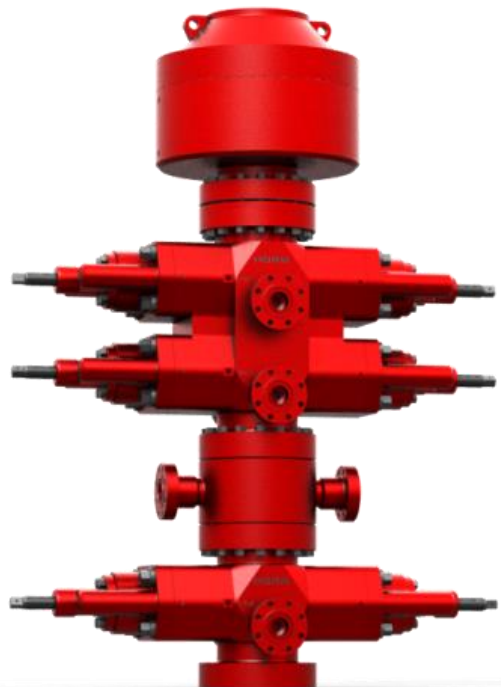
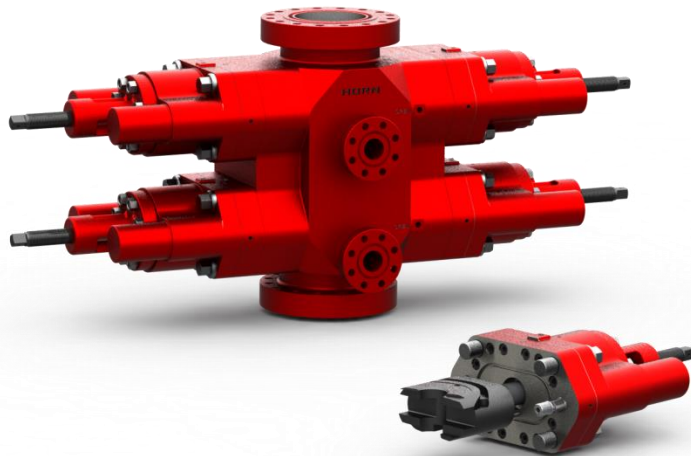




TYPE HU BLOWOUT PREVENTERS

OPERATING MANUAL

Rev. 3



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ii. HORN HU OPERATION and MAINTENANCE

Horn Equipment Company, LLC (HEC) HSU and HDU Ram Type Blowout Preventers are simple and proven effective at meeting the demanding pressure control requirements of today's drilling industry. It is highly recommended to perform periodic inspections of rams, seals, and over-all integrity to prevent problems in a well control situation.

A. Before Installing Blowout Preventer

Inspect the bore of the preventer to confirm that both ram blocks are in the open position. Inspect for any damage to the top and bottom ring grooves. Clean ring grooves with emery cloth and lightly oil prior to placing ring gaskets into place.

ALWAYS replace ring gaskets when the preventer is removed and reinstalled. Inspect studs and nuts for damage. Replace any stud that is shorter than required to maintain full thread engagement or has thread damage. Ensure all studs and nuts are properly torqued when the preventer is in use.

B. Open and Close Operations

HSU and HDU Models are operated via hydraulic pressure. Hydraulic operating pressure of 1500 psi will energize the rams; however, hydraulics can be operated up to 3000 psi as needed. Hydraulic Fluid translates between each side to allow equal pressure in both ram assemblies. Rams can be manually locked by turning the locking screw clockwise. Locking screws are visible on each end of the blowout preventer.

Opening the rams requires hydraulic pressure by moving the switch to the open position on the closing unit. To fully open rams, both locking shafts must be in their unlocked position by turning the locking shaft counter-clockwise.

Table 1: Hydraulic Connector Sizes

Description	Size	Location
Open Port	1" NPT	BOP Body, Right Side
Close Port	1" NPT	BOP Body, Left Side

C. Preventative Maintenance

All blowout preventers should be cleaned and tested before being put back into operation or moved to another job site. Prolonged intervals of non-operation and no lubrication will cause seals to freeze up and possibly break or lock up the preventer. To inspect operating parts, vent all hydraulic operating pressure before performing any maintenance on blowout preventers.

Blowout Preventer should be operated at least once per week

D. Ram Types Available For HU

- Blind Rams: to seal off the well with no pipe
- Slip Rams: to grip tubing and hold it in place
- Pipe Rams: to seal around the pipe
- VBR Rams: to seal around variable diameters of pipe
- Shear/Blind Rams: to shear pipe and seal off the well
 - Shear Bonnets and Tandem Booster must be installed to shear
 - Maximum Shear Pressure: 3000 psi.

NOTICE

If VBR's or flex packers are being used, they should only be closed around appropriate sized pipe. Rams **SHOULD NOT** be closed on an open hole unless closing pressure is less than 300 psi.

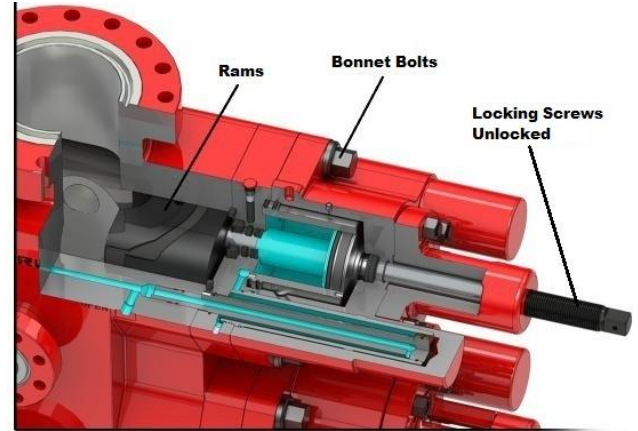


Figure 1: Open

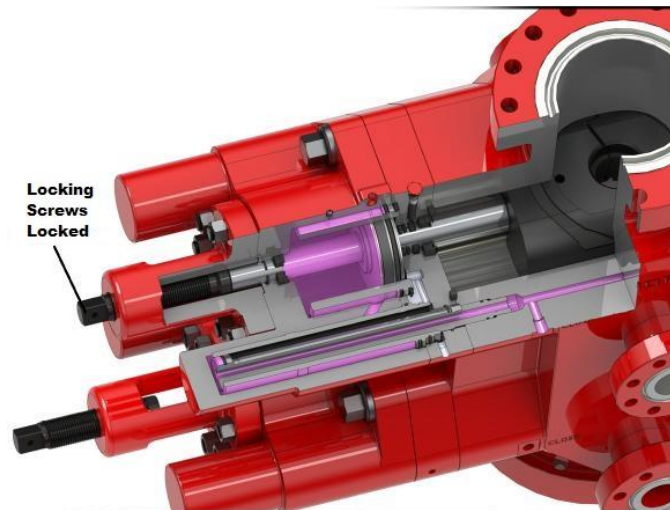


Figure 2: Closed – Locking Shaft Locked

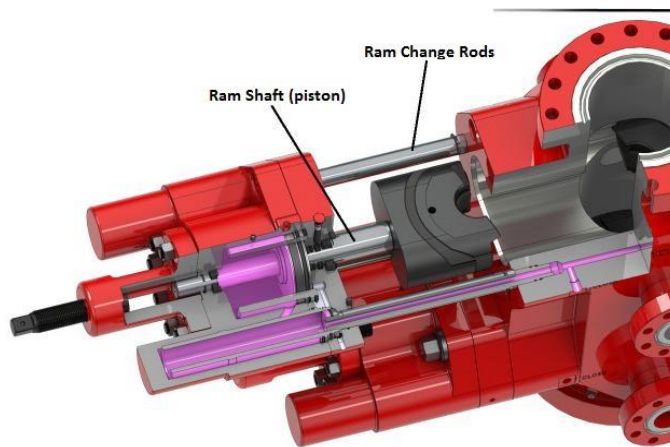


Figure 3: Closed (No Bonnet Bolts) – Open Bonnet's for Inspection

E. Operating Capacity

Standard bonnet operating fluid data for HU Ram Type blowout preventers are listed in the table below. One set of rams is the total number of rams it takes to completely block a ram bore cavity, or 2 rams. The closing ratio is the ratio between the pressure in the well bore and the operating-piston pressure needed to close the rams against a particular well head pressure. The opening ratio is the ratio between the pressure in the well bore and the operating piston pressure needed to open the rams.

Table 2: HU Hydraulic Operating Capacities

SIZE AND WORKING PRESSURE	CONFIGURATION	Gallons to Open Rams (1 set)	Gallons to Close Rams (1 set)	Closing Ratio	Locking Screw Turns (Each End)	Opening Ratio
7-1/16" 5, 10, 15M	Standard	1.3	1.4	6.9:1	19.5	2.9:1
7-1/16" 10, 15M	REG. Shear Booster	1.7	3.5	13.8:1	24	4.4:1
7-1/16" 10, 15M	SD Booster	1.7	4.6	19.3:1	24	4.4:1
11" 3, 5, 10M	Standard	3.4	3.5	7.3:1	29.5	3.7:1
11" 3, 5, 10M	Large Bore & Shear Boosters	6.8	12.2	19.3:1	34	3.7:1
13-5/8" 3, 5M	Standard	5.6	5.9	7.0:1	34	3.6:1
13-5/8" 3, 5M	Large Bore & Shear Boosters	10.5	17.2	17.9:1	41.5	4.6:1
13-5/8" 10M	Standard	5.5	5.8	7.0:1	34	3.6:1
13-5/8" 10M	Large Bore & Shear Boosters	10.6	17.3	17.9:1	41.5	4.6:1
20-3/4"-3M	Standard	8.2	8.8	7.0:1	48	2.2:1

F. Operating Fluids

HU Ram Type blowout preventers have 1" NPT connections for the hydraulic operating system. Light hydraulic oil of 10 weights or equivalent or passivated water based fluid is suitable operating fluids. It's important oil and antifreeze is added if water is used to prevent corrosion in the operating chambers.

G. Operating Pressures

The rated continuous working pressure is 1,500 psi. Hydraulic pressure can be applied up to 3,000 psi in emergency situations. Optimal seal life can be attained if the hydraulic pressure is limited to 1,500 psi.

H. Bonnet Bolt Torque

To install bonnet bolts on the HU BOP apply thread compound (anti-seize) to the threads and the torque shoulder of the bolt shown in figure 4 below. The recommended thread compound shall be molybdenum disulfide/graphite based anti-seize. The bolts can be applied using an air impact wrench, a hammer wrench, or a torque wrench. The torque values are listed in table 3 below. When installing Bonnet Bolts, follow the pattern shown in figure 5 to ensure the bonnet is seated flush to the body.

NOTE: When using an air wrench to install the bonnet bolts, it is important to start the bolt by hand or a hand speed wrench until tight. This will ensure that the threads on the body as well as the bolt will not be damaged during installation. Over torquing bonnet bolts may cause damage to the bonnet bolts or to the BOP body.

