made from stainless steel that has been fitted with a carbide liner.

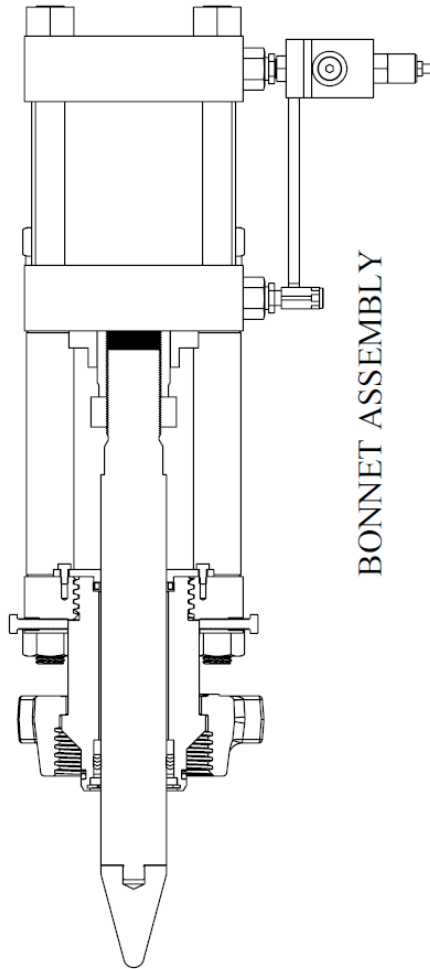
CHOKE MAIN SUB-ASSEMBLIES

3/4" & 1" MAXIMUM ORIFICE (2" IRON)

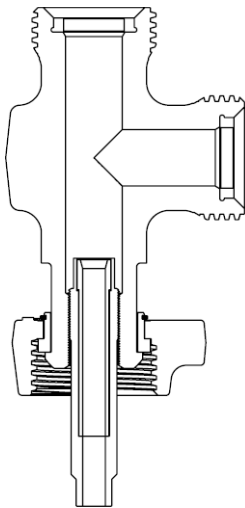
2" MAXIMUM ORIFICE (3" IRON)



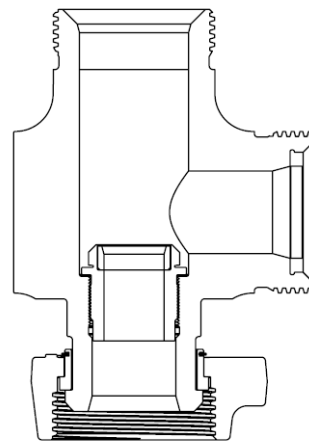
BONNET ASSEMBLY



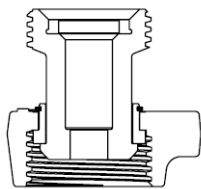
BONNET ASSEMBLY



TEE ASSEMBLY



TEE ASSEMBLY



NIPPLE ASSEMBLY

1.3. Choke Performance

MSI adjustable chokes are available in three trim sizes. Our 3/4" and 1" maximum trim sizes are available for use with our chokes that use 2" 1502 connections. The 2" maximum trim size is only available for use with our chokes that use 3" 1502 connections.

For liquid flow, the mathematical equation for determining Cv is:

$$Cv = q \left(\frac{SG}{dp} \right)^{\frac{1}{2}}$$

where:

q = flow rate (gpm)

SG = fluid specific gravity (1 for 60°F water)

dp = pressure drop across choke (psi)

1.4. Cylinder Description

The hydraulically actuated chokes are operated with double acting hydraulic linear actuator or cylinder. The cylinder AA0036 is used with choke fittings that utilize 2"1502 or WS20 connections and 3/4" or 1" maximum equivalent orifice size. AA0056 is used with the fittings that use 3"1502 or WS30 connections and 2" maximum equivalent orifice size. Both cylinders use SAE J1926 straight thread O-ring type ports. The smaller cylinder AA0036 uses -8 port and AA0056 uses a -12 port.

1.5. Cylinder Specifications

MSI Part Number	AA0036		AA0056	
Hydraulic Pressure (max)	3,000 psig		3,000 psig	
Port Size (Extend/Retract)	-8 SAE	-8 SAE	-8 SAE	-8 SAE
Fluid Displacement** (Extend/Retract)	9.2 fl.oz.	6.5 fl.oz.	47.0 fl.oz.	38.8 fl.oz

**Please note the amount of fluid displacement is the amount to actuate the cylinder fully. This is not the total amount of the hydraulic control system. This volume does not include the amount needed for fittings and hydraulic lines. Every system is different based on setup and application, we cannot specify minimum required fluid volumes for any particular hydraulic system.

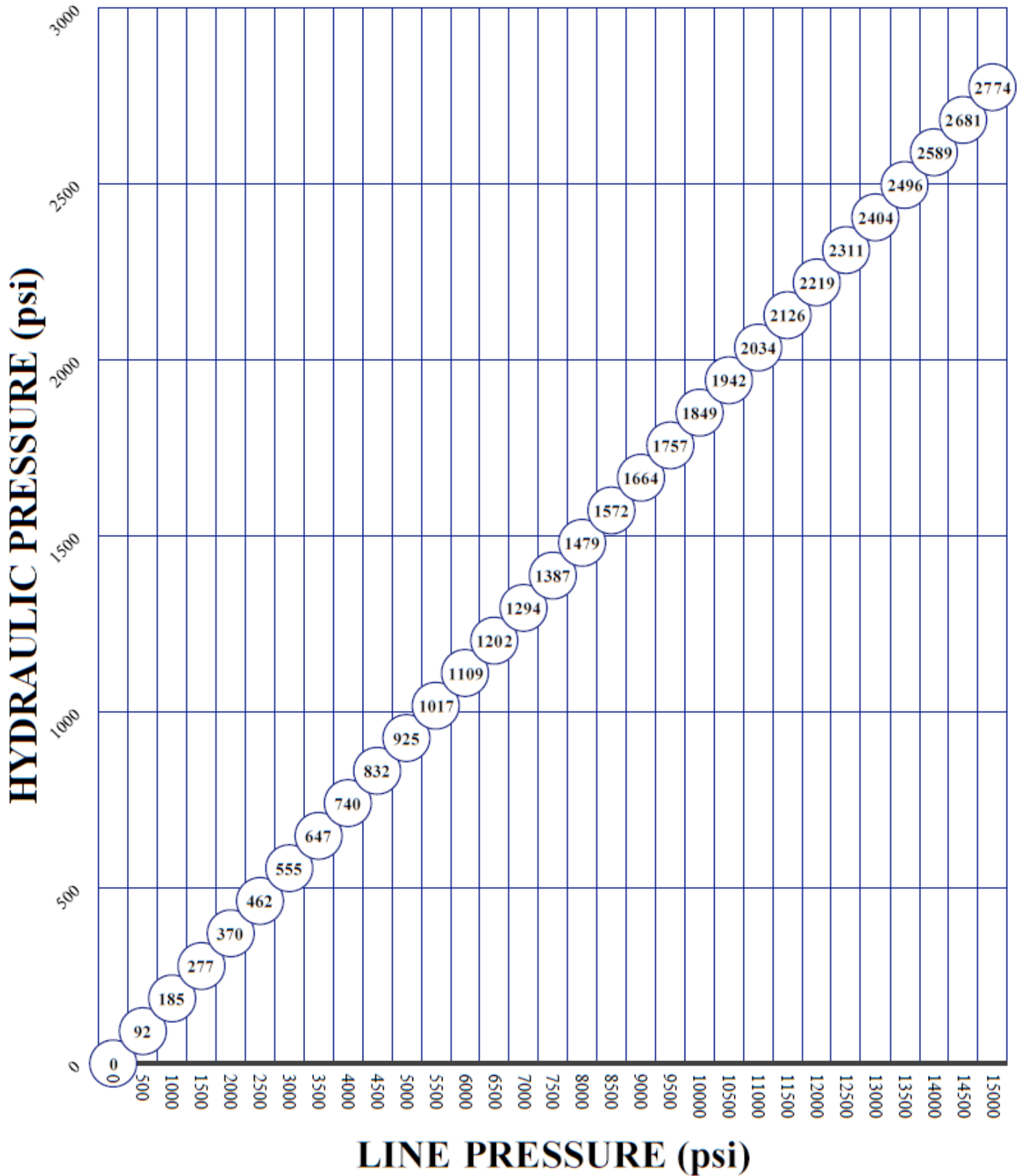
1.6. Choke Balance Pressure

The pressure listed below is the hydraulic pressure required to balance the system, i.e. hold the choke stem at a desired flow position for an equivalent orifice value. This is not the pressure required to actuate the choke. An increase in hydraulic pressure over the calculated value is required to overcome the frictional forces of the packing and begin to actuate the choke stem. Once the stem begins to move, the hydraulic pressure should reduce to a value just over the calculated value. Further increases in pressure increase the speed at which the choke stem will move towards the seat.

