HORN EQUIPMENT COMPANY, L.L.C.

WELL INTERVENTION EQUIPMENT

COIL TUBING HU

OPERATION MANUAL

www.hornequipment.com

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I. HORN CTHU OPERATIONS AND MAINTENANCE

Horn Equipment Company, LLC (HEC) Coil Tubing (CTHU) Well Intervention equipment is simple and proven effective at meeting the demanding pressure control requirements of today's well intervention 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 CTHU

Inspect the bore of the CTHU 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 CTHU 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 damaged threads. All studs and nuts should be torqued to the recommended torque when the CTHU is in use.

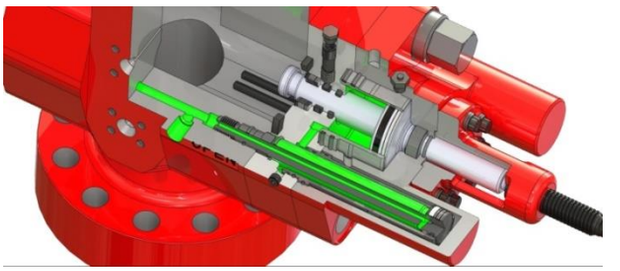

Figure 1: Open

Table 1: Stud Torques

Size	Torque (ft·lb)	Torque (N·m)
1-1/2" Stud	1530	2075
7/8" Stud	280	380

B. Open and Close Operations

CTHU 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 CTHU.

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

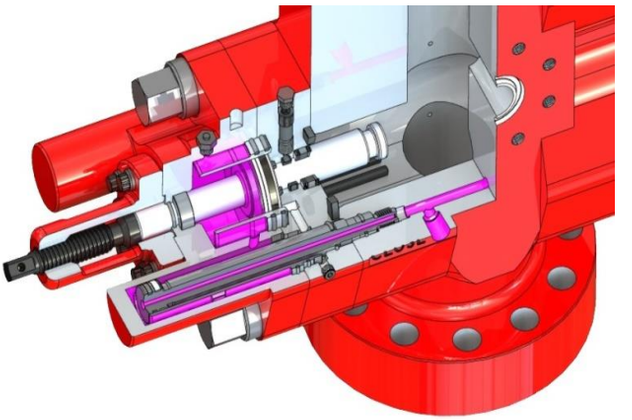

Figure 2: Closed – Locking Shaft Locked

Table 2: Hydraulic Connector Sizes

Description	Size	Location
Open Port	3/4" NPT	CTHU Body, Right Side
Close Port	3/4" NPT	CTHU Body, Left Side

C. Preventative Maintenance

All CTHU's 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 CTHU. To inspect operating parts, vent all hydraulic operating pressure before performing any maintenance on the CTHU.

CTHU should be operated at least once per week

D. Ram Types Available for CTHU

- Blind Rams: to seal off the well with no tubing
- Slip Rams: to grip tubing and hold it in place
- Pipe Rams: to seal around the tubing
- Shear and Seal Rams: to shear tubing and seal off the well
  - Shear bonnets and boosters required
  - See Operations Characteristics
- Non-Sealing Shear Rams: to shear tubing without the ability to seal
  - Shear bonnets and boosters required
  - See Operations Characteristics
- Sealing Slip Rams V2.0: Grip tubing and hold in place while sealing well bore pressure around tubing
  - See Operational Characteristics
- Slip Non-Sealing Rams V2.0: Grip tubing and hold in place inside of wellbore
  - See Operaional Characteristics

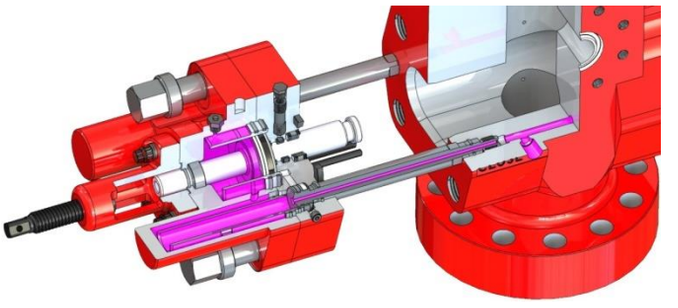

Figure 3: Closed (No Bonnent Bolts) – Open Bonnet for Inspection

E. Operating Capacity

Standard bonnet operating fluid data for the CTHU are listed in the table below. One set of rams, 2 ram blocks, is the total number of rams it takes to completely block a ram bore cavity. 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 3: CTHU Hydraulic Operating Capacaties