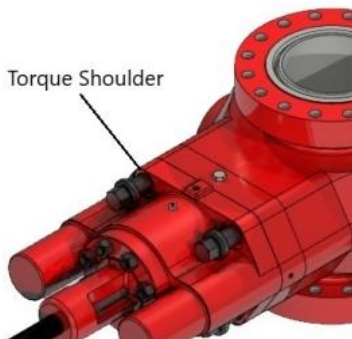


Figure 4: Torque Shoulder

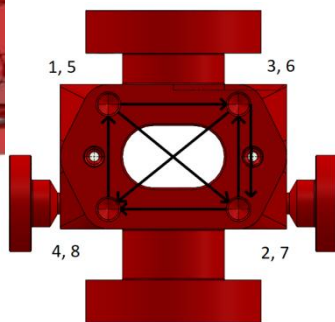


Figure 5: Torque Pattern

Table 3: Bonnet Bolt Torque Values

Size	Pressure Rating (psi)	Thread 8UN	HEX ACROSS FLATS	Torque (lbf-ft) w/anti-seize	Torque (N m)
7-1/16"	3,000	1-3/4"	2-3/8"	900	1220
7-1/16"	5,000	2"	2-3/8"	1200	1630
7-1/16"	10,000	2-1/2"	2-3/4"	2300	3120
7-1/16"	15,000	2-7/8"	2-3/4"	3300	4475
11"	3,000	2-1/4"	2-3/4"	1600	2170
11"	5,000	2-1/2"	2-3/4"	2300	3120
11"	10,000	3-1/8"	2-3/4"	4100	5560
13-5/8"	3,000	2-3/4"	2-3/4"	3000	4070
13-5/8"	5,000	2-7/8"	2-3/4"	3300	4475
13-5/8"	10,000	3-3/4"	3-1/2"	7500	10170
20-3/4"	3,000	2-1/2"	2-3/4"	2300	3120
21-1/4"	2,000	2-1/4"	2-3/4"	1600	2170

I. Ram Installation and Inspection

1. Prior to starting, ensure the hydraulic system has been bled off and has no pressure and rams and/or operating piston is in the open position.
2. Loosen Bonnet Bolts
 - a. Using an Impact or hammer wrench and the specified socket size found on Table 3.
 - b. Loosen the Bonnet Bolts until they are fully disengaged.
 - c. Pull the bolts back by hand.
 - i. Bolts can remain in the Bonnet. (figure 7)
3. Open Bonnet
 - a. Apply hydraulic pressure to the closed side to fully extend operating pistons.
 - b. With bonnet bolts unscrewed and rams closed, continue applying hydraulic pressure to the CLOSE side until the bonnets extend out and the ram is visible. (figure 8)
4. Inspection (figure 9)
 - a. Bonnet Gasket and Seal Area.
 - i. Inspect Gasket Groove for damage or debris.
 - ii. Inspect Gasket for damage (replace if damaged).
 - iii. Inspect Seal Area on Body Bonnet Face for damage.
 - b. Bonnet Bolts
 - i. Inspect Bonnet bolt threads for damage or debris.
 - ii. Inspect Bonnet bolt holes on the BOP body for damage or debris.
 - c. Operating piston and ram change rods for any damage to chrome surfaces
5. Grease Ram Bore
 - a. Use moly based lube grease (Recommended Guardian 1640 Core).
 - b. Apply light grease coating all around ram bore.
 - i. NOTE* Do not apply grease to Bonnet face or Bonnet Seal.
6. Install Bonnet Seal
7. Apply Grease to operating piston button
 - a. Use moly based lube grease (Recommended Guardian 1640 Core).
8. Install ram onto the operating piston
 - a. Inspect lifting eye hole in ram prior to installing lifting eye.
 - b. Inspect ram block for damage.
 - c. Inspect ram packers and top seals for damage.
 - i. Replace if needed.
 - d. Install proper size lifting eye into the ram block.
 - e. Pick ram up with hoist or other lifting device.
 - f. Place ram block onto operating piston button.
 - g. Apply light coating of grease to ram side packers and Top Seal.
 - i. Use moly based lube grease (Recommended Guardian 1640 Core).
9. Apply anti-seize to bonnet bolts (Recommended molybdenum disulfide/graphite based anti-seize)
 - a. Bonnet bolts threads.
 - b. Bonnet bolt holes in BOP body.
 - c. Bonnet Bolt torque shoulder.
10. Closing Bonnet
 - a. Ensure Bonnet Bolts are still pulled back through the bonnets so that the bolts do not contact the BOP body when the Bonnet Closes
 - b. Apply Hydraulic pressure to the OPEN Side.
 - i. Apply hydraulic pressure until rams retract.
 - ii. Once the rams retract keep applying pressure until the bonnets close back onto the body of the BOP.
11. Tighten Bonnet Bolts
 - a. Start the bolts by hand
 - i. Once bolts are started an impact, hammer, or torque wrench may be used.
 - ii. The Bonnet bolts should be tightened using the order in Figure 5 above.
 1. When using a torque wrench, Bonnet Bolts should be torqued to the values provided on Table 3 above.



Figure 6: Bonnets Closed



Figure 7: Bonnet Bolts Loose

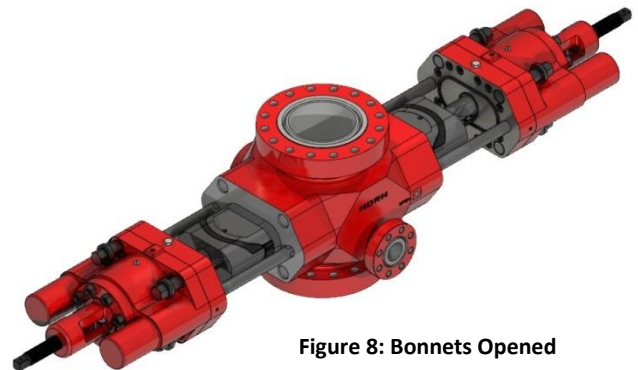


Figure 8: Bonnets Opened

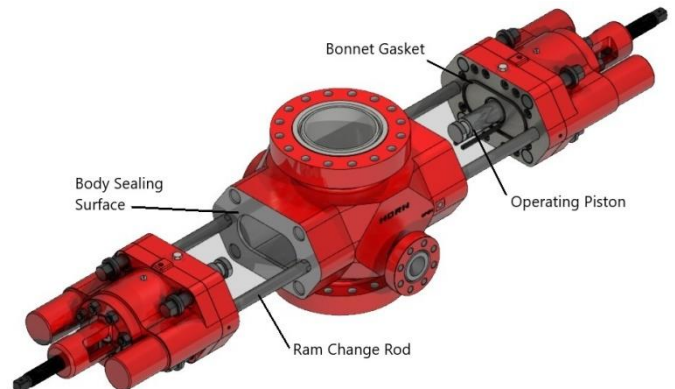


Figure 9: Rams Removed for Inspection

J. Storage

1. Remove Rams from BOP
 - a. Remove Seals and Packers from rams and wash the rams
 - b. Apply grease on all surfaces of the ram
 - i. DO NOT STORE the rams inside of the Blowout Preventer
2. Clean Blowout Preventer
 - a. Wash the mud and dirt from the inside and outside of the BOP
 - b. Blow off the BOP until the machined surfaces are dry
3. Apply grease to the ram bores and bonnet faces
4. Close the Bonnet on the BOP
 - a. Apply hydraulic pressure until the Bonnets are pulled back to the BOP body
 - b. Follow instructions for reinstalling Bonnet Bolts
 - c. Once Bonnet Bolts are torqued down, Apply Hydraulic Pressure to the Close side to move the pistons in
 - d. With the pistons in, Drive the locking screws in to protect them from being bent while being moved or stored
5. Cover outlet holes with flange protectors
6. Relieve Hydraulic pressure from both open and close sides
 - a. Remove hydraulic connectors and install 1" NPT plugs

K. Packers and Seals

HSU and HDU Ram Type Blowout Preventers use an Acrylonitrile Butadiene Rubber (NBR) for the packers and seals.

Temperature Rating: 20°F to 200°F

L. Operating Characteristics

- Minimum Operating Pressure for Low Pressure Sealing(MOPFLPS) for standard doors.
 - 7-1/16" 5/10/15M
 - Blind Rams: 200 psi.
 - Pipe Rams: 250 psi.
 - 11" 5/10M
 - Blind Rams: 200 psi.
 - Pipe Rams: 250 psi.
 - VBR and Flex Packer: 750 psi.
 - 13-5/8" 5/10M
 - Blind Rams: 200 psi.
 - Pipe Rams: 250 psi.
 - VBR and Flex Packer: 750 psi.
- Fatigue Test/ Locking Device
 - 78 pressure cycles
 - 546 open and closes
- Ram Access Test
 - 10 pressure cycles
 - 200 open and closes of BOP doors
- Low Temp. Test
 - 3 pressure cycles at or below 20°F
- High Temp. Test
 - 10 pressure cycles at or above 200°F
 - 1 hour pressure cycle at or above 200°F
- Hang-Off
 - 11" and 13-5/8" HU Pipe Rams
 - Rated up to 600,000 lbs.
 - 5" Test mandrel with 18° taper
 - 7-1/16" HU Pipe Rams
 - Rated up to 450,000 lbs.
 - 3-1/2" test mandrel with 18° taper
 - Note: Do not recommend hanging off on the smallest size pipe for VBR rams
- Stripping
 - 7-1/16" HU
 - 3-1/2" test mandrel
 - 50,000 ft. of pipe stripped at 3,000 psi wellbore
 - Not Recommended on VBR's or flex packers

iii. HORN HU DIMENSIONS AND PARTS

A. Physical Description and Engineering Data

The following information applies to Horn Unit ram type model blowout preventers. Standard specifications for Horn Single Units and Horn Double Units are listed in the charts below. Any combination of studded top, studded bottom, flanged connection or side outlets is available upon request. Special application Horn blowout preventers with unique specifications are available. No castings here – the HSU and HDU are made of 4130 grade forged steel for the utmost quality and strength. Corrosion resistant ring and seal grooves are standard.

- A - Over-all Length of Bonnets Closed, Locking Screws Unlocked
- B - Over-all Length of Bonnets closed, Locking Screws locked
- C - Over-all Length of Bonnets open, Locking Screws unlocked
- D1 - Height of Top Flange Face to Bottom Flange Face
- D2 - Height of Top Studded Face to Bottom Studded Face
- D3 - Height of Top Studded Face to Bottom Flanged Face
- D4 - Height of Top Flanged Face to Bottom Studded Face
- E - Height of Top Outlet Center to Face
(Corresponding # to bolted/face configuration)
- F - Height of Bottom Outlet Center to Face
(Corresponding # to bolted/face configuration)
- G - Height of Ram Bore
- H - Distance Between Ram Bores (HDU ONLY)
- J - Length of Top face to Top of Ram Bore
(Corresponding # to bolt/face configuration)
- K - Width of Body
- L - Distance Between Outlets (Specified by Customer)