Hydraulic Choke Cylinder Balance Pressure		
Line Pressure (psig)	Hydraulic Pressure (psig)	
	2" Iron (1" max orifice)	3" Iron (2" max orifice)
500	92	88
1,000	185	176
1,500	277	264
2,000	370	352
2,500	462	439
3,000	555	527
3,500	647	615
4,000	740	703
4,500	832	791
5,000	925	879
5,500	1,017	967
6,000	1,109	1,055
6,500	1,202	1,143
7,000	1,294	1,230
7,500	1,387	1,318
8,000	1,479	1,406
8,500	1,572	1,494
9,000	1,664	1,582
9,500	1,757	1,670
10,000	1,849	1,758
10,500	1,942	1,846
11,000	2,034	1,934
11,500	2,126	2,021
12,000	2,219	2,109
12,500	2,311	2,197
13,000	2,404	2,285
13,500	2,496	2,373
14,000	2,589	2,461
14,500	2,681	2,549
15,000	2,774	2,637

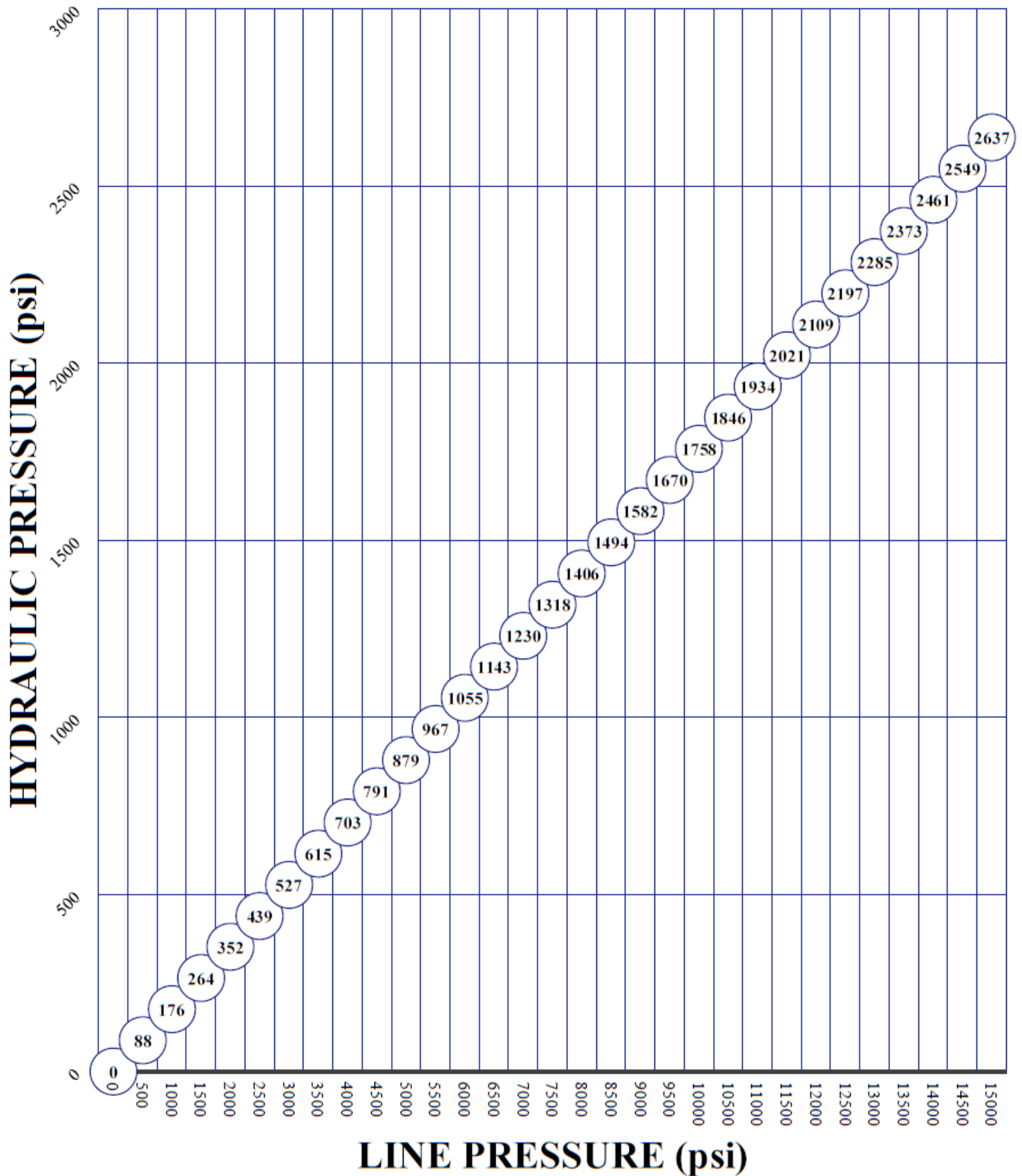
HYDRAULIC BALANCE PRESSURE VS. LINE PRESSURE

3/4" & 1" EQUIVALENT ORIFICE CHOKES



HYDRAULIC BALANCE PRESSURE VS. LINE PRESSURE

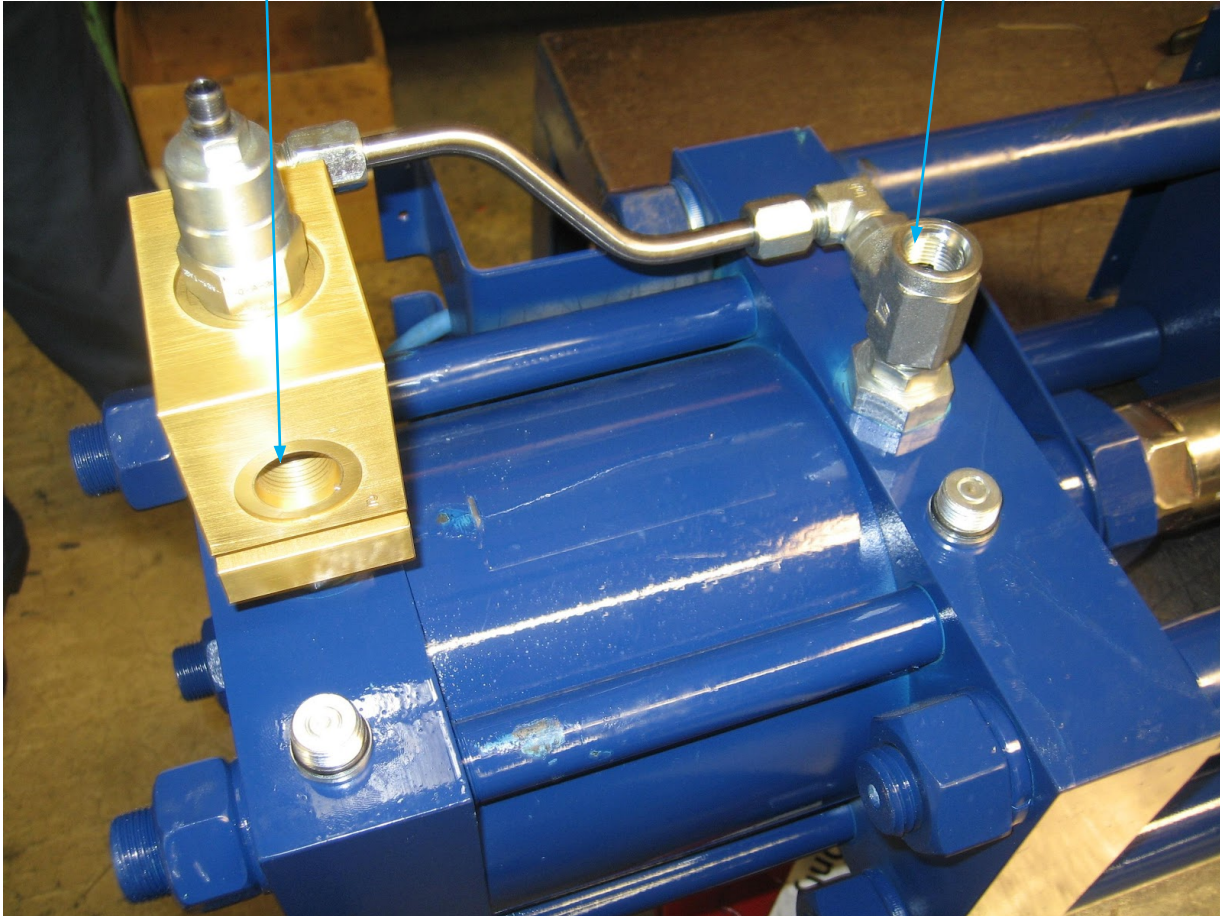
2" EQUIVALENT ORIFICE CHOKES



1.7. Hydraulic Port Location

CYLINDER PORT
(EXTEND) -8 SAE

CYLINDER PORT
(RETRACT) -8 SAE



The ports on the hydraulic cylinder both act as inlet and outlet ports, so for the purposes of identification we will use the terms extend and retract. This will more clearly identify the result when pressurized hydraulic fluid is applied to the respective port. When hydraulic pressure is supplied to the extend port, this “pushes” the cylinder rod out from the cylinder. Thereby decreasing the equivalent orifice opening (reducing flow) of the choke until it is completely shut. Hydraulic pressure supplied to the retract port, will pull the cylinder rod into the cylinder. This will increase the equivalent orifice opening (increasing flow) of the choke until fully open.

Note a 3/4”-1” maximum equivalent orifice opening choke utilizing a body with 2” connections shown above. The respective locations will be the same for a 2” maximum equivalent orifice opening choke that utilizes a body with 3” connections.

For the connection port sizes refer to the table in section [2.5 Cylinder Specifications](#).

PARTS

1.8. Exploded View

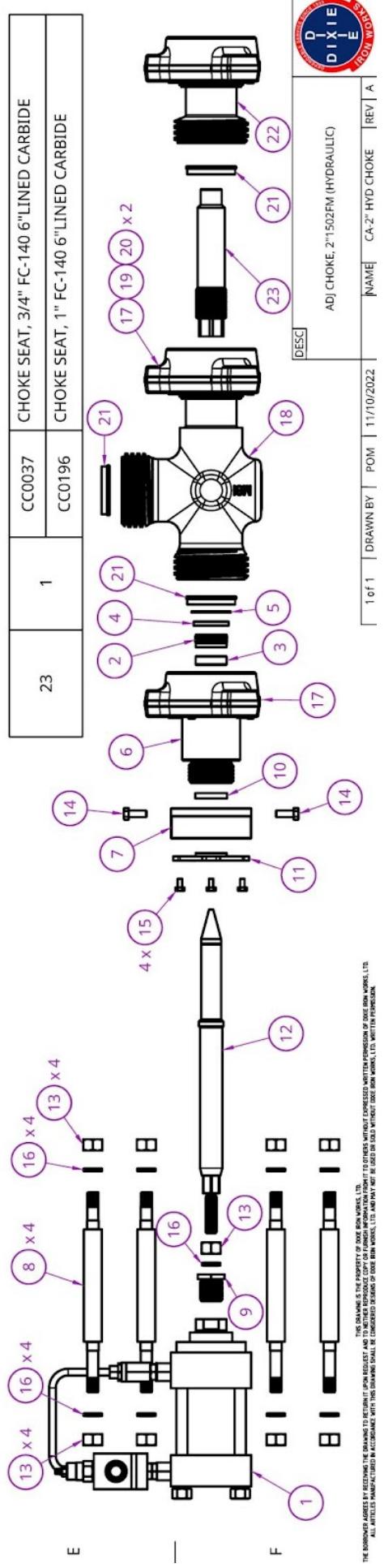
See the following drawings and bill of materials for replacement parts.