SIZE AND WORKING PRESSURE	GALLONS TO OPEN RAMS (1 SET)	GALLONS TO CLOSE RAMS (1 SET)	LOCKING SCREW TURNS (EACH END)	CLOSING RATIO	OPENING RATIO
5-1/8" 15M	.6	.6	13.5	7.9:1	3.5:1
5-1/8" 15M Tandem Shear Booster	.7	1.4	15.5	15.8:1	3.5:1
5-1/8" 15M Large Bore Tandem Shear Booster	1.1	1.8	15.5	20.8:1	5.2:1

F. Operating Fluids

CTHU's have 3/4" 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 that oil and antifreeze are added if water is used to prevent corrosion in the operating chambers.

G. Operating Pressures

The rated continuous working pressure is 1,500 psi. With maximum operator pressure up to 3000 psi, for shearing and slip rams. 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 CTHU, apply thread compound (anti-seize) to the threads and the torque shoulder of the bolt shown in figure 4 below. The recommended thread compound is BESTOLIFE SUPR COPR. The bolts can be applied using an air impact wrench, a hammer wrench, or a torque wrench. The torque values are listed in table 4 below. When installing bonnet bolts, follow the pattern shown in figure 5 below 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 torqueing bonnet bolts may cause damage to the bonnet bolts or to the CTHU body.

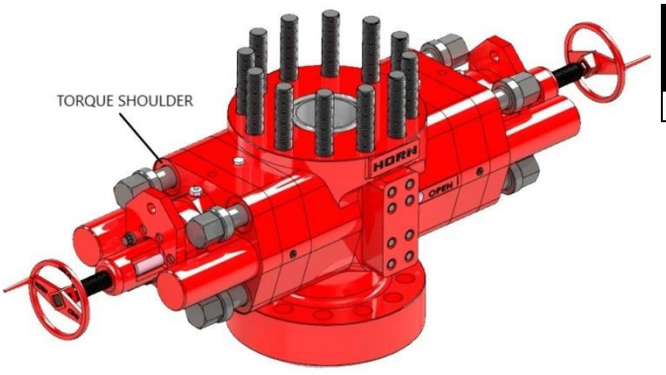

Figure 4: Torque Shoulder

Table 4: Bonnet Bolt Torque Values w/ BESTOLIFE SUPR COPR

Size	Pressure Rating (psi)	Thread 8UN	HEX ACROSS FLATS	Torque (ft·lb)	Torque (N·m)
5-1/8"	15,000	2"	2-3/8"	1125	1525

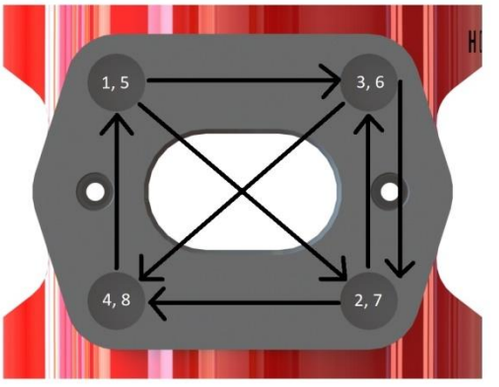

Figure 5: Torque Pattern

I. HORN CTHU OPERATIONS AND MAINTENANCE

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 4.
    b. Loosen the bonnet bolts until they are fully disengaged.
    c. Pull the bolts back by hand.
        i. Bolts can remain in the bonnets. (figure 7)
3. Open bonnets (figure 8)
    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 as seen in the figure 8.
    c. FOR THE SHEAR RAMS: Once the bonnet is fully open, pressure must be applied to the open side to move the operating piston back to allow enough room for the rams to be installed or removed.
4. Inspection (figure 9)
    a. Bonnet gasket and seal area.
        i. Inspect bonnet gasket groove on the intermediate flange for damage or debris.
        ii. Inspect gasket for damage (replace if damaged).
        iii. Inspect sealing surface on body where bonnet gasket seals for damage.
    b. Bonnet bolts
        i. Inspect bonnet bolt threads for damage or debris.
        ii. Inspect bonnet bolt holes on the CTHU body for damage or debris.
    c. Operating piston and ram change pistons for any damage to sealing 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 gasket
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.
9. Apply anti-seize to bonnet bolts (Recommended BESTOLIFE SUPR COPR)
    a. Bonnet bolts threads.
    b. Bonnet bolt holes in CTHU 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 CTHU 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 CTHU.
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.
            1. When using a torque wrench, bonnet bolts should be torqued to the values provided on Table 4.