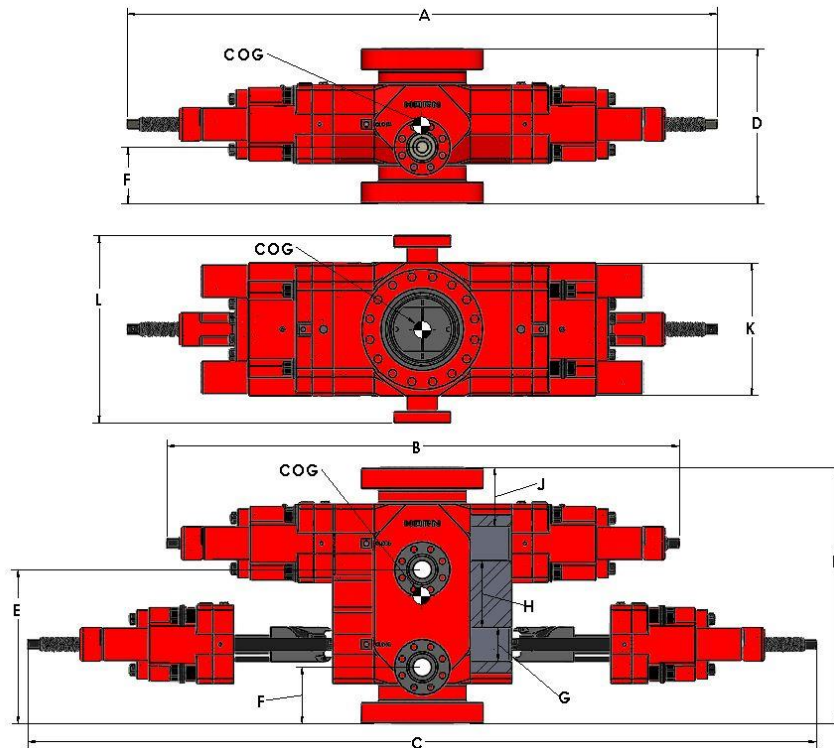


Figure 10: HU Dimensions

Table 4: HU Dimensions

Size (in.)	Pressure Rating (psi)	A (in.)	B (in.)	C (in.)	D-1 (in.)	D-2 (in.)	D-3 (in.)	D-4 (in.)	E-1 (in.)	E-2 (in.)	F-1 (in.)	F-2 (in.)	G (in.)	H-1 (in.)	J-1 (in.)	J-2 (in.)	K (in.)
7-1/16" Single	5,000	84.0	77.0	114.0	27.5	13.8	21.0	20.3	-	-	10.5	3.3	5.5	-	10.1	3.6	20.0
7-1/16" Double	5,000	84.0	77.0	114.0	44.2	30.4	37.7	36.9	27.1	19.8	10.5	3.3	5.5	11.2	10.1	3.6	20.0
7-1/16" Single	10,000	84.0	77.0	114.0	30.6	15.3	23.4	22.4	-	-	11.1	2.9	5.5	-	12.0	4.9	20.0
7-1/16" Double	10,000	84.0	77.0	114.0	48.6	33.3	41.3	40.5	29.1	21.2	11.1	2.9	5.5	12.6	12.0	4.9	20.0
7-1/16" Single	15,000	84.0	77.0	114.0	31.8	15.3	24.0	23.0	-	-	11.7	2.9	5.5	-	12.7	4.9	20.0
7-1/16" Double	15,000	84.0	77.0	114.0	49.9	33.3	42.1	41.1	29.8	21.0	11.7	2.9	5.5	12.6	12.7	4.9	20.0
11" Single	5,000	110.0	98.0	150.0	34.3	17.4	26.0	25.7	-	-	13.1	5.7	6.8	-	13.2	4.8	25.1
11" Double	5,000	110.0	98.0	150.0	54.5	37.6	46.2	45.9	32.6	24.0	13.1	5.7	6.8	13.4	13.2	4.8	25.1
11" Single	10,000	110.0	98.0	150.0	35.7	17.6	26.8	26.5	-	-	14.1	5.0	6.8	-	13.8	4.9	25.8
11" Double	10,000	110.0	98.0	150.0	55.9	37.8	47.0	46.7	33.3	24.2	14.1	5.0	6.8	19.1	13.8	4.9	25.8
13-5/8" Single	5,000	131.0	114.0	174.0	33.8	17.8	25.9	25.7	-	-	12.3	4.2	7.5	-	12.8	4.9	29.0
13-5/8" Double	5,000	131.0	114.0	174.0	55.9	39.8	48.0	47.7	33.6	25.5	12.3	4.2	7.5	14.6	12.8	4.9	29.0
13-5/8" Single	10,000	131.0	114.0	176.0	41.7	20.4	31.0	31.0	-	-	15.1	4.5	7.5	-	17.1	6.4	29.0
13-5/8" Double	10,000	131.0	114.0	176.0	66.6	45.3	56.0	56.0	40.1	29.4	15.1	4.5	7.5	17.4	17.1	6.4	29.0
20-3/4" Single	3,000	168.0	146.0	230.0	40.6	-	-	-	-	-	14.3	-	8.0	-	16.3	-	39.8
20-3/4" Double	3,000	168.0	146.0	230.0	66.1	-	-	-	39.9	-	14.3	-	8.0	17.6	16.3	-	39.8



Table 5: HU Assembled Weights

Bore Size (in.)	Number of Rams	Pressure Rating (psi)	Flange x Flange (lbs.)	Stud x Stud (lbs.)	Stud x Flange (lbs.)	Flange x Stud (lbs.)
7-1/16"	Single	5,000	3,200	2,830	3,020	3,005
7-1/16"	Double	5,000	6,400	6,050	6,235	6,220
7-1/16"	Single	10,000	3,910	3,250	3,580	3,580
7-1/16"	Double	10,000	7,470	6,810	7,140	7,140
7-1/16"	Single	15,000	4,070	3,245	3,670	3,645
7-1/16"	Double	15,000	7,615	6,790	7,215	7,190
11"	Single	5,000	6,810	5,855	6,345	6,320
11"	Double	5,000	13,285	12,330	12,820	12,795
11"	Single	10,000	7,590	5,985	6,795	6,775
11"	Double	10,000	14,180	12,740	13,460	13,420
13-5/8"	Single	5,000	9,500	8,240	8,880	8,880
13-5/8"	Double	5,000	18,800	17,540	18180	18,180
13-5/8"	Single	10,000	11,990	9,500	10,745	10,745
13-5/8"	Double	10,000	22,595	20,070	21,350	21,350
20-3/4"	Single	3,000	16,821	N/A	N/A	N/A
20-3/4"	Double	3,000	34,172	N/A	N/A	N/A