ITEM NO.	QTY	PART NO.	DESCRIPTION
1	1	AA0036	HYD CYLINDER, DOUBLE ACTING 3.25" (2"STROKE)
2	1	CC0028	CHOKE PACKING, 2" CHEVRON TYPE
3	1	CC0029	CHOKE STEM GUIDE, 2" CHOKE
4	1	CC0030	CHOKE PACKING RETAINER, 2" CHOKE
5	1	CC0044	SNAP RING, 2" CHOKE BONNET
6	1	CC0230	BONNET, 2" H2S 15M MSI FOR HYD 2"1502
7	1	CC0231	BONNET FLANGE, 2" 15M MSI FOR HYD
8	4	CC0233	BONNET STAY BOLT, 2" 15M MSI FOR HYD
9	1	CC0236	STEM BUSHING, 2" 15M MSI FOR HYD
10	1	CC0274	SEAL, HYDRAULIC CHOKE STEM 2"
11	1	CC0275	ROD SEAL RETAINER, 2" 15M HYDRAULIC ACTUATOR
12	1	CC0336	CHOKE STEM, 3/4"-1" 15M FOR MSI HYD (LONG)
13	9	HC0012	HEX NUT, 5/8"-11 HEAVY HEX 2H
14	2	HC0015	HEX HD, 3/8"-16 x 1.00"
15	4	HC0124	HEX HD, 1/4"-20 x 0.50"
16	9	HC0209	LOCK WASHER, 5/8" STANDARD
17	3	UC0012	WINGNUT, 2"1502 STD
18	1	CC0043	CHOKE BODY, 2"1502 STD 15M
19	2	UC0003	NUT RETAINER SET, 2"1502
20	2	UC0004	SPIRAL RETAINER RING, 2"1502
21	3	UC0011	RESILIENT SEAL, 2"602/1002/1502 STD (BUNA)
22	1	CC0012	CHOKE NIPPLE, 2"1502 STD 15M

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8	4	CC0233	BONNET STAY BOLT, 2" 15M MSI FOR HYD
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14	2	HC0015	HEX HD, 3/8"-16 x 1.00"
15	4	HC0124	HEX HD, 1/4"-20 x 0.50"
16	9	HC0209	LOCK WASHER, 5/8" STANDARD
17	3	UC0002	WINGNUT, 2"1502 STD
18	1	CC0043	CHOKE BODY, 2"1502 STD 15M
19	2	UC0003	NUT RETAINER SET, 2"1502
20	2	UC0004	SPIRAL RETAINER RING, 2"1502
21	3	UC0011	RESILIENT SEAL, 2"602/1002/1502 STD (BUNA)
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15	4	HC0124	HEX HD, 1/4"-20 x 0.50"
16	9	HC0209	LOCK WASHER, 5/8" STANDARD
17	3	UC0013	WINGNUT, 2"1502 H2S
18	1	CC0018	CHOKE BODY, 2"1502 H2S 10M
19	2	UC0003	NUT RETAINER SET, 2"1502
20	2	UC0004	SPIRAL RETAINER RING, 2"1502
21	3	UC0012	RESILIENT SEAL, 2"602/1002/1502 H2S (HNBR)
22	1	CC0011	CHOKE NIPPLE, 2"1502 H2S 10M

23	1	CC0037	CHOKE SEAT, 3/4" FC-140 6" LINED CARBIDE
		CC0196	CHOKE SEAT, 1" FC-140 6" LINED CARBIDE





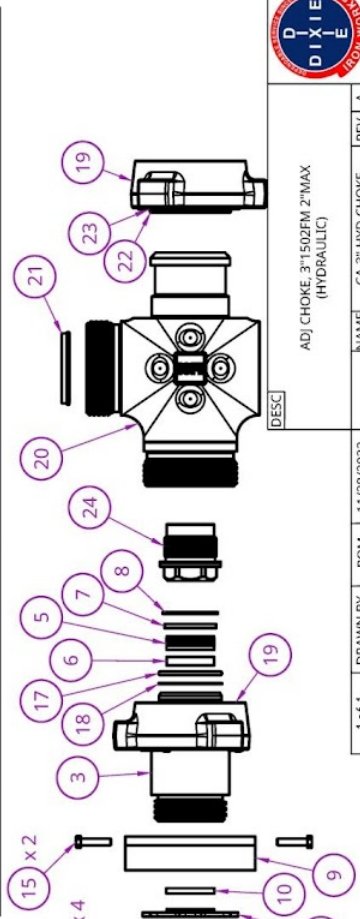
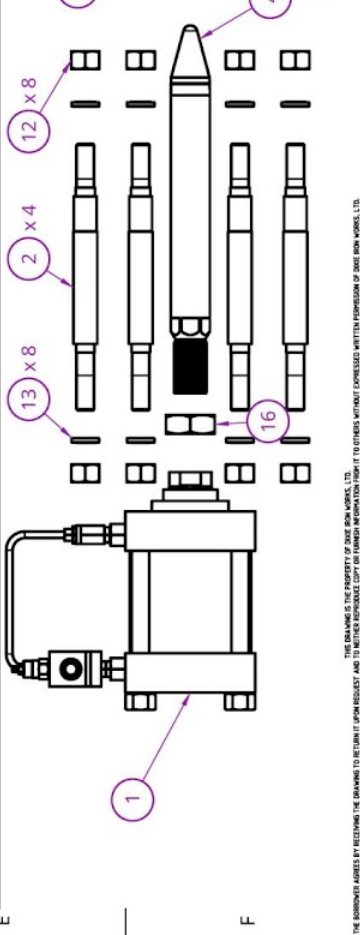
1 of 1 | DRAWN BY | POM | 11/10/2022 | NAME | CA-2" HYD CHOKE | REV | A

DESC | ADJ CHOKE, 2"1502FM (HYDRAULIC)

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1	2	3	4	5	6
ITEM NO.	QTY	PART NO.	DESCRIPTION	PART NO.	DESCRIPTION
1	1	AA0056	HYD CYLINDER, DOUBLE-ACT 6.00" (3"STROKE)	H2S	
2	4	CC0252	BONNET STAY BOLT, 3" 15M MSI FOR HYD ACTUATOR		
3	1	CC0287	BONNET, 3" STD 15M MSI FOR HYDRAULIC ACTUATOR		
4	1	CC0314	CHOKE STEM, 2"MAX HYDRAULIC		
5	1	CC0318	CHOKE PACKING 3" HYDRAULIC		
6	1	CC0319	CHOKE STEM GUIDE, 3" HYDRAULIC CHOKE		
7	1	CC0320	CHOKE PACKING RETAINER, 3" HYDRAULIC CHOKE		
8	1	CC0321	SNAP RING, 3" HYDRAULIC BONNET		
9	1	CC0322	BONNET FLANGE, 3" 15M HYDRAULIC ACTUATOR		
10	1	CC0323	SEAL, HYDRAULIC CHOKE STEM 3"		
11	1	CC0324	ROD SEAL RETAINER, 3" 15M HYDRAULIC ACTUATOR		
12	8	HC0092	HEX NUT, 1"-8 HEAVY HEX 2H		
13	8	HC0101	LOCK WASHER, 1" STANDARD		
14	4	HC0124	HEX HD, 1/4"-20 x 0.50"		
15	2	HC0345	HEX HD, 3/8"-16 x 1.75"		
16	1	HC0346	HEX NUT, 1 7/8"-12 THIN		
17	1	OC0023	O-RING, 3" BONNET H2S (2-339)		
18	1	OC0024	PAR-BACK, 3" BONNET H2S (8-339)		
19	2	UC0009	WINGNUT, 3"1502 STD		
20	1	CC0182	CHOKE BODY, 3"1502FM STD 15M 2"MAX		
21	1	UC0013	RESILIENT SEAL, 3" UNION STD (NBR)		
22	1	UC0006	NUT RETAINER SET, 3"1502		
23	1	UC0015	SPIRAL RETAINER RING, 3"1502		
24	1	CC0007	CHOKE SEAT, 2"MAX CARBIDE H-2		

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3	1	CC0251	BONNET, 3" H2S 15M MSI FOR HYDRAULIC ACTUATOR		
4	1	CC0314	CHOKE STEM, 2"MAX HYDRAULIC		
5	1	CC0318	CHOKE PACKING 3" HYDRAULIC		
6	1	CC0319	CHOKE STEM GUIDE, 3" HYDRAULIC CHOKE		
7	1	CC0320	CHOKE PACKING RETAINER, 3" HYDRAULIC CHOKE		
8	1	CC0321	SNAP RING, 3" HYDRAULIC BONNET		
9	1	CC0322	BONNET FLANGE, 3" 15M HYDRAULIC ACTUATOR		
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17	1	OC0023	O-RING, 3" BONNET H2S (2-339)		
18	1	OC0024	PAR-BACK, 3" BONNET H2S (8-339)		
19	2	UC0005	WINGNUT, 3"1502 H2S		
20	1	CC0211	CHOKE BODY, 3"1502FM H2S 10M 2"MAX		
21	1	UC0014	RESILIENT SEAL, 3" UNION H2S (HNBR)		
22	1	UC0006	NUT RETAINER SET, 3"1502		
23	1	UC0015	SPIRAL RETAINER RING, 3"1502		
24	1	CC0007	CHOKE SEAT, 2"MAX CARBIDE H-2		



DESC
ADJ CHOKE 3"1502FM 2"MAX
(HYDRAULIC)

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MAINTENANCE

1.9. Preventative

The choke stem should be thoroughly greased during assembly. This grease should be replaced at every rebuild. In the case that there is a need to lubricate the stem between rebuilds, deep penetrating oil can be used in the interim. Temporarily removing the rod seal retainer will expose more of the choke stem if needed.