Figure 6: Bonnets Closed

Figure 7: Bonnets Bolts Loosened

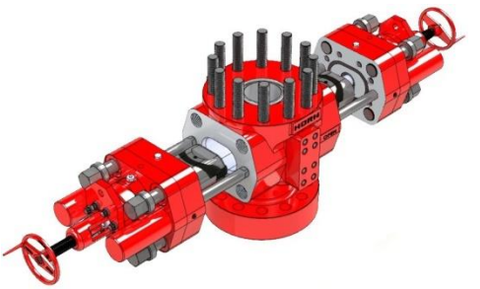

Figure 8: Bonnets Opened

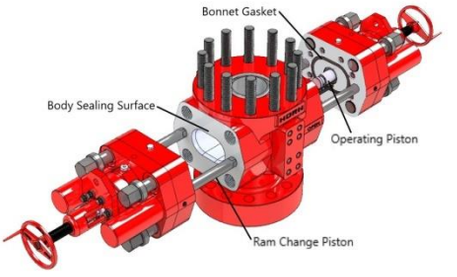

Figure 9: Inspection

J. Storage

1. Remove Rams from CTHU
    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 CTHU
2. Clean CTHU
    a. Wash the mud and dirt from the inside and outside of the CTHU
    b. Blow off the CTHU until the machined surfaces are dry
3. Apply grease to the ram bores
4. Install bonnet gaskets
5. Close the bonnet on the CTHU
    a. Apply hydraulic pressure until the bonnets are pulled back to the CTHU 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
6. Cover outlet holes with flange protectors
7. Relieve hydraulic pressure from both OPEN and CLOSE sides
    a. Remove hydraulic connectors and install 3/4” NPT plugs.

K. Packers and Seals

CTHU Ram Type Well Intervention Equipment uses an Acrylonitrile Butadiene Rubber (NBR) for the ram packers and top seals.

Temperature rating: 20°F to +200°F

L. Operational Characteristics Summary

- Slip/Seal Ram
    - Rated for up to 50,000 lbs. of hang off
    - Recommended hydraulic pressure for hang off: 3000 psi.
    - Locking screws locked
    - When testing Sealing Slip Rams use tubing test plug, **DO NOT TEST WITH SOLID TEST PLUG**.
- Shear and Seal Rams
    - Recommended hydraulic pressure for shearing tube: 3000 psi.
    - Shear bonnets and boosters must be installed to use shear rams
- CTHU temperature rating
    - 20°F to +200°F

II. HORN CTHU DIMENSIONS AND PARTS

A. CTHU Physical Description and Engineering Data

The following information applies to Coil Tubing Horn Unit Well Intervention Equipment. Standard specifications for single, double, and quad units are listed in the charts below. Any combination of studded top, studded bottom, flanged connection or side outlets is available upon request. No castings here – the CTHU is 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 open, Locking Screws Unlocked

C1-Height of Top Flange Face to Bottom Flange Face

C2-Height of Top Studded Face to Bottom Studded Face

C3-Height of Top Studded Face to Bottom Flanged Face

C4-Height of Top Flanged Face to Bottom Studded Face

D-Height of Side Outlet Center to Face on Double
(Corresponding # to Double Flange/Studded Face)

E- Height of Side Outlet Center to Face on Quad
(Corresponding # to Quad Flange/Studded Face)

F-Height of Ram Bore to Bottom Flange/Studded Face

G-Distance Between Ram Bores (Double & Quad ONLY)