B. HU Standard Bonnet Parts List

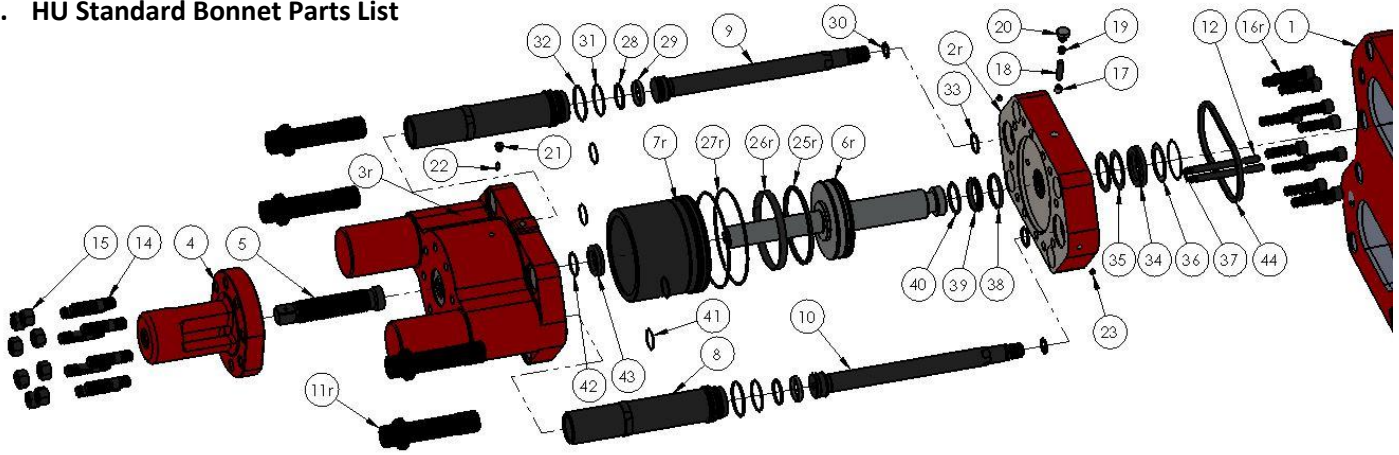


Figure 11: HU EXPLODED ASSEMBLY

Table 6: HU Parts List

Item	Description	Qty. (Single)	Qty. (Double)	7 1/16"-5M	7 1/16"-10M	7 1/16"-15M	11"-3M	11"-5M	11"-10M	13 5/8"-5M	13 5/8"-10M	20-3/4"-3M
1a	Body, Single	1	-	7-5HSU	7-10HSU	7-15HSU	11-3HSU	11-5HSU	11-10HSU	13-5HSU	13-10HSU	20-3HSU
1b	Body, Double	-	1	7-5H DU	7-10H DU	7-15H DU	11-3H DU	11-5H DU	11-10H DU	13-5H DU	13-10H DU	20-3H DU
2r	Intermediate Flange	2	4	03-0014	03-0014-1	03-0014-1	03-0023	03-0023	03-0023	03-0018	03-0019	03-0025
3r	Bonnet	2	4	03-0014-1	03-0014-2	03-0014-4	03-0024	03-0024	03-0024	03-0024-2	03-0024-1	03-0024-3
4	Lock Screw Housing	2	4	80-80002	80-80002	80-80002	80-80001	80-80001	80-80001	80-80000	80-80000	80-80003
5	Locking Screw	2	4	50-5006	50-5006	50-5006	50-5005	50-5005	50-5005	50-5004	50-5004	50-5007LS
6r	Operating Piston	2	4	03-0014-3	03-0014-3	03-0014-3	58-5816	58-5816	58-5816	58-5815	58-5814	58-5816-3
7r	Operating Cylinder	2	4	57-5707	57-5707	57-5707	57-5706	57-5706	57-5706	57-5705	57-5705	57-5712
8	Ram Change Cylinder	4	8	56-5602	56-5602	56-5602	56-5601	56-5601	56-5601	56-5600	56-5600	56-5604
9	Ram Change Piston Open	2	4	49-4906-1	49-4906-1	49-4906-1	49-4904-1	49-4904-1	49-4904-1	49-4902-1	49-4900-1	49-4908-1
10	Ram Change Piston Close	2	4	49-4907-1	49-4907-1	49-4907-1	49-4905-1	49-4905-1	49-4905-1	49-4903-1	49-4901-1	49-4909-1
11r	Bonnet Bolt	8	16	59-5903	59-5903-1	59-5901	59-5902	59-5902	59-5902-1	59-5901	59-5900	59-5912
12	Ram Guide Pins	4	8	00-0001-1	00-0001-1	00-0001-1	00-0001	00-0001	00-0001	00-0001	00-0001	00-0001
14	Lock Screw Housing Stud	16	32	1x4.25	1x4.25	1x4.25	1.25x5.25	1.25x5.25	1.25x5.25	1.50x6.25	1.50x6.25	TE1.50x6.25
15	Lock Screw Housing Nut	16	32	1"	1"	1"	1-1/4"	1-1/4"	1-1/4"	1-1/2"	1-1/2"	1-1/2"
16r	Capscrew, Int. Flg. To Bonnet	16*	32*	03-0055	03-0055	03-0055	03-0056	03-0056	03-0056	03-0056	03-0057	03-0058
17	Check Valve, Plastic	2	4	03-0021	03-0021	03-0021	03-0021	03-0021	03-0021	03-0021	03-0021	03-0021
18	Plastic Packing	2	4	03-0021-2	03-0021-2	03-0021-2	03-0021-2	03-0021-2	03-0021-2	03-0021-2	03-0021-2	03-0021-2
19	Screw, Plastic Packing	2	4	03-0021-1	03-0021-1	03-0021-1	03-0021-1	03-0021-1	03-0021-1	03-0021-1	03-0021-1	03-0021-1
20	Pipe Plug, Plastic Packing	2	4	03-0036	03-0036	03-0036	03-0036	03-0036	03-0036	03-0036	03-0036	03-0036
21	Gland, Bleeder	2	4	03-0002	03-0002	03-0002	03-0002	03-0002	03-0002	03-0002	03-0002	03-0002
22	Plug, Bleeder	2	4	03-0001	03-0001	03-0001	03-0001	03-0001	03-0001	03-0001	03-0001	03-0001
23	NPT Plug	4	8	03-0036	03-0036	03-0036	03-0036	03-0036	03-0036	03-0036	03-0036	03-0036
25r	Operating Piston Seal	2	4	03-0020-8	03-0020-8	03-0020-8	03-0047	03-0047	03-0047	03-0013-5	03-0013-5	03-0013-5
26r	Operating Piston Wear Band	2	4	03-0020-7	03-0020-7	03-0020-7	03-0046	03-0046	03-0046	03-0010	03-0010	03-0010
27r	Operating Cylinder Seal	4	8	64-6456	64-6456	64-6456	64-6459	64-6459	64-6459	64-6459-2	64-6459-2	64-6459-2
28	Ram Change Piston Seal	4	8	64-6437	64-6437	64-6437	64-6438-1	64-6438-1	64-6438-1	64-6441-1	64-6441-1	64-6451-3
29	Ram Change Piston Wear Band	4	8	03-0009-3	03-0009-3	03-0009-3	03-0036	03-0036	03-0036	03-0009-1	03-0009-1	03-0036
30	Ram Change Rod Seal to Body	4	8	64-6430-1	64-6430-1	64-6430-1	64-6432	64-6432	64-6432	64-6434	64-6434	64-6439
31	Ram Change Cyl. Seal To Int. Flange	4	8	64-6441-1	64-6441-1	64-6441-1	64-6453-2	64-6453-2	64-6453-2	64-6448-2	64-6448-2	64-6452-1
32	Ram Change Cyl. Seal to Bonnet	4	8	64-6445	64-6445	64-6445	64-6448	64-6448	64-6448	64-6451-3	64-6451-3	64-6453-00
33	Ram Change Rod Seal to Int. Flange	4	8	64-6434-1	64-6434-1	64-6434-1	64-6436-1	64-6436-1	64-6436-1	64-6438	64-6438	64-6444
34	Connecting Rod Seal (Mud Seal)	2	4	03-0020-2	03-0020-2	03-0020-2	03-0008-1	03-0008-1	03-0008-1	03-0003	03-0003	03-0003
35	Back-up Ring - Connecting Rod	4	8	03-0020-1	03-0020-1	03-0020-1	03-0036	03-0036	03-0036	03-0036	03-0036	03-0036
36	Washer - Connecting Rod	2	4	03-0020	03-0020	03-0020	03-0043	03-0043	03-0043	03-0013	03-0013	03-0013
37	Spirolox retainer ring	2	4	03-0020-3	03-0020-3	03-0020-3	03-0044	03-0044	03-0044	03-0013-3	03-0013-3	03-0013-3
38	Plastic Energizing Ring	2	4	03-0020-4	03-0020-4	03-0020-4	03-0041	03-0041	03-0041	03-0013-1	03-0013-1	03-0013-1
39	Plastic Packing Ring	2	4	03-0020-5	03-0020-5	03-0020-5	03-0042	03-0042	03-0042	03-0013-2	03-0013-2	03-0013-2
40	Operating Piston Hydraulic Seal	2	4	03-0014	03-0014	03-0014	03-0045	03-0045	03-0045	03-0013-4	03-0013-4	03-0013-4
41	Bonnet Bolt O-ring	8	16	64-6411	64-6411-1	64-6411-2	64-6411-1	64-6411-1	64-6419-1	64-6411-2	64-6421-1	64-6411-1
42	Tail Shaft Wiper O-ring	2	4	64-6436-1	64-6436-1	64-6436-1	64-6438-1	64-6438-1	64-6438-1	64-6441	64-6441	64-6441
43	Tail Shaft Seal	2	4	03-0020-9	03-0020-9	03-0020-9	03-0048	03-0048	03-0048	03-0012	03-0012	03-0012
44	Bonnet Gasket	2	4	74-7409	74-7409	74-7409	74-7410	74-7410	74-7410	74-7411	74-7411	74-7411-2

* 13 5/8" requires 24 for single and 48 for double

NOTICE

HEC recommends having Ram packers, top seals, and door gaskets for spare parts.

C. Blind Rams

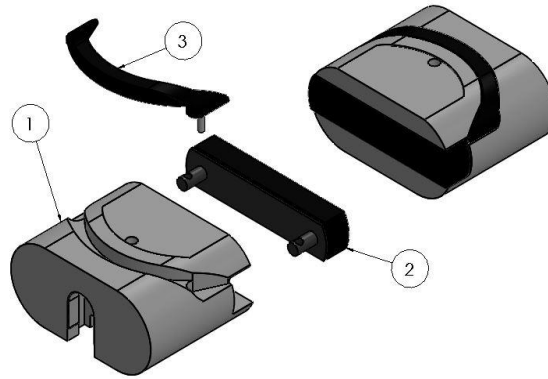


Figure 12: BLIND RAMS EXPLODED

Table 7: HU Blind Rams

Item	Part Description	QTY: (per ram bore)
1	Blind Ram	2
2	Blind Ram Packer	2
3	Ram Top Seal	2

D. 7-1/16" HU Sealing Shear Rams (SSR's)

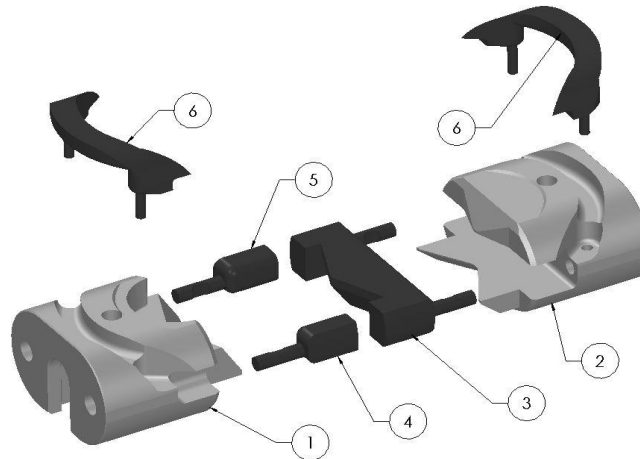


Figure 13: SSR RAMS EXPLODED

Table 8: HU 7-1/16 " Sealing Shear Rams

Item	Part Description	QTY: (per ram bore)
1	Sealing Shear Ram Upper	1
2	Sealing Shear Ram Lower	1
3	Sealing Shear Ram Packer	1
4	Sealing Shear Ram Side Packer Right	1
5	Sealing Shear Ram Side Packer Left	1
6	Ram Top Seal	2

E. Pipe Rams

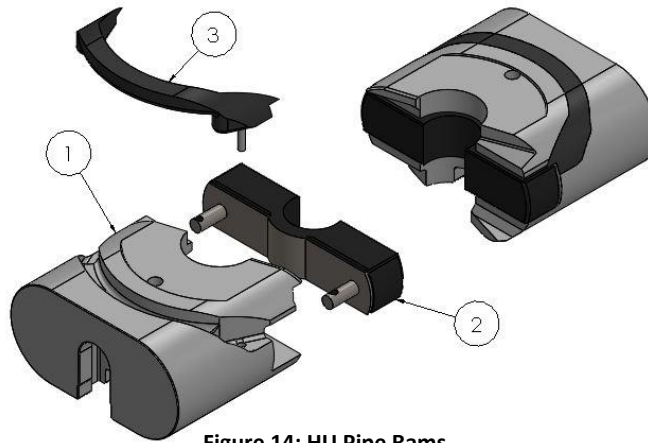


Figure 14: HU Pipe Rams

Table 9: HU Pipe Rams

Item	Part Description	QTY: (per ram bore)
1	Pipe Ram	2
2	Pipe Ram Packer	2
3	Ram Top Seal	2

Table 10: Pipe Ram Sizes

Pipe Size (in.)	7 1/16"	11"	13 5/8"	20-3/4"
	5M to 15M	5M to 10M	5M to 10M	3M
1.315	X	-	-	-
1.660	X	-	-	-
1.900	X	-	-	-
2.062	X	X	X	-
2.375	X	X	X	X
2.625	X	-	-	-
2.875	X	X	X	X
3.500	X	X	X	X
4.000	X	X	X	X
4.500	X	X	X	X
5.000	X	X	X	X
5.500	X	X	X	X
5.875	-	-	X	X
6.625	-	X	X	X
7.000	-	X	X	X
7.625	-	-	X	X
8.625	-	-	X	X
9.625	-	-	X	X
10.750	-	-	X	X
13.625	-	-	-	X

F. VBR/Flex Packer Rams

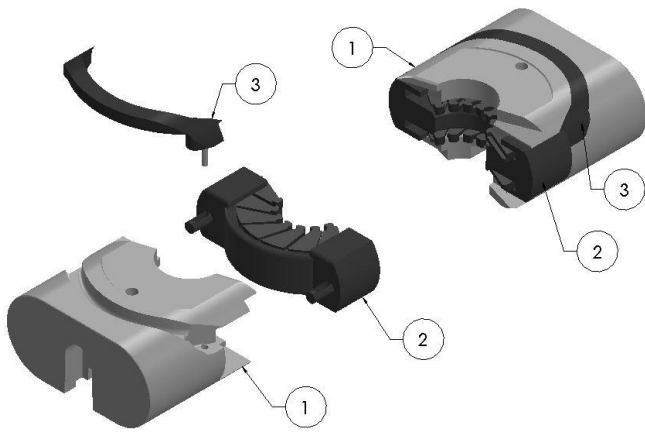


Figure 15: VBR RAMS EXPLODED

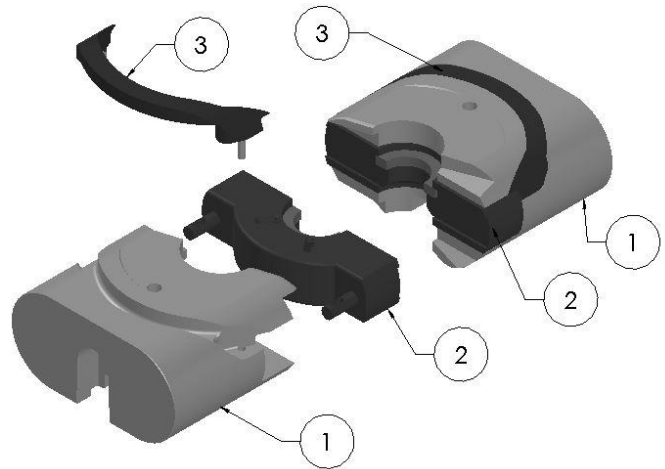


Figure 16: FLEX PACKER RAMS EXPLODED

Table 11: HU VBR/FLEX PACKER RAMS

Item	Part Description	QTY: (per ram bore)
1	Ram Block	2
2	Packer	2
3	Ram Top Seal	2

Table 12: HU VBR Sizes

Size	Pressure (psi.)	Pipe Size (in.)	
7-1/16"	5,000 to 15,000	2-3/8" x 3-1/2"	
11"	5,000 to 10,000	2-7/8" x 5"	3-1/2" x 5-1/2"
13-5/8"	5,000 to 10,000	2-7/8" x 5"	3-1/2" x 5-1/2" 4-1/2" x 7"

Table 13: HU Flex Packer Sizes

Size	Pressure (psi.)	Pipe Size (in.)
11"	5,000 to 10,000	3-1/2" x 5"
13-5/8"	5,000 to 10,000	3-1/2" x 5"

iv. HORN HU BOOSTER OPERATION and MAINTANENCE

A. HU Tandem Booster

HU BOP's can be equipped with tandem boosters to increase force for shearing pipe.