1.10. Inspection

After degreasing the parts, visually inspect for abnormal wear, corrosion, erosion, or any other physical damage.

1. Inspect the threads, packing area, shaft and carbide tip of the stem and replace as necessary. The cone of the carbide tip should be smooth and without grooves or cracks.
2. Inspect the threads and carbide liner of the seat and replace as necessary. The entry bevel of the carbide liner should be smooth and without grooves or cracks. Look down the orifice for washouts in the mid-section of the liner.
3. Always discard the packing when removed from the bonnet. Replace with new packing.
4. Replace the wingnut if the lugs are excessively deformed or damaged.

1.11. Pictorial Inspection

Clean and degrease the parts, and visually inspect for abnormal wear, corrosion, erosion, or other physical damage.

Inspect the stem threads. If there is abnormal wear on the threads (such as a step on the thread flank), replace the stem.

If there are any burrs or nicks present, these need to be removed.



Inspect stem packing sealing surface and shaft.

Sealing surface should be free of scratches or imperfections. Lightly buff out any light scratches to improve sealing surface finish.

If there is any wear on the sealing surface, replace the stem.



Inspect the carbide tip of the stem. The cone of the carbide tip should be smooth and without grooves or cracks.

The brazing between carbide tip and stem should be free of cracks or pits.

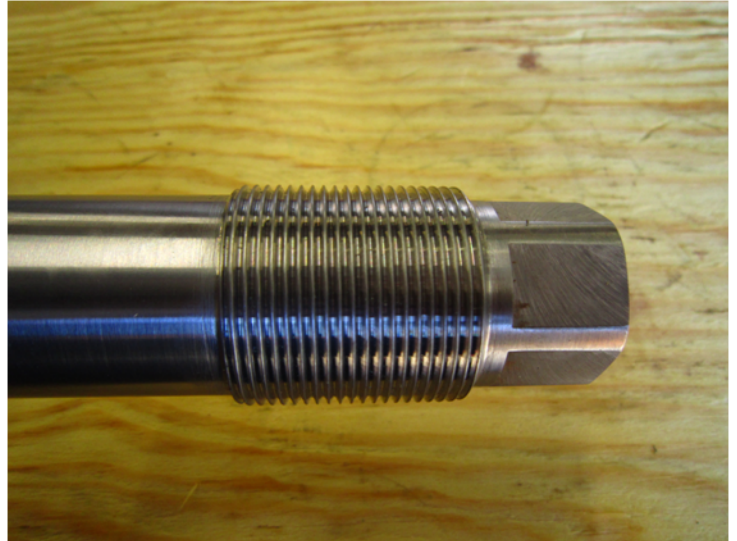
NOTE: THE STEP DEPICTED ON IMAGE HAS CRACKS ON BRAZING. THIS NEEDS TO BE REPLACED.



Replace stem as necessary

Inspect the threads of the seat for any damage.

Any burrs or nicks should be removed to prevent galling with fitting internal threads if reused.



Inspect the entry bevel of the carbide liner. It should be smooth and without grooves or cracks.

NOTE: THE SEAT DEPICTED ON IMAGES SHOWS CRACKING AND IS CHIPPED. THIS NEEDS TO BE REPLACED.



Look down the orifice for washouts in the mid-section of the liner.

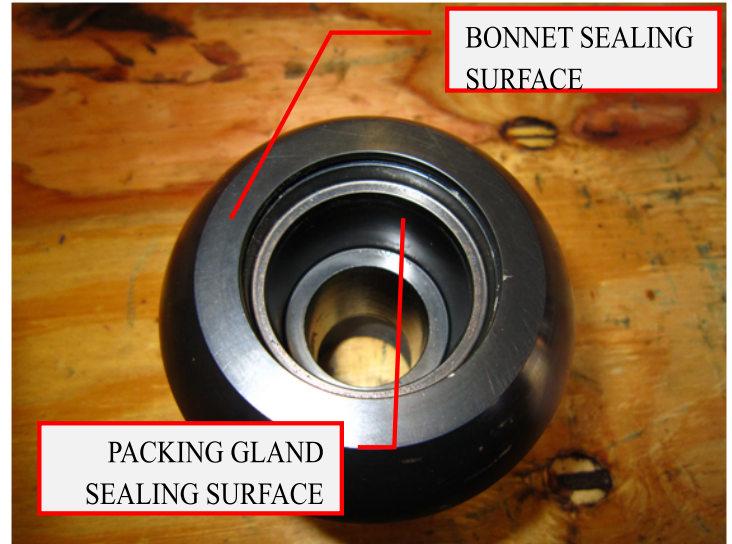
Replace seat as necessary



Inspect the bonnet sealing surface and packing gland sealing surface

Buff any light scratches or surface imperfections to improve sealing surface finish.

Replace bonnet as necessary



Inspect wing nut for excess wear and damage.

Replace if severe damage is present.

Remove any nicks or burrs on threads if present.

WARNING: WING NUT DEPICTED AT RIGHT AND BOTTOM IS BEYOND SERVICEABLE LIFE AND IS A SAFETY HAZARD. IT SHOULD BE REPLACED.



1.12. Pictorial Assembly

Note - Always use high quality graphite grease or anti-seize during assembly. Lubricate all parts thoroughly, especially threads.

1.12.1. Assembling the Tee subassembly



Lubricate resilient seal gland on female connection
(light general purpose grease)

Install resilient seal on gland



Install spiral retaining ring over male end

For a 3" choke assembly only: Ensure that the spiral retaining ring is over the step on the outer diameter of the male end (see image).

If this is not done, it will be very difficult to install the retainer segment set.



Install wingnut, nut retainer segment set, and spiral retaining ring.

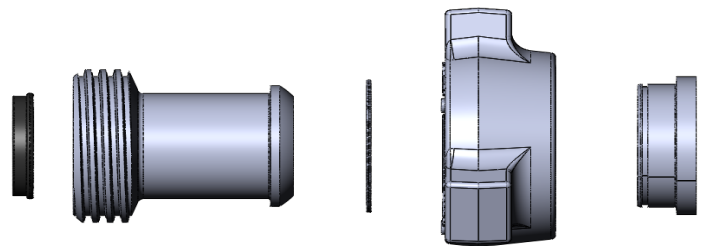


Apply a liberal amount of anti-seize to the internal threads on male end connection

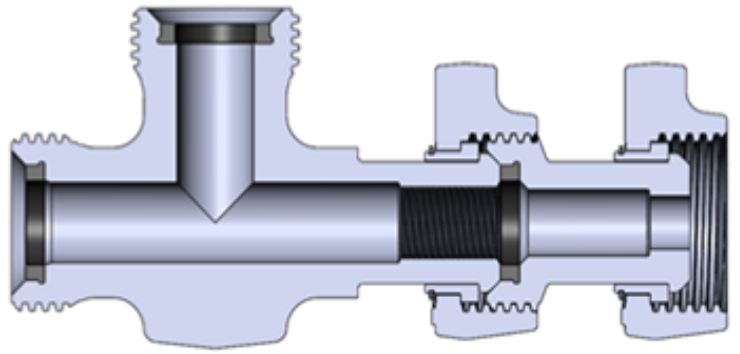


For a 2” choke assembly only: assemble the choke nipple subassembly:

- lubricate sealing gland with light general purpose grease and install resilient seal
- Install wingnut, nut retainer segment set, and spiral retaining ring.



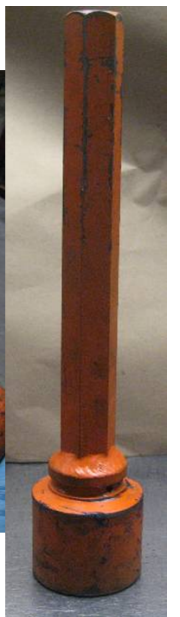
For a 2" choke assembly only: assemble the choke nipple with the choke tee subassembly:



Lubricate (with anti-seize) the choke seat threads thoroughly



Using the appropriate choke seat wrench, insert the choke seat through the female end connection of the Tee fitting

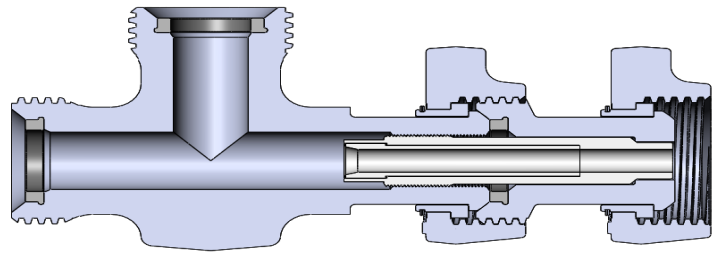


Using a torque wrench, fully tighten the choke seat to the recommended torque below.

Choke Size	Torque (ft*lbs)
2"	100
3"	125

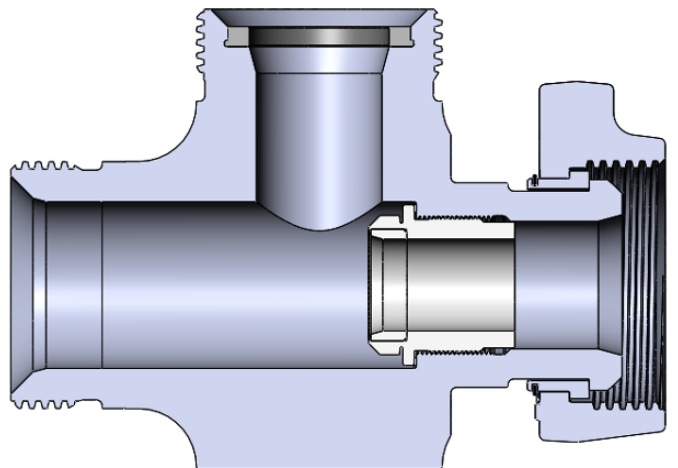


2" CHOKE TEE/NIPPLE SUBASSEMBLY



Tee subassembly is complete.