H- Over-all length of Shear Bonnets closed, Locking Screws Unlocked

I- Over-all length of Shear Bonnets open, Locking Screws Unlocked

J-Width of Body with Equalizer Blocks

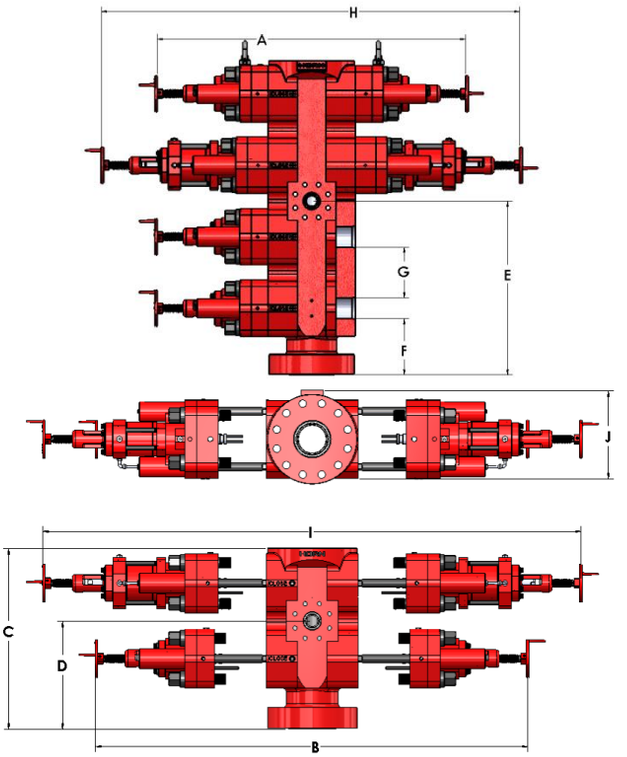

Figure 10: CTHU Drawings

Table 5: CTHU Dimensions

Bore Size (in.)	Number of Rams	Pressure Rating (psi)	A (in.)	B (in.)	C-1 (in.)	C-2 (in.)	C-3 (in.)	C-4 (in.)	D-1 (in.)	D-2 (in.)	E-1 (in.)	E-2 (in.)	F-1 (in.)	F-2 (in.)	G (in.)	H (in.)	I (in.)	J (in.)
5-1/8"	Single	15,000	60.50	79.75	25.875	12.875	19.375	19.375	-	-	-	-	10.938	4.438	-	81.5	99	14.50
5-1/8"	Double				39.75	26	33.25	33.25	20.875	14.375	-	-			9.875			14.50
5-1/8"	Quad				68.5	55.5	61	61	-	-	34.785	28.285			9.875			14.50

Table 6: CTHU 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.)
5-1/8"	Single	15,000	1,680*	1,350*	1,500*	1,500*
5-1/8"	Double	15,000	3,170*	2,730*	2,900*	2,900*
5-1/8"	Quad	15,000	5,810	5,170	5,640	5,640