Tandem boosters can only be installed with shear or large bore bonnets.

Tandem boosters increase the closing ratio and the gallons of hydraulic fluid needed to operate the BOP. The new numbers can be found on Table 2 for HU BOP's. The booster is controlled hydraulically and is connected to the hydraulics from the BOP using a manifold that connects from the back of the bonnet to the booster. (figure XX)

NOTICE

When shearing pipe, Horn Equipment recommends isolating wellbore pressure below the shear rams.

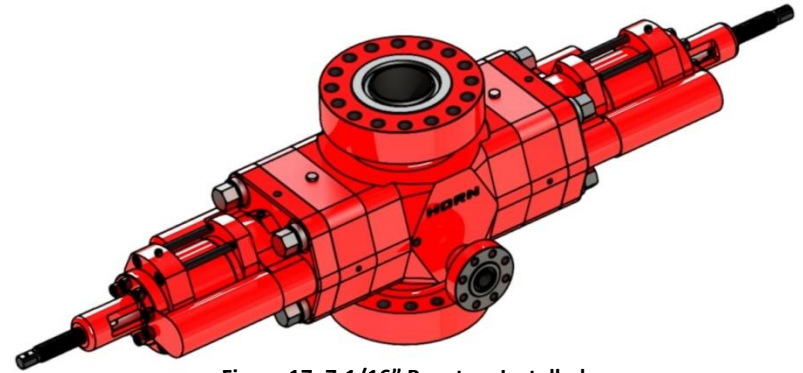


Figure 17: 7-1/16" Boosters Installed

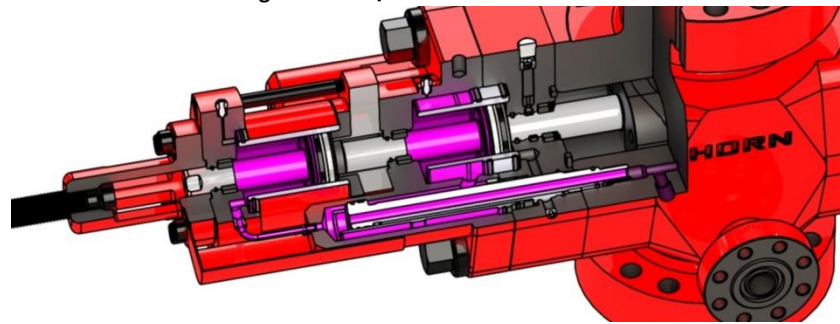


Figure 18: 7-1/16" Closed with Boosters

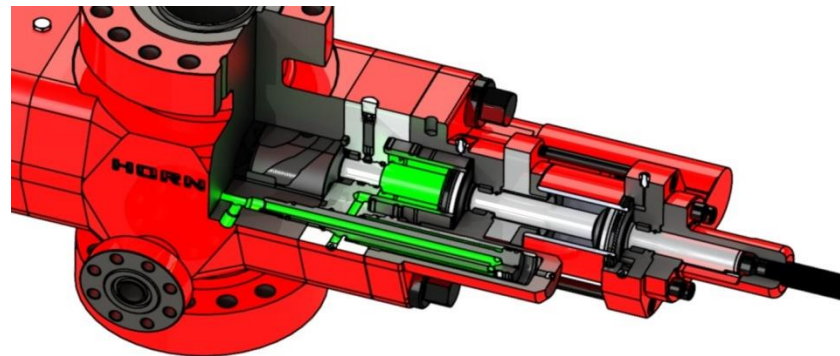


Figure 19: 7-1/16" Opened with Boosters

B. HU Booster Dimensions and Weights

The following information applies to the Tandem Shear Booster and SD Booster for the 7-1/16" HU BOP. The dimensions and weights listed are the only ones that change from standard bonnets.

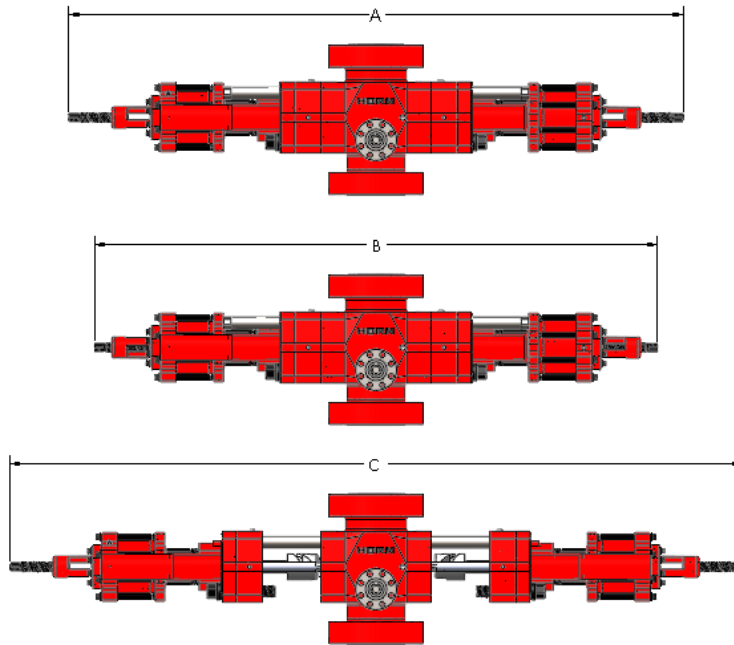


Figure 20: Shear Booster Dimensions

Table 14: Booster Dimensions and Weights

Size	Pressure Rating (psi)		Booster Type	A (in.)	B (in.)	C (in.)	Flange x Flange (lbs.)	Stud x Stud (lbs.)	Stud x Flange (lbs.)	Flange x Stud (lbs.)
7-1/16"	10,000	Single	Standard	116	105	141	4,336	3,676	4,006	4,006
		Double					7,896	7,236	7,566	7,566
7-1/16"	10,000	Single	SD	130	119	155	4,665	4,005	4,335	4,335
		Double					8,225	7,565	7,895	7,895
7-1/16"	15,000	Single	Standard	116	105	141	4,496	3,671	4,096	4,071
		Double					8,041	7,216	7,641	7,616
7-1/16"	15,000	Single	SD	130	119	155	4,825	4,000	4,425	4,400
		Double					8,370	7,545	7,970	7,945
11"	5,000	Single	Large Bore Tandem	156	137	190	7,606	6,719	7,231	7,231
		Double					13,801	12,914	13,426	13,426
11"	10,000	Single	Large Bore Tandem	156	137	190	8,267	6,743	7,584	7,584
		Double					14,573	13,170	13,889	13,889
13-5/8"	5,000	Single	Large Bore Tandem	180	159	220	10,229	8,969	9,609	9,609
		Double					19,357	18,097	18,737	18,737
13-5/8"	10,000	Single	Large Bore Tandem	181	161	221	13,294	10,737	11,949	11,949
		Double					23,810	21,306	22,597	22,597

C. HU Shear Bonnet Parts

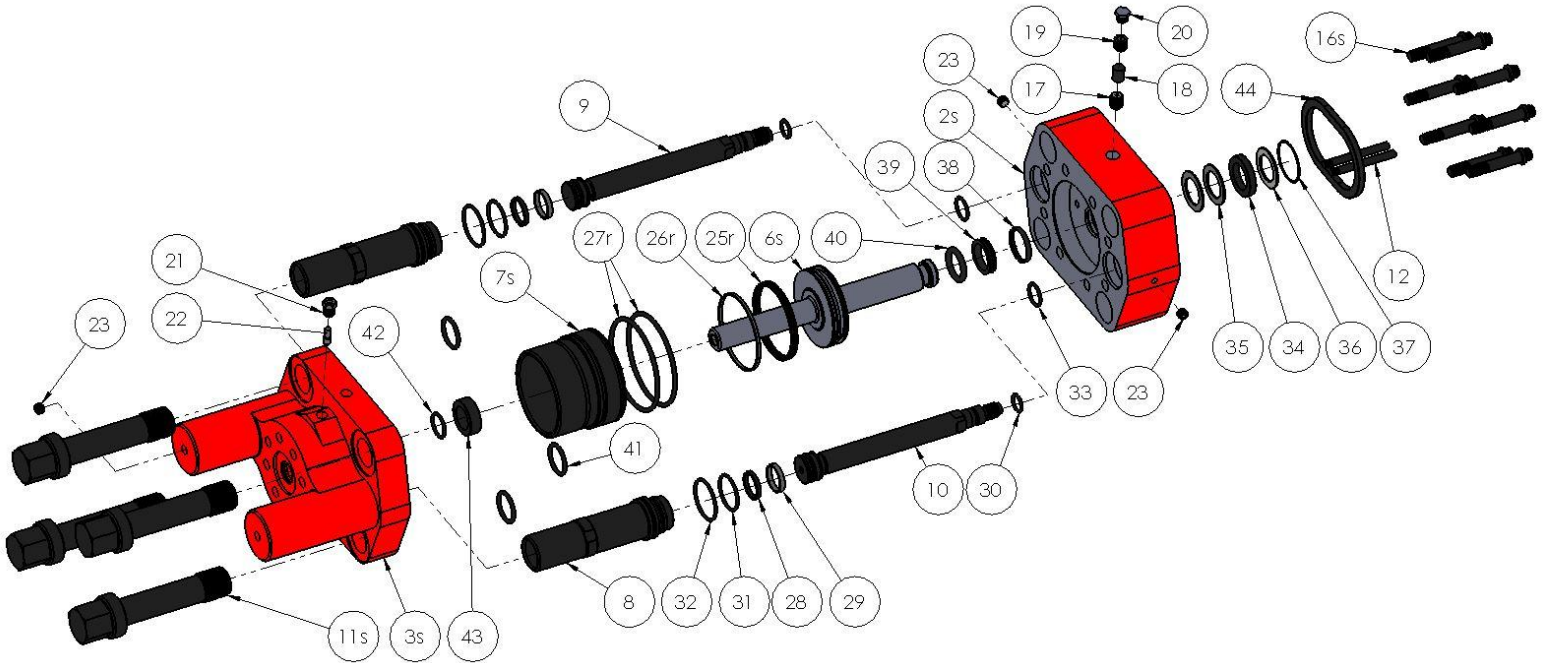


Figure 21: HU Shear Bonnet Exploded

Table 15: HU Shear Bonnet Parts

Item	Description	Qty. (1 set of rams)
2s	Intermediate Flange, Shear	2
3s	Bonnet, Shear	2
6s	Operating Piston, Shear	2
7s	Operating Cylinder, Shear	2
8	Ram Change Cylinder	4
9	Ram Change Piston Open	2
10	Ram Change Piston Close	2
11s	Bonnet Bolt, Shear	8
12	Ram Guide Pins	4
16s	Capscrew, Int. Flg. To Bonnet, Shear	16*
17	Check Valve, Plastic	2
18	Plastic Packing	2
19	Screw, Plastic Packing	2
20	Pipe Plug, Plastic Packing	2
21	Gland, Bleeder	2
22	Plug, Bleeder	2
23	NPT Plug	6

Table 16: HU Shear Bonnet Seals

Item	Description	Qty. (1 set of rams)
25s	Operating Piston Seal	2
26s	Operating Piston Wear Band	2
27r	Operating Cylinder Seal	4
28	Ram Change Piston Seal	4
29	Ram Change Piston Wear Band	4
30	Ram Change Rod Seal to Body	4
31	Ram Change Cyl. Seal To Int. Flange	4
32	Ram Change Cyl. Seal to Bonnet	4
33	Ram Change Rod Seal to Int. Flange	4
34	Connecting Rod Seal (Mud Seal)	2
35	Back-up Ring - Connecting Rod	4
36	Washer - Connecting Rod	2
37	Spirolox retainer ring	2
38	Plastic Energizing Ring	2
39	Plastic Packing Ring	2
40	Operating Piston Hydraulic Seal	2
41	Bonnet Bolt O-ring	8
42	Tail Shaft Wiper O-ring	2
43	Tail Shaft Seal	2
44	Bonnet Gasket	2

- Shear bonnets and intermediates are available in 7-1/16", 11" and 13-5/8" HU BOP's. Contact Horn Equipment for individual part numbers and ordering information.