3" CHOKE TEE SUBASSEMBLY



1.12.2. Assembling the Bonnet subassembly



Lubricate the choke stem seal gland with light general purpose grease



Position choke stem seal on gland, and using the appropriate tool, install seal



Verify choke stem seal is fully installed on gland



Lubricate the packing gland of the bonnet with light general purpose grease



Install the stem guide.



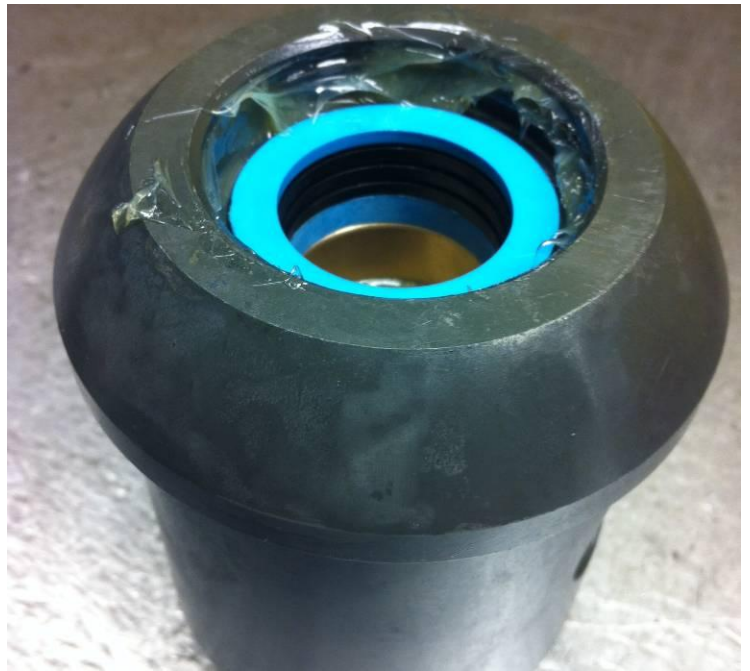
Identify correct orientation of new packing



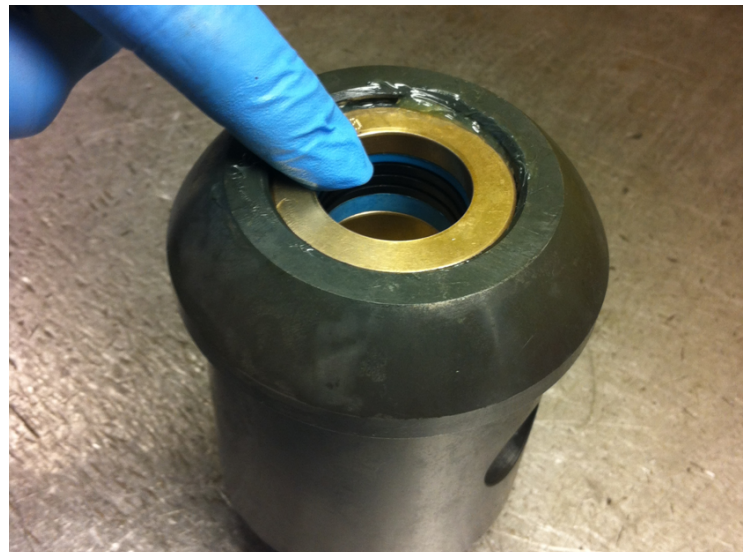
INSERT THIS END FIRST



Install new packing as shown



Install packing retainer

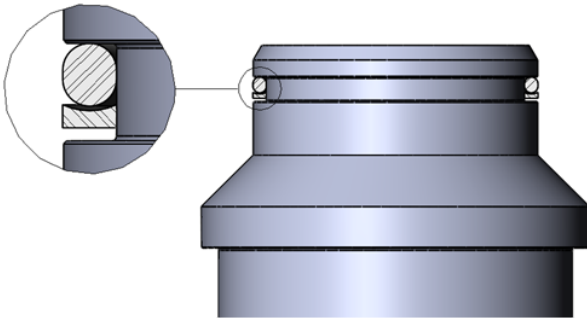


Install snap ring in place

Lubricate inside of packing with light general purpose grease



For a 3" choke assembly only: Using light general purpose grease, install backup ring on seal gland as shown



If backup ring has a concave surface, install flat side first as depicted on image above



For a 3" choke assembly only: Using light general purpose grease, install o-ring on seal gland as shown.

Slide wingnut over bonnet and subassembly is complete.



1.12.3. Assembling the hydraulic cylinder and bonnet subassembly



If position indication is required on the choke assembly, position the upper mount indicator bracket as shown

Use anti-seize on stay bolt threads.

Insert bonnet stay bolts on hydraulic cylinder, install lock washers and hex nuts (hand tight)

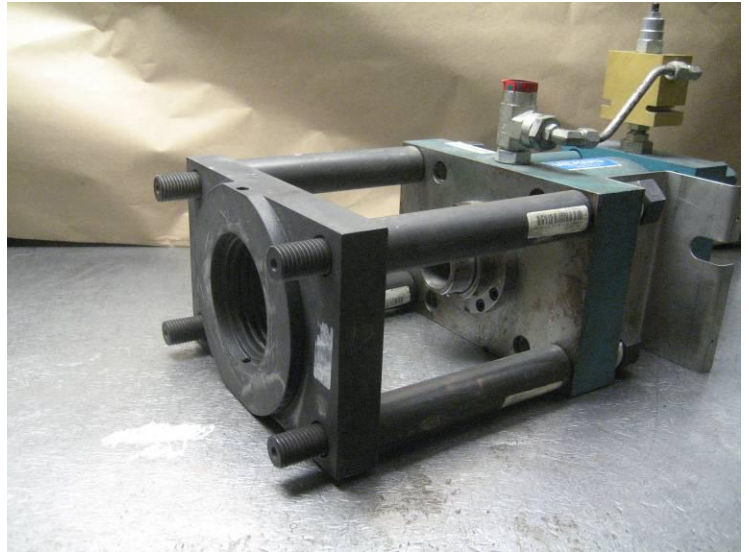
Do NOT fully tighten hex nut at this time



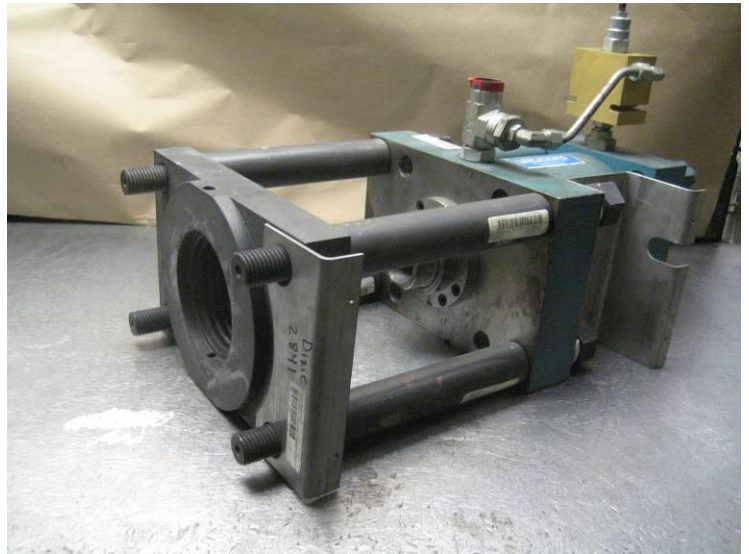
Repeat for the remaining two stay bolts.



Lubricate the four holes on the bonnet flange and install bonnet flange



If position indication is required on this choke assembly, position the lower mount indicator bracket as shown



Use anti-seize on stay bolt threads.

Install 4 lock washers and hex nuts (hand tight)

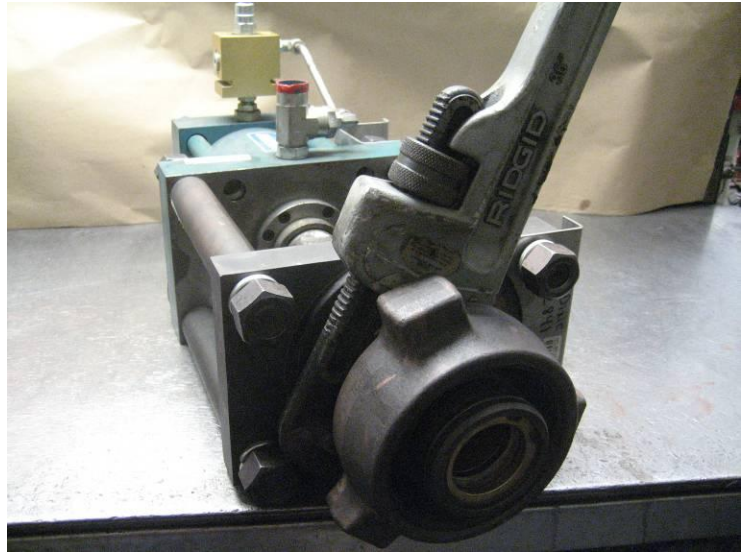
Do NOT fully tighten hex nut at this time



Apply anti-seize to the bonnet flange internal threads

Install the previously assembled Bonnet subassembly

No specific torque needed. Lock screws will keep it in place and prevent unscrewing.



Assembly is ready for choke stem installation.
Proceed to next steps

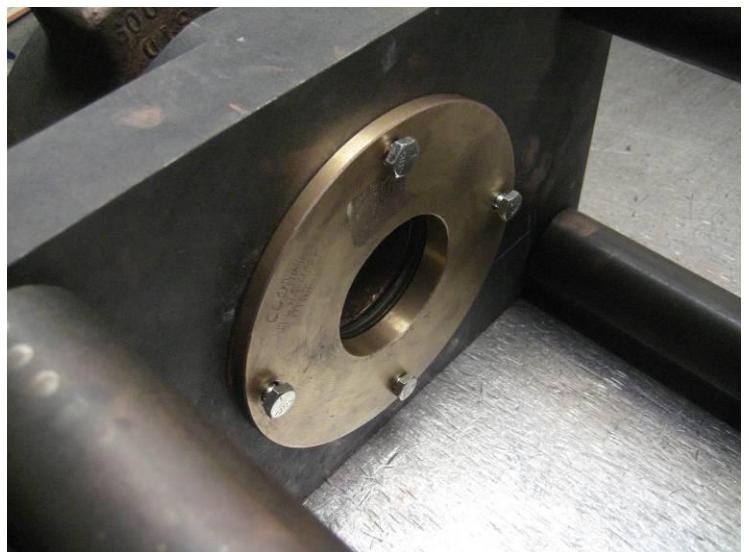


Note: The rod seal was previously installed on the bonnet assembly

Use anti-seize on threads

Position the rod seal retainer plate on the bonnet flange, and install the 4 hex screws (hand tight)

Do NOT fully tighten hex screws at this time. This will be done once the choke stem is in place and fully aligned with the retainer plate.