*Add 190 lbs. if Shear Boosters are installed

II. HORN CTHU DIMENSIONS AND PARTS

B. CTHU Single Bonnet Parts

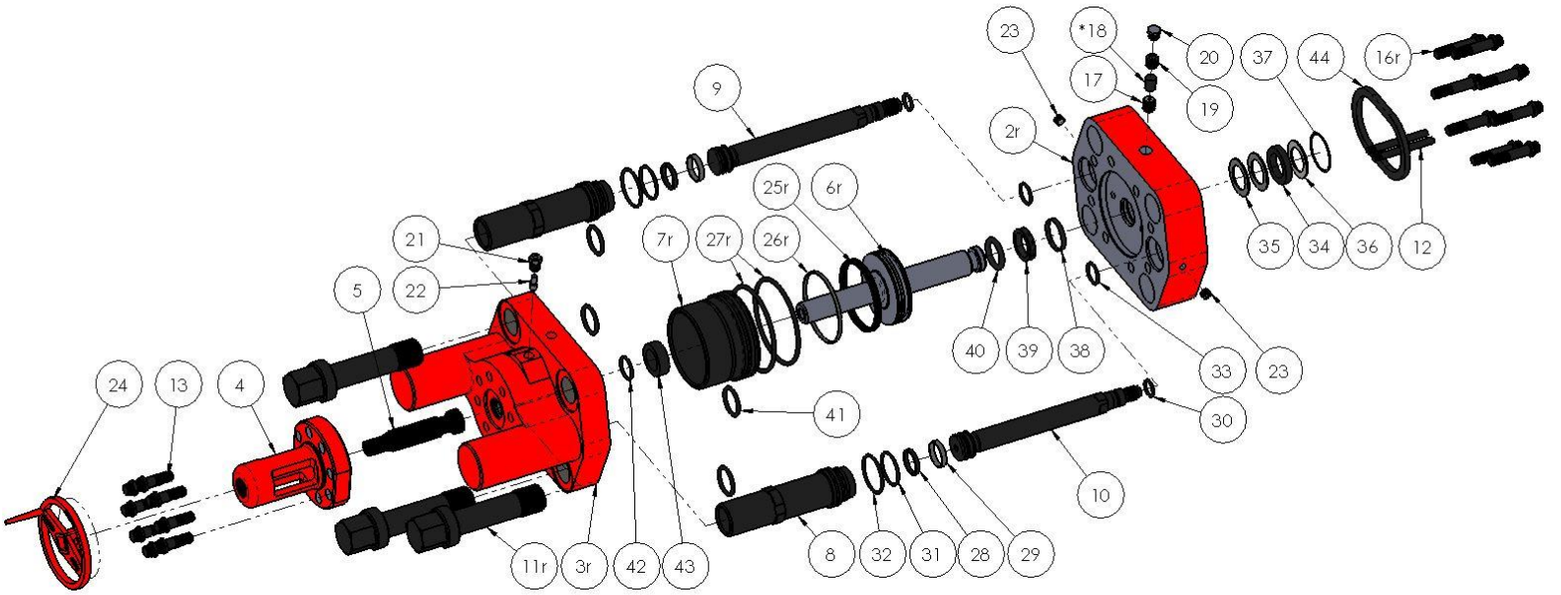

Figure 11: CTHU Single Bonnet

Table 7: CTHU Single Bonnet Parts List

ITEM #	PART #	QUANTITY	PART NAME
2r	03-0012	1	Intermediate Flange
3r	03-0013	1	Bonnet
4r	80-80004	1	Lock Screw Housing
5	50-5008	1	Lock Screw
6r	58-5818	1	Operating Piston
7r	57-5714	1	Operating Cylinder
8	56-5605	2	Ram Change Cylinder
9	49-4910	1	Ram Change Piston Open
10	49-4911	1	Ram Change Piston Close
11r	59-5914	4	Bonnet Bolts
12	00-0001-2	2	Ram Guide Pins
13	03-0022-11	8	Lock Screw Housing Cap Screws
16r	03-0022-12	8	Intermediate Flange Bolts
17	03-0021-0	1	Ball Check Valve
18*	03-0021-2	1	Plastic Packing
19	03-0021-1-1	1	Screw, Plastic Packing
20	03-0036	1	Pipe Plug
21	03-0002	1	Gland, Bleeder
22	03-0001	1	Plug, Bleeder
23	03-0036	2	NPT Plug
24	20777	1	Handwheel, Manual Lock

*plastic packing is not installed at the manufacturer.

Table 8: CTHU Single Bonnet Seals List

ITEM #	PART #	QUANTITY	PART NAME
25r	64-6461-3	1	Operating Piston Seal
26r	03-0022-6	1	Operating Piston Wear Band
27r	64-6451-1-1	2	Operating Cylinder Seal
28	64-6465	2	Ram Change Piston seal
29	03-0022-7	2	Ram Change Piston Wear Band
30	64-6403	2	Ram Change Rod Seal to Body
31	64-6411-0	2	Ram Change Cyl. seal to Int. Flg
32	64-6411-1-1	2	Ram Change Cyl. seal to Bonnet
33	64-6410	2	Ram Change Rod Seal to Int Flg
34	03-0022-2	1	Connecting Rod Seal (Mud Seal)
35	03-0022-3	2	Back-up Ring - Connecting Rod
36	03-0022-4	1	Washer - Connecting Rod
37	03-0022-5	1	Spirolox retainer ring
38	03-0022-9	1	Plastic Energizing Ring
39	03-0022-8	1	Plastic Packing Ring
40	64-6451-1-2	1	Operating Piston Hydraulic Seal
41	64-6411	4	Bonnet Bolt O-rings
42	64-6410-1	1	Tail Shaft Wiper O-ring
43	03-0022-10	1	Tail Shaft Seal
44	74-7408-1	1	Bonnet Gasket

NOTICE

3/8”-16-2” Bolt, Lock Nut, and Washer required to secure handwheel on to lock screw.