D. HU Large Bore Shear Bonnet Parts

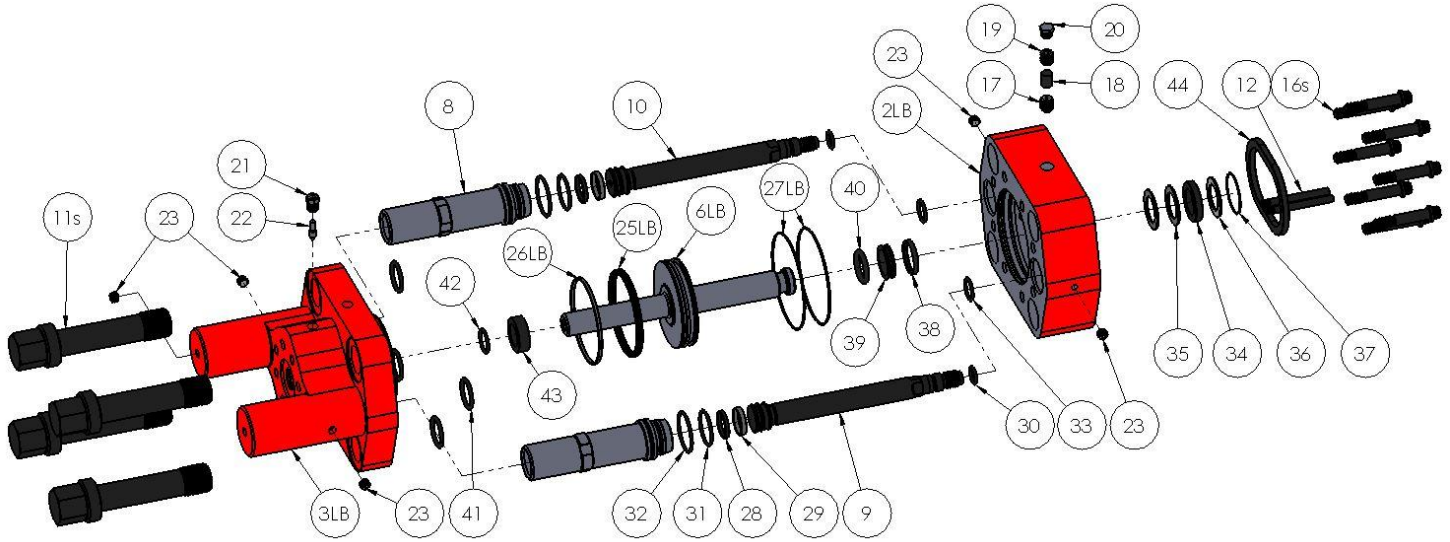


Figure 22: HU Large Bore Shear Bonnet Exploded

Table 17: HU Large Bore Shear Bonnet Parts

Item	Description	Qty. (1 set of rams)
2LB	Intermediate Flange, Large Bore	2
3LB	Bonnet, Large Bore	2
6LB	Operating Piston, Large Bore	2
8	Ram Change Cylinder	4
9	Ram Change Piston Open	2
10	Ram Change Piston Close	2
11s	Bonnet Bolt, Shear	8
12	Ram Guide Pins	4
16s	Capscrew, Int. Flg. To Bonnet, Shear	16*
17	Check Valve, Plastic	2
18	Plastic Packing	2
19	Screw, Plastic Packing	2
20	Pipe Plug, Plastic Packing	2
21	Gland, Bleeder	2
22	Plug, Bleeder	2
23	NPT Plug	6

Table 18: HU Large Bore Shear Bonnet Seals

Item	Description	Qty. (1 set of rams)
25LB	Operating Piston Seal, Large Bore	2
26LB	Operating Piston Wear Band, Large Bore	2
27LB	Operating Cylinder Seal, Large Bore	4
28	Ram Change Piston Seal	4
29	Ram Change Piston Wear Band	4
30	Ram Change Rod Seal to Body	4
31	Ram Change Cyl. Seal to Int. Flange	4
32	Ram Change Cyl. Seal to Bonnet	4
33	Ram Change Rod Seal to Int. Flange	4
34	Connecting Rod Seal (Mud Seal)	2
35	Back-up Ring - Connecting Rod	4
36	Washer - Connecting Rod	2
37	Spirolox retainer ring	2
38	Plastic Energizing Ring	2
39	Plastic Packing Ring	2
40	Operating Piston Hydraulic Seal	2
41	Bonnet Bolt O-ring	8
42	Tail Shaft Wiper O-ring	2
43	Tail Shaft Seal	2
44	Bonnet Gasket	2

- Large Bore Shear bonnets and intermediates are available in 11" and 13-5/8" HU BOP's. Contact Horn Equipment for individual part numbers and ordering information.

E. HU Shear Booster Parts

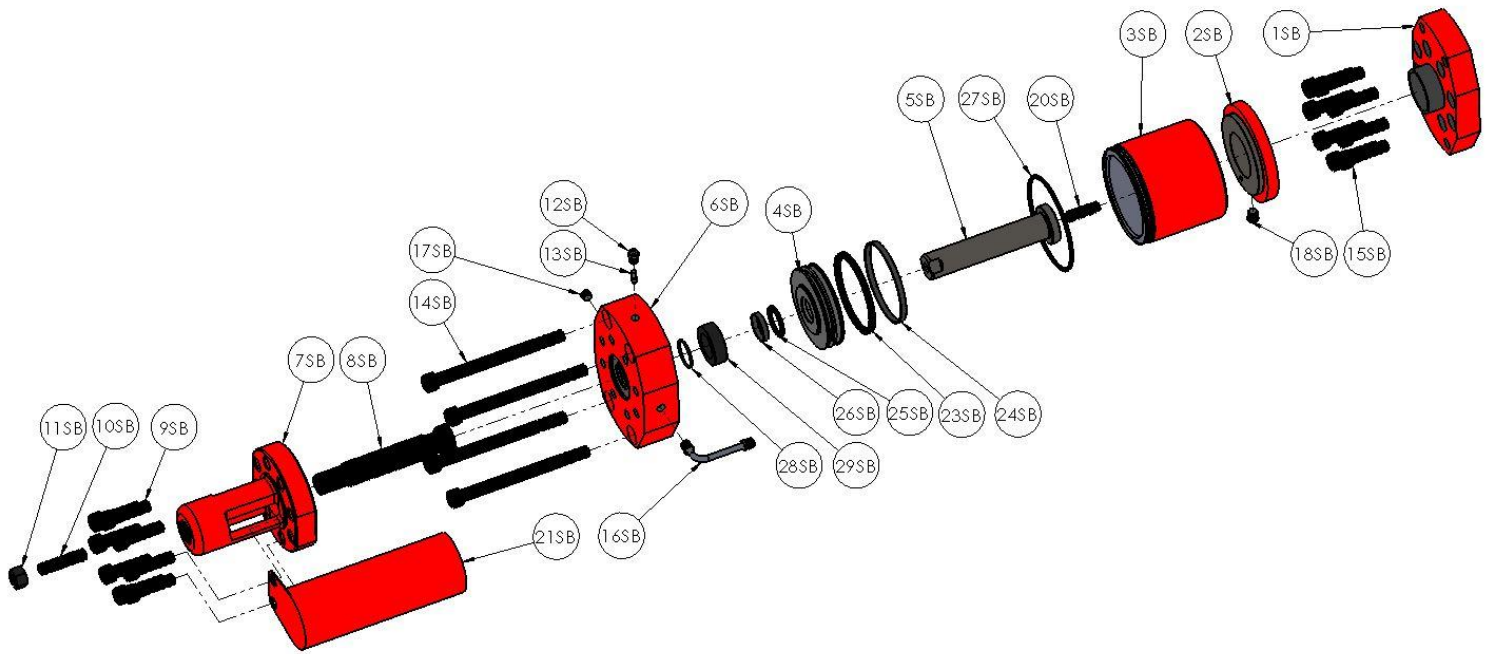


Figure 23: HU Shear Booster Exploded

Table 19: HU Shear Booster Parts List

Item	Description	Qty. (1 set of Rams)
1SB	Booster Adapter Plate	2
2SB	Booster Adapter Spacer	2
3SB	Booster Operating Cylinder	2
4SB	Booster Operating Piston	2
5SB	Booster Tail Rod	2
6SB	Booster Cylinder Head	2
7SB	Lock Screw Housing	2
8SB	Lock Screw	2
9SB	Lock Screw Housing Cap Screw	0 or 16
10SB	Lock Screw Housing Stud	16 or 0
11SB	Lock Screw Housing Nut	16 or 0
12SB	Gland, Bleeder	2
13SB	Plug, Bleeder	2
14SB	Bolts, Booster Cylinder Head	8
15SB	Bolts, Booster Adapter Plate	16
16SB	Booster Manifold Tube Assy.	2
17SB	NPT Plug	2
18SB	NPT Muffler	2
20SB	Tail Rod Stud	2
21SB	Booster Manifold Tube Cover	2

Table 20: HU Shear Booster Seals List

Item	Description	Qty. (1 set of Rams)
23SB	Oper. Piston Seal	2
24SB	Oper. Piston Wear Band	2
25SB	Piston I.D. Seal	2
26SB	Piston I.D. Wear Band	2
27SB	Operating Cylinder Seal	2
28SB	Tail Shaft Wiper O-ring	2
29SB	Tail Shaft Seal	2

v. HORN 7-1/16" SD BOOSTER



The HEC SD Booster fits on all 7-1/16" HU BOP's. The SD Booster can be added to any 7-1/16" HU BOP already equipped with shear bonnets and tandem booster.

A. Ram Installation and Inspection with SD Boosters

The process for installing and removing rams is similar to standards bonnets. The difference is before the bonnets are opened after the bonnet bolts are removed, guide rods must be installed in the top two bonnet bolt holes.