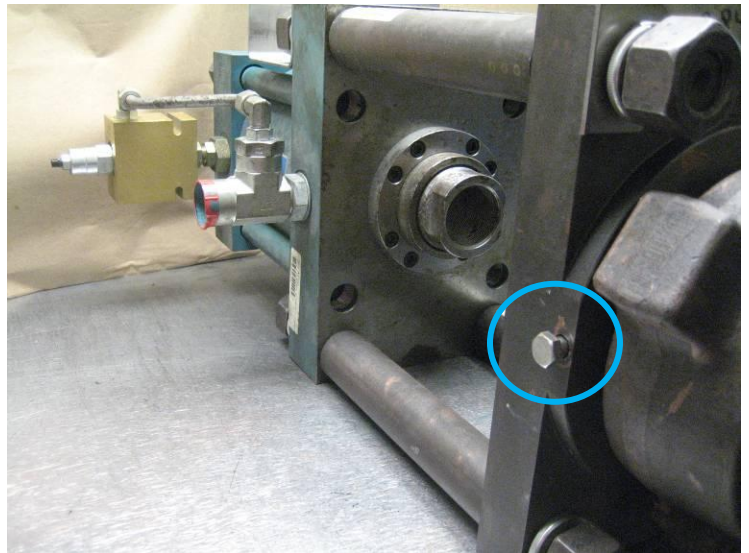


Apply anti-seize to the bonnet locking hex screws

Note: Flip the choke assembly on its side to install both bonnet locking hex screws. This screws prevent unscrewing of the bonnet assembly during use.



Install top hex screw to 16.5 ft-lbs



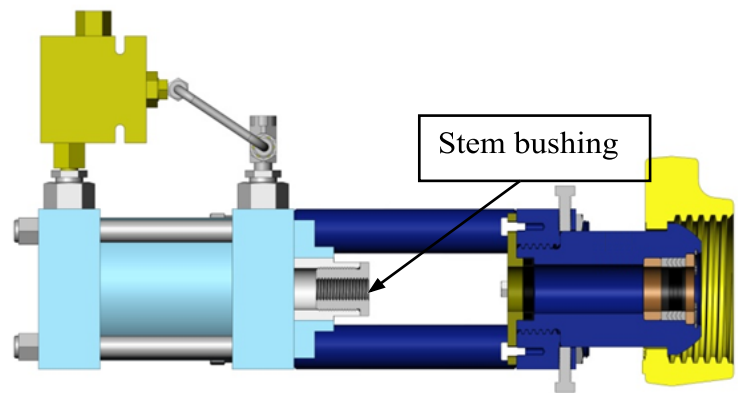
Install bottom hex screw to 16.5 ft-lbs



Verify packing is well lubricated. If not, lubricate inside of packing with light general purpose grease



For a 2" choke assembly only: Apply anti-seize to the thread bushing and screw into hydraulic cylinder



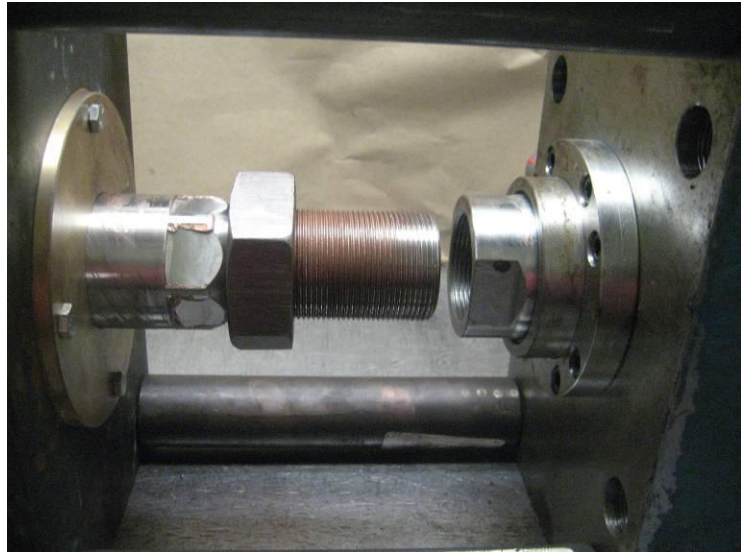
Insert choke stem through packing until threaded end comes out of bonnet assembly



Apply anti-seize to choke stem threads thoroughly

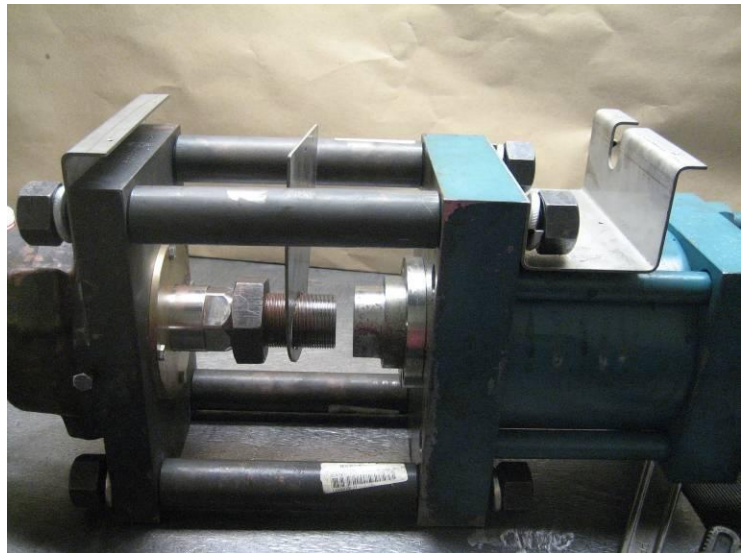


Fully thread hex nut on choke stem until it bottoms out (flat side of hex nut facing away from stem)



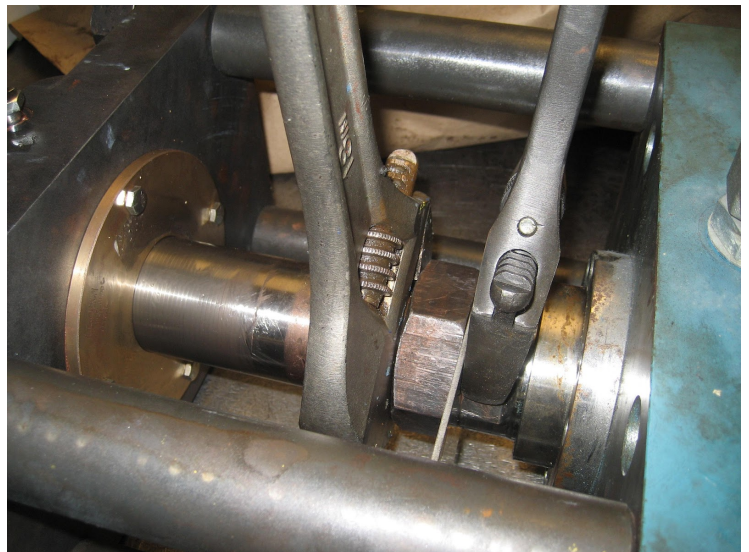
If position indication is required on this choke assembly, install position indicator arm as shown

Note: Position indicator arm must be on same side of upper and lower mount brackets.



For a 2" choke assembly only: Install lock washer and thread stem into stem bushing

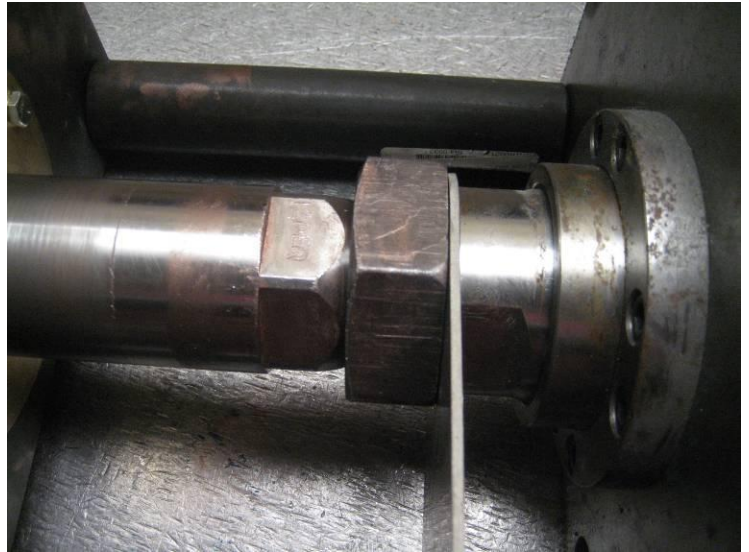
For a 3" choke assembly only: Thread stem into hydraulic cylinder



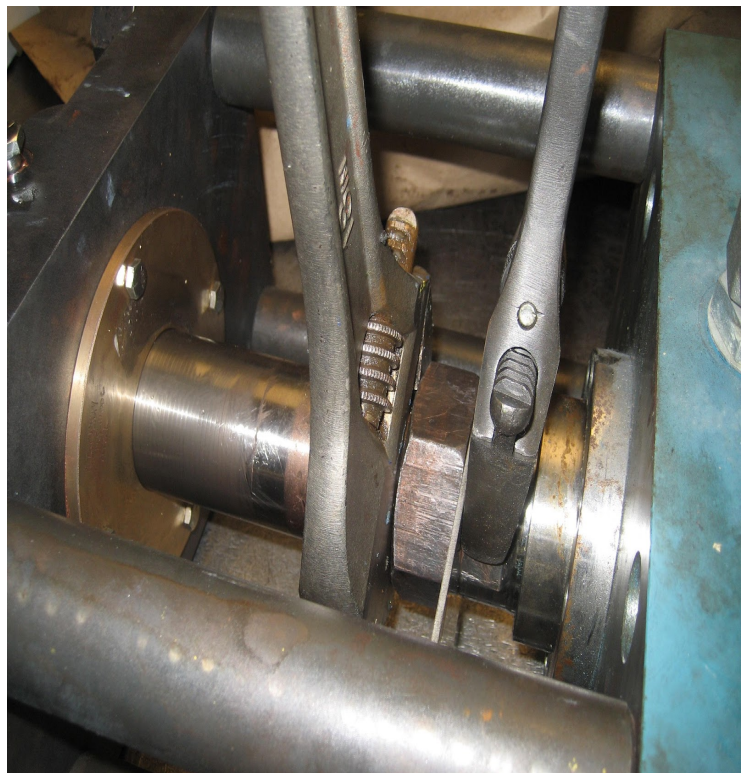
Choke stem should be screwed all the way towards the hydraulic cylinder

Note: No need to wrench tighten at this point, but if needed, a wrench may be used to turn the choke stem until fully seated. Do NOT use cheaters or extensions.