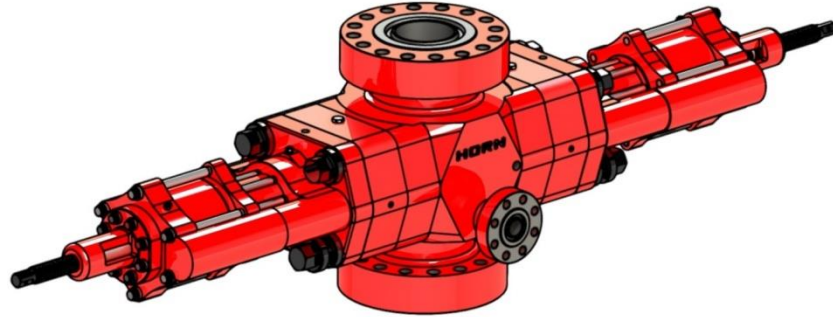


Figure 24: SD BOOSTER Installed

Table 21: SD Booster Guide Rods

BOP Size	Thread Size	Hex Size
7-1/16" 10M	2-1/2"-8UN	2-3/16"
7-1/16" 15M	2-7/8"-8UN	2-9/16"

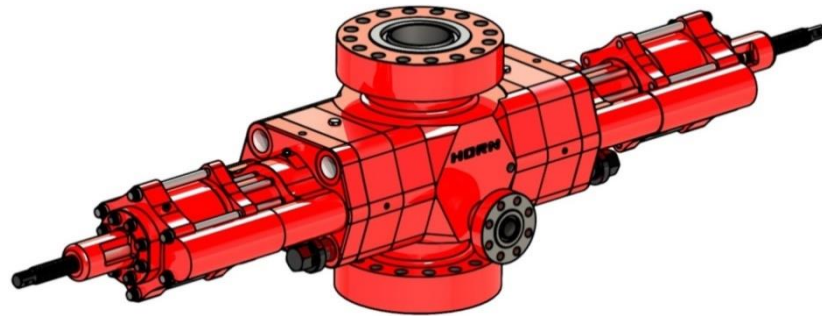


Figure 25: Bonnet Bolts Removed

1. Prior to starting, ensure the hydraulic system is pressured up to 1500 psi on the open side.
2. Loosen Bonnet Bolts
 - a. Using an Impact or hammer wrench and the specified socket size found on Table 3.
 - b. Loosen the Bonnet Bolts until they are fully disengaged.
 - c. Pull the bolts back by hand.
 - i. Top 2 bolts for each bonnet need to be removed from bonnet. (figure 25)
3. Install guide rods into the bonnet bolt holes. (figure 26)
 - a. Using an Impact or hammer wrench and the specified socket size found on Table 21.
 - b. Guide rods must be installed
4. Open Bonnet
 - a. Apply hydraulic pressure to the closed side to fully extend operating pistons.
 - b. Continue applying pressure until bonnets are fully extended from the body. (figure 27)
5. Once Bonnets are fully opened, apply only **500 psi**, of hydraulic pressure to the open side, to retract the rams fully from the ram bore.
6. Continue with Step 4 from Ram Installation and Inspection.

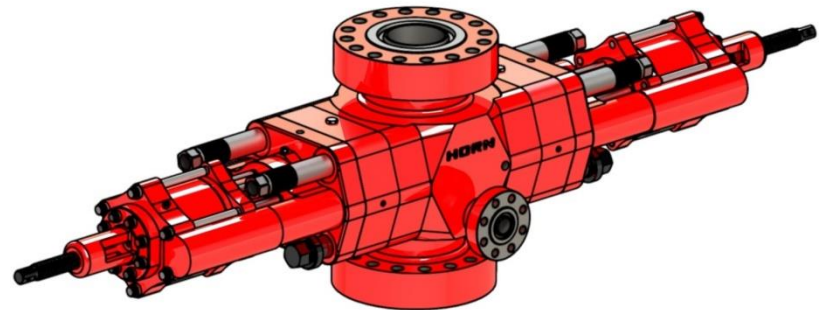


Figure 26: Guide Rods Installed

NOTICE
If SD Boosters are installed, bonnets SHOULD NOT be opened without guide rods installed.

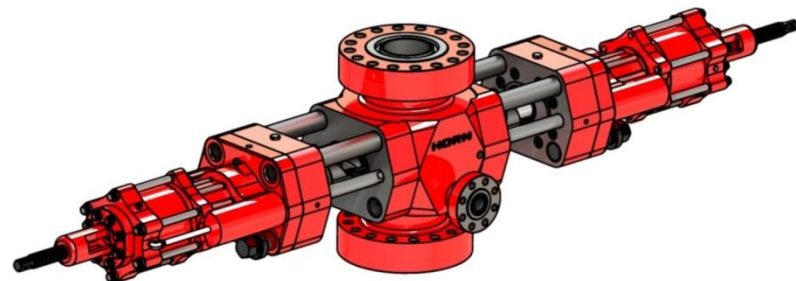


Figure 27: Bonnets Opened

B. HU 7-1/16" SD Booster Parts

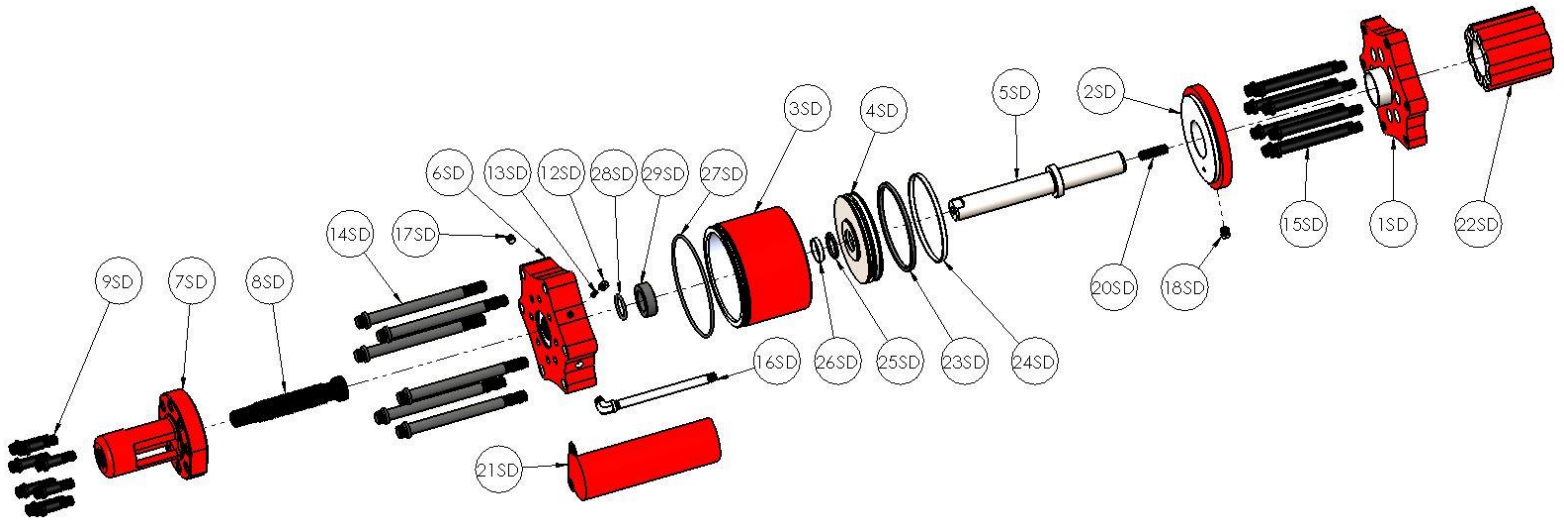


Figure 28: HU 7-1/16" SD Booster Exploded

Table 22: 7-1/16" HU SD Booster Parts List

Item	Description	Qty. (1 set of rams)
1SD	SD Booster Adapter Plate	2
2SD	SD Booster Adapter Spacer	2
3SD	SD Booster Operating Cylinder	2
4SD	SD Booster Operating Piston	2
5SD	SD Booster Tail Rod	2
6SD	SD Booster Cylinder Head	2
7SD	Lock Screw Housing	2
8SD	Lock Screw	2
9SD	Lock Screw Housing Cap Screw	16
12SD	Gland, Bleeder	2
13SD	Plug, Bleeder	2
14SD	Bolts, SD Booster Cylinder Head	12
15SD	Bolts, SD Booster Adapter Plate	16
16SD	SD Booster Manifold Tube Assy.	2
17SD	NPT Plug	2
18SD	NPT Muffler	2
20SD	Tail Rod Stud	2
21SD	SD Booster Manifold Tube Cover	2
22SD	SD Booster Spacer	2

Table 23: 7-1/16" HU SD Booster Seals List

Item	Description	Qty. (1 set of rams)
23SD	Oper. Piston Seal	2
24SD	Oper. Piston Wear Band	2
25SD	Piston I.D. Seal	2
26SD	Piston I.D. Wear Band	2
27SD	Operating Cylinder Seal	2
28SD	Tail Shaft Wiper O-ring	2
29SD	Tail Shaft Seal	2

vi. HORN HU HYDRAULIC DIAGRAMS



A. HU Hydraulic Diagrams For Open/Close Rams

Closing Rams:

- Bonnet Bolts Installed
- Apply hydraulic pressure through the close port
- Once rams are closed, locking screws can be locked (as shown) and/or pressure can held on the close port

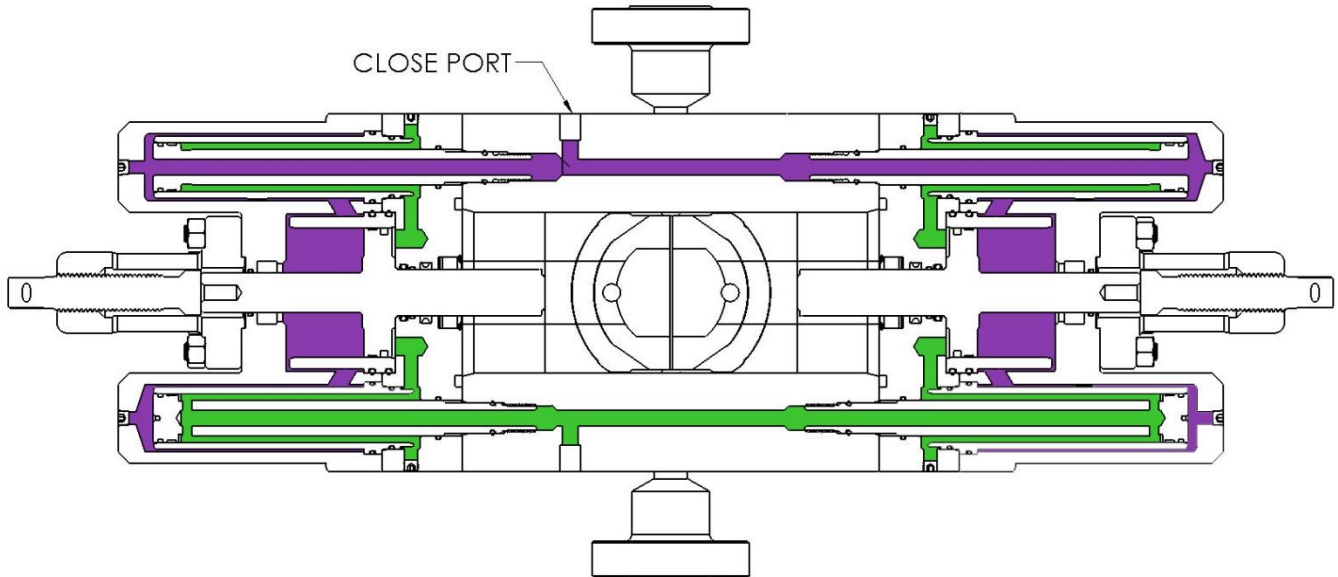


Figure 29: HU Hydraulics Close Rams Path

Opening Rams:

- Bonnet Bolts Installed
- Locking screws unlocked
- Apply hydraulic pressure through the open port