Note: There should be NO GAPS between the parts, and there should be NO THREADS visible before continuing



Since the choke stem is in place now, at this point tighten the 4 hex screws on the rod seal retainer plate to 5.1 ft-lbs



Making sure anti-seize is applied on threads, fully tighten all 8 hex nuts on the bonnet stay bolts to the torque specified below:

Choke Size	Thread Size	Torque (ft*lbs)
2"	5/8" – 11	143
3"	1" - 8	620

Note: Leaving the hex nuts loose and tightening them only after the bonnet and choke stem are in place helps the components align themselves better, and prevents the assembly from being on a bind. Consequently, this also makes threading of the choke stem easier.



Hydraulic cylinder and bonnet subassembly is complete

Apply anti-seize to Tee fitting assembly threads

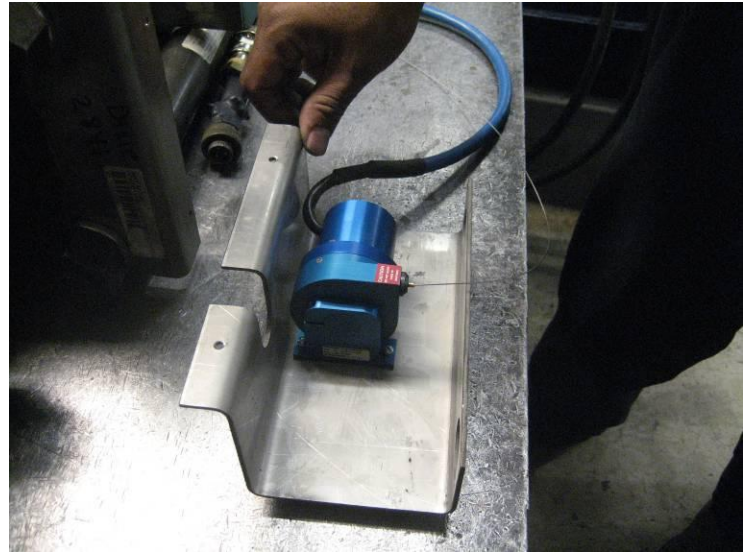


Carefully align and make up the connection between the bonnet and the choke tee



1.12.4. Installing position sensor (if required)

Remove bracket previously installed



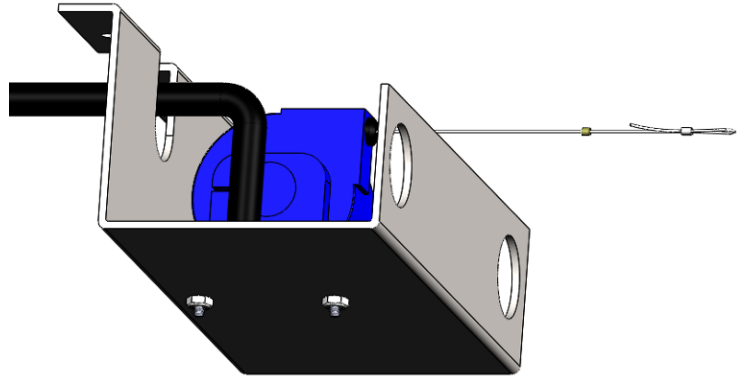
Install screws on position sensor



Aligning the screws with the mounting holes, and position the sensor and screws on the bracket



Install the two locknuts



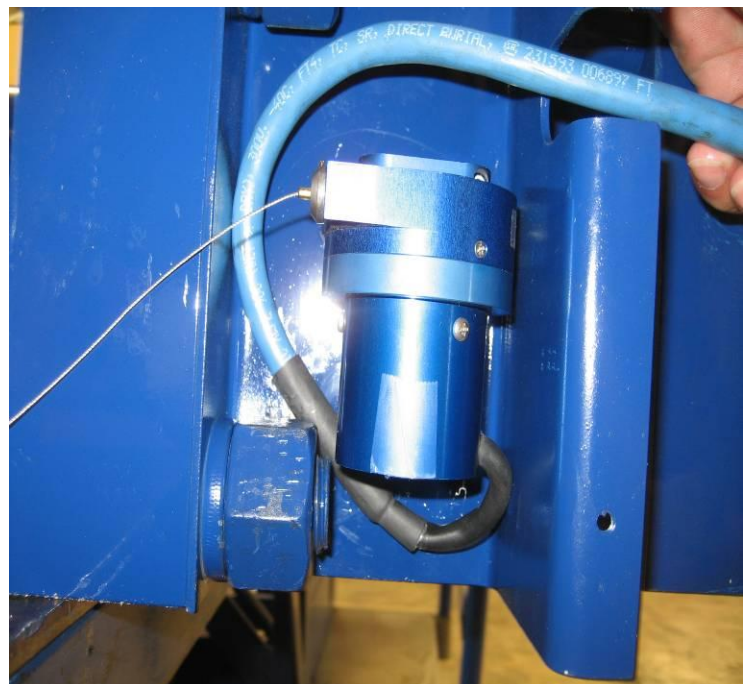
With position sensor in place, reinstall bracket on hydraulic cylinder assembly:

- Route the cable below the position sensor body and hex nut (see image)
- Position lock washer and bracket on edge of bonnet stay bolt
- Insert hex nut, and gradually turn it to move the bracket in place
- Fully tighten hex nut



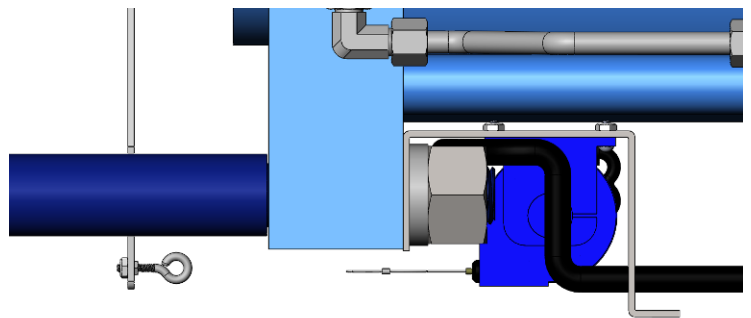
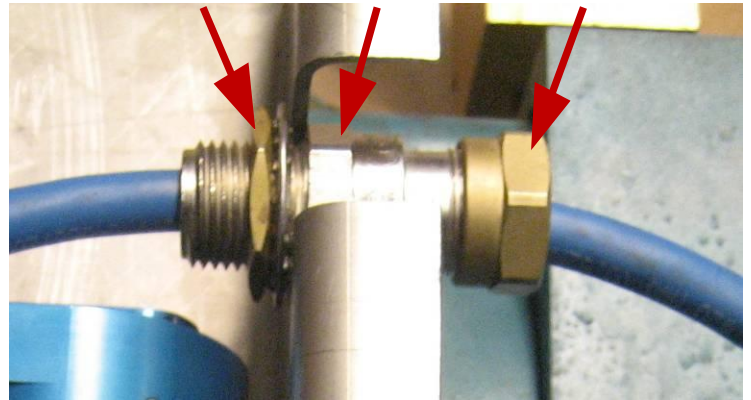
Verify connection cable is routed correctly

Fully tighten second hex nut securing the bracket in place



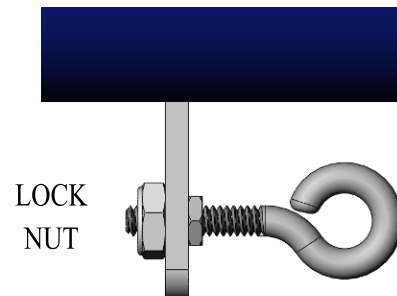
Install cable fitting:

- Loosen hex nut (right arrow) to loosen cable from cable fitting
- Loosen thin hex nut (left arrow)
- Slide connector so that the bracket is between lock washer and fitting hex (middle arrow)
- Tighten thin hex (left arrow) nut to secure fitting on bracket
- Accommodate cable inside bracket so that there are nice radii and ensure cable is not on a bind
- Tighten the hex nut (right arrow) by hand to secure the cable on fitting. **DO NOT OVER TIGHT TO PREVENT DAMAGE TO CABLE**



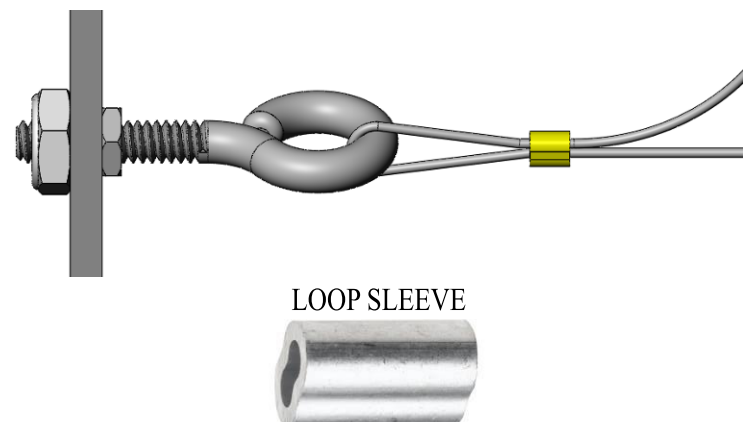
Install eyebolt on indicator arm:

- Eyebolt is supplied with a regular hex nut
- Use this hex nut to position the eyebolt on the indicator arm
- Secure it with a locknut, ensuring it fully engages the eyebolt threads

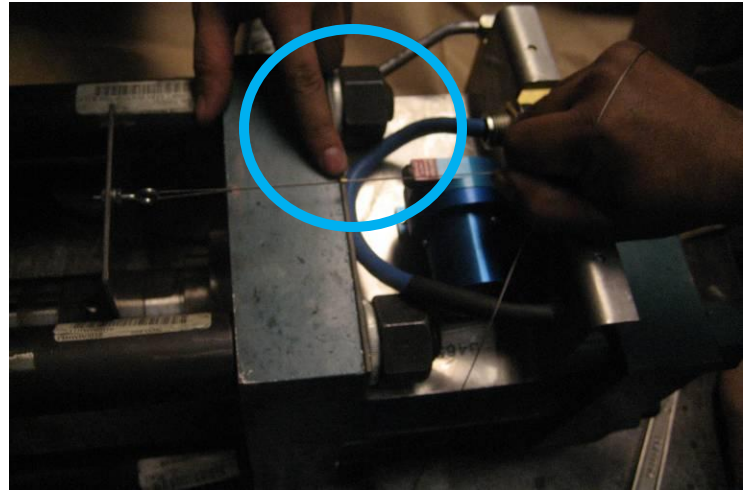
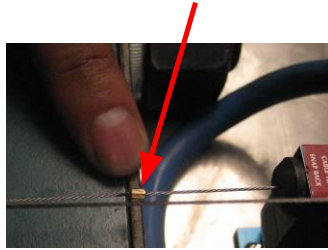


Loop wire on eye bolt:

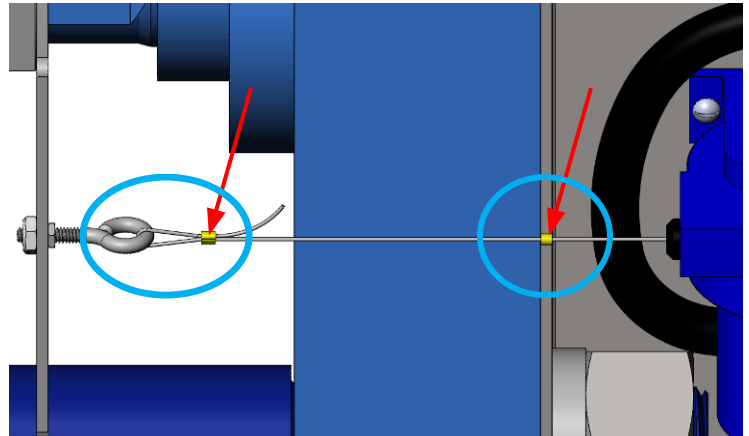
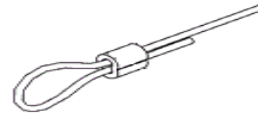
- Insert wire through one opening of loop sleeve
- Insert wire through eyebolt
- Insert wire through second opening on loop sleeve
- Position loop sleeve close to eyebolt



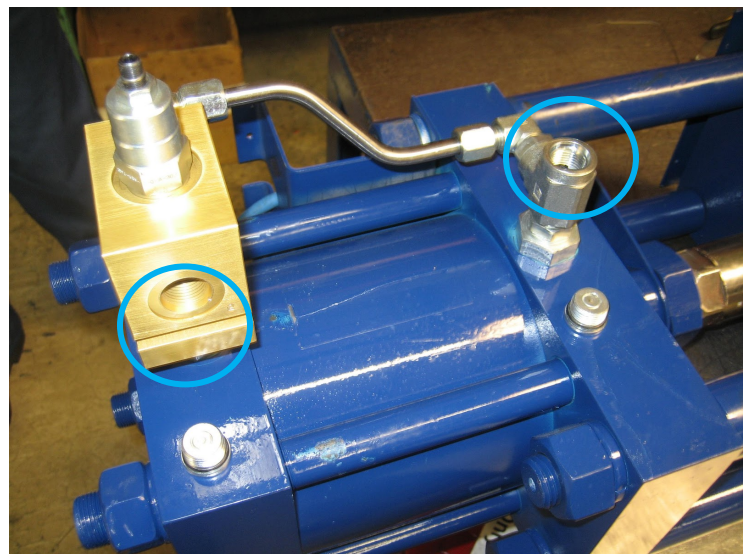
Pull the wire out of the position sensor about 1". A good indicator for that is aligning the factory cable stop sleeve with the edge of the mounting bracket (as shown on the image)



Holding wire in the position described above, crimp the loop sleeve together using crimping pliers



1.12.5. Hydraulic choke stem synchronization procedure



Install hydraulic hose connections



Caution: Before proceeding, verify that the choke stem is fully seated all the way towards the hydraulic cylinder. If not, the following step will cause damage to choke components since the stem is not synchronized with the choke seat position at this time.

Fully extend the hydraulic cylinder out to the choke “Close” position. At this point, the cylinder has bottomed out to its internal stop, but the choke stem is still not making contact with the choke seat.



Verify that choke stem is NOT making contact with choke seat (use a flashlight on the Tee inlet, and look through Tee outlet for light)



For a 2” choke assembly only: Hold stem bushing in place and unscrew the choke stem out until it makes contact with the choke seat, but don’t apply excessive force after that.

For a 3” choke assembly only: Hold the hydraulic cylinder in place and unscrew the choke stem out towards the choke seat, but don’t apply excessive force after that.

Note: Seat the choke stem by hand if possible. Use a wrench if necessary to turn it until snug-tight, but don’t apply more force after that.

Do NOT use cheaters, or extensions.

Do NOT over tighten the choke stem against the seat.



For a 2” choke assembly only: Tighten the hex nut against the lock washer, position indicator arm, stem bushing, and hydraulic cylinder. **Use a wrench to hold the stem in place.**

For a 3” choke assembly only: Tighten the hex nut against the position indicator arm and the hydraulic cylinder. **Use a wrench to hold the stem in place.**

Note: If done correctly, the choke stem should be synchronized to the hydraulic cylinder travel and choke seat position.

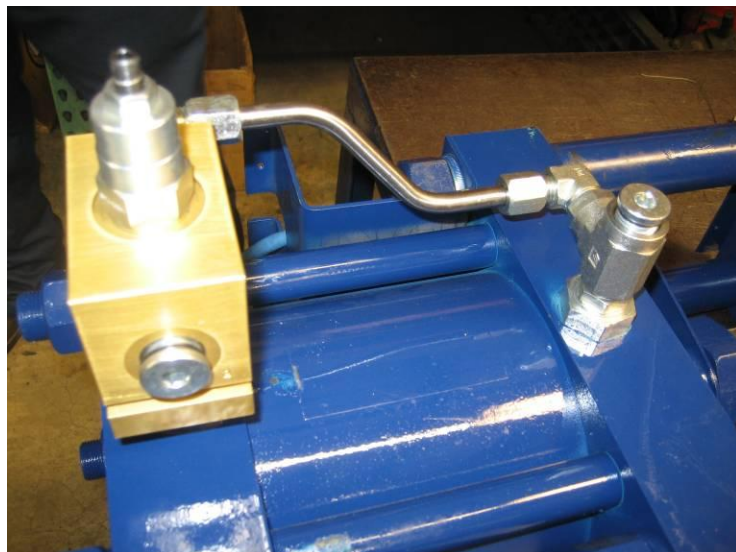


Verify that position indicator arm is not rubbing against the bonnet stay bolts (if it is, tap the plate to one side to separate it from the stay bolt)

Retract the hydraulic cylinder to the choke “Open” position and verify the position indicator arm is not rubbing.



Disconnect hydraulic hoses and install factory hydraulic inlet/outlet plugs



Position indicator cover in place as shown

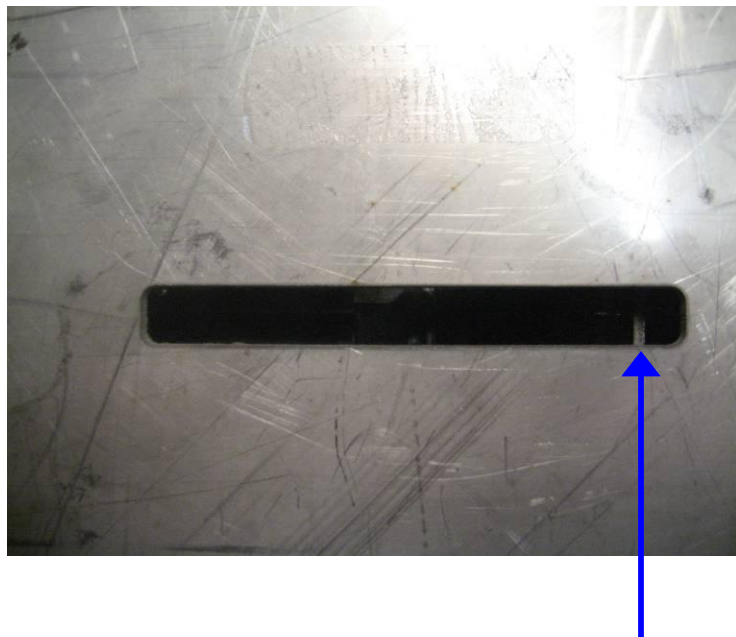


Secure the indicator cover by installing the 4 screws



Verify that position indicator arm is visible in the choke "Open" position

Choke assembly is complete





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