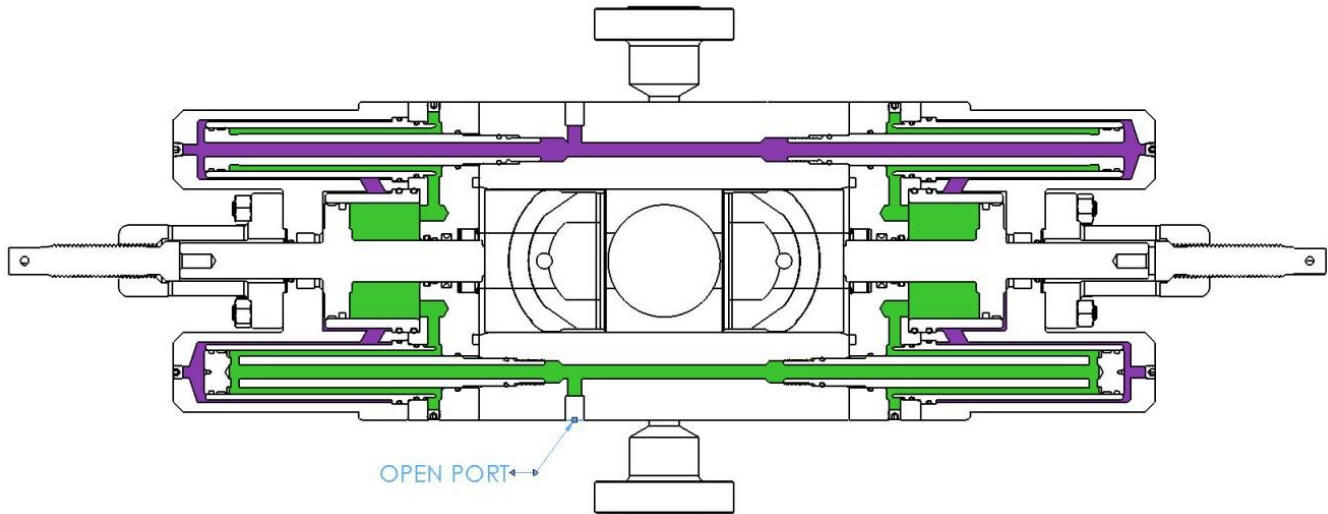


Figure 30: HU Hydraulics Open Rams Path

B. HU Hydraulic Diagrams For Open/Close Bonnets

Opening Bonnets:

- No hydraulic Pressure on BOP
- Loosen Bonnet Bolts, unscrewed fully from BOP body
- Locking screws unlocked
- Apply hydraulic pressure through the close port
- Once rams are fully extended, the hydraulic pressure will open the bonnets from the body.
- Once bonnets are open, relieve hydraulic pressure from BOP
- If rams are still not fully out of the body once the bonnets are fully extended, hydraulic pressure can be applied to the Open port to move the rams towards the bonnets (Figure XX)

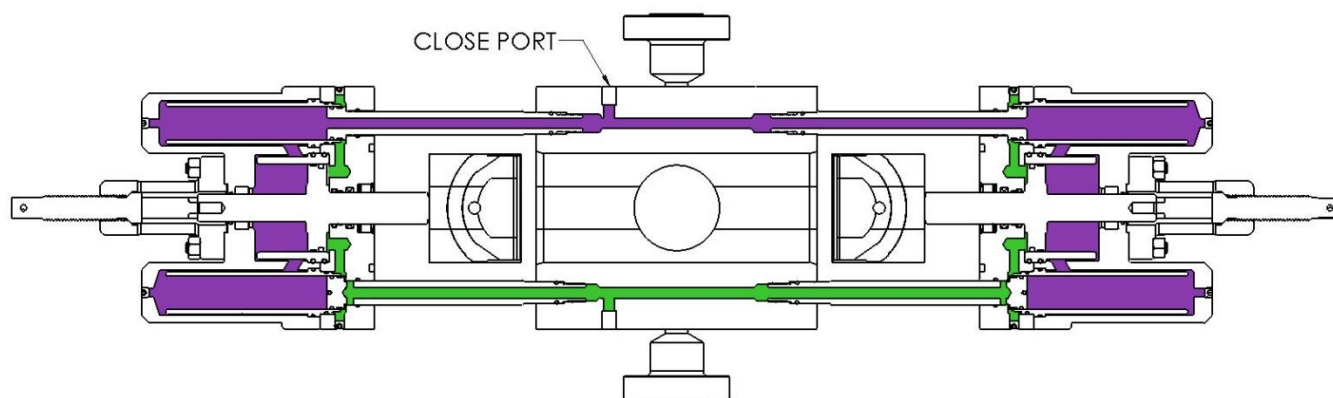


Figure 31: HU Hydraulics Open Bonnets Path

Closing Bonnets:

- Apply hydraulic pressure to the open port
- If rams are not fully open, the rams will move to the open position
- Continue applying hydraulic pressure to the open port, the bonnets will begin to close on the body
 - Make sure door gaskets are properly installed
- Once bonnets are closed, keep pressure on the open hydraulics
- reinstall bonnet bolts
 - Always begin bonnet bolts by hand before using impact
- Torque bonnet bolts to recommended torque for specific BOP size.

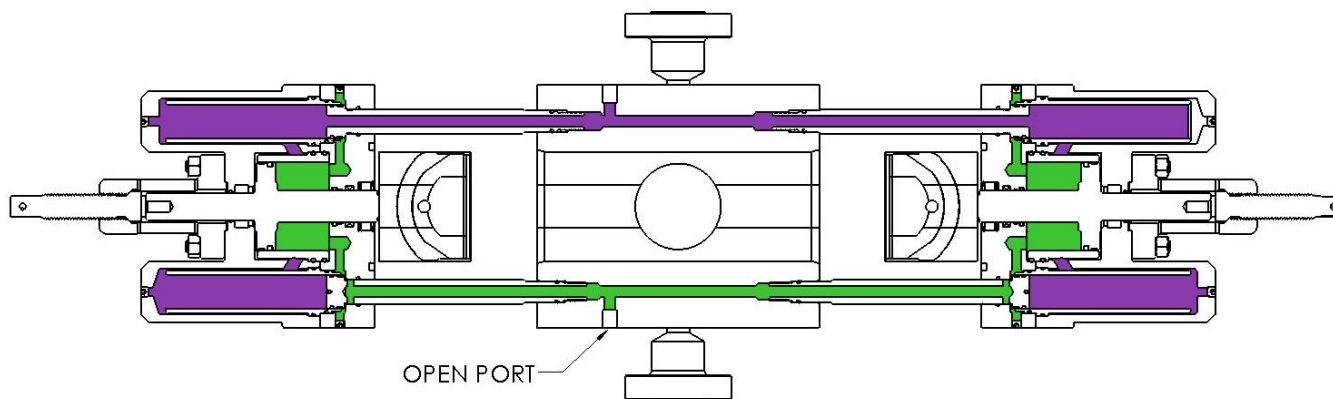


Figure 32: HU Hydraulics Open Bonnets Open Rams Path

C. HU Booster Hydraulic Diagrams For Open/Close Rams

Opening Rams:

- Bonnet Bolts Installed
- Locking screws unlocked
- Apply hydraulic pressure through the open port
- With booster installed, the booster is not used for opening the rams.

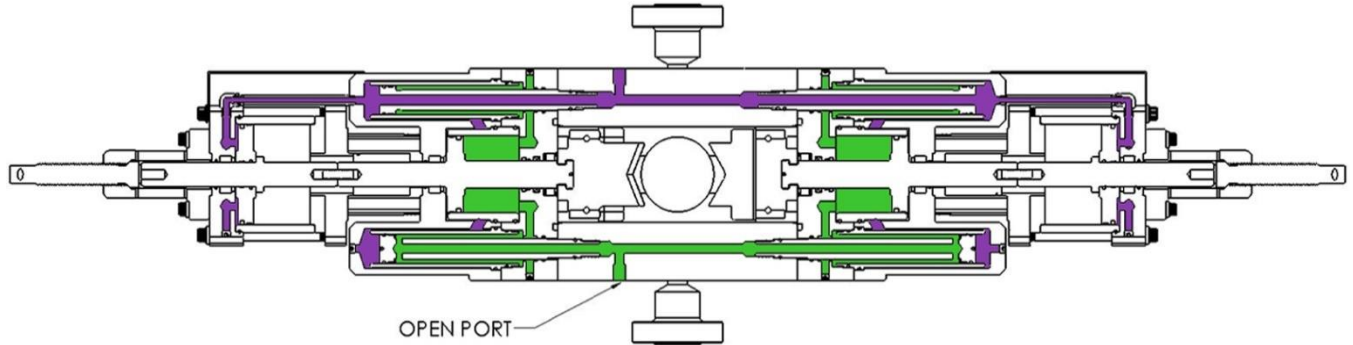


Figure 33: Booster Hydraulics Close Path

Closing Rams:

- Bonnet Bolts Installed
- Apply hydraulic pressure through the close port
- With boosters installed, a manifold is used to connect the booster to the close hydraulics
- Once rams are closed, locking screws can be locked (as shown) and/or pressure can be held on the close port

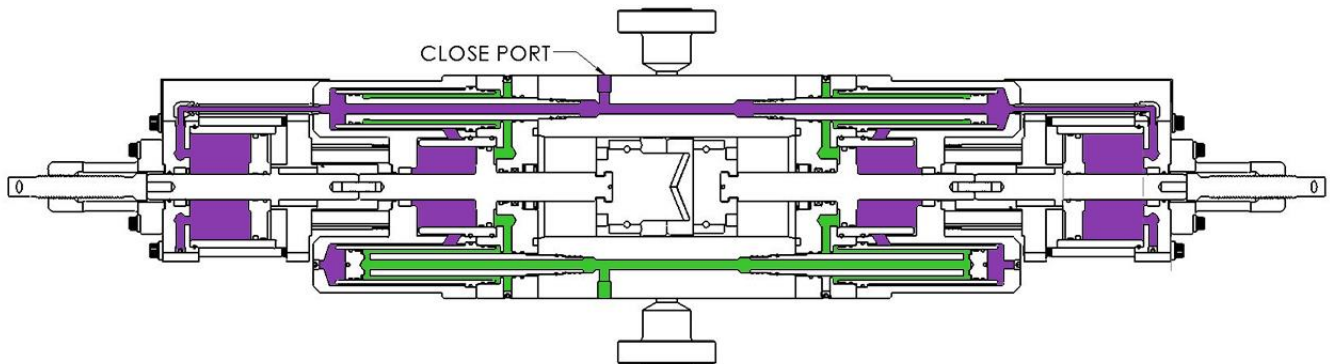


Figure 34: Booster Hydraulics Close Path



vii. Revisions

REVISION	SECTION	SUB-SEC	CHANGE	DATE	Completed By:	Review by:
0	II	D	Notice for VBR's and Flex Packers	8-21-2018	Bryson Simer	Scott Spurlin
1	II	E	Corrected OP. Capacities and reformatted table 2..	12-11-2018	Bryson Simer	KH & SS
2	IV	C	Added parts list for Shear Doors	12-11-2018	Bryson Simer	SS
2	IV, V	ALL	Added Boosters and SD Boosters	12-11-2018	Bryson Simer	SS
2	IV, V	E, B	Added parts list for boosters and SD Boosters	12-11-2018	Bryson Simer	SS
2	III	C, D, E	Added available rams	12-11-2018	Bryson Simer	SS
2	VI	A, B, C	Added Hydraulic paths for regular bonnets and for shear bonnets with boosters.	12-11-2018	Bryson Simer	SS
3	III	A	Added Center of gravity	7-26-2019	Bryson Simer	SS
3	II	L	Added Op. Characteristics	7-26-2019	Bryson Simer	SS

NOTICE
This product is covered by U.S. Patent D700,681



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