II. HORN CTHU DIMENSIONS AND PARTS

C. CTHU Single Shear Bonnet Parts

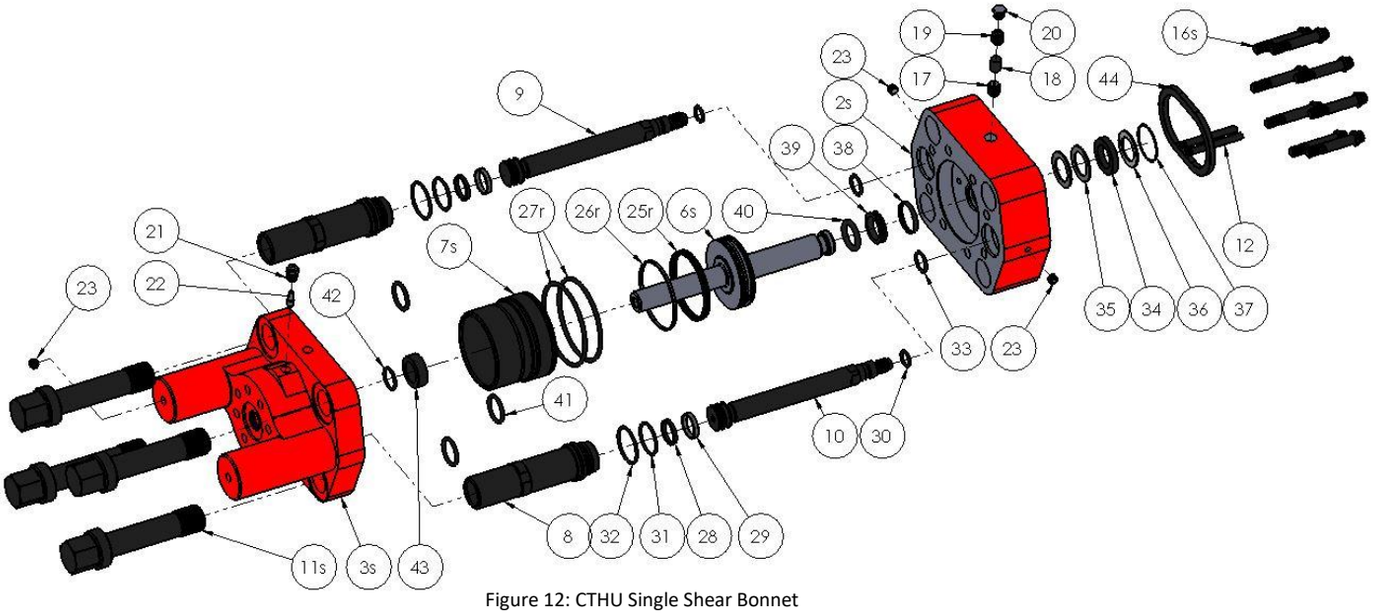

Figure 12: CTHU Single Shear Bonnet

Table 9: CTHU Single Shear Bonnet Parts List

ITEM #	PART #	QUANTITY	PART NAME
2s	03-0012-1	1	Intermediate Flange, Shear
3s	03-0013-1	1	Bonnet, Shear
6s	58-5818-1	1	Operating Piston, Shear
7s	57-5714-1	1	Operating Cylinder, Shear
8	56-5605	2	Ram Change Cylinder
9	49-4910	1	Ram Change Piston Open
10	49-4911	1	Ram Change Piston Close
11s	59-5914-1	4	Bonnet Bolts, Shear
12	00-0001-3	2	Ram Guide Pins, Shear
16s	03-0022-13	8	Intermediate Flange Bolts, Shear
17	03-0021-0	1	Ball Check Valve
18*	03-0021-2	1	Plastic Packing
19	03-0021-1-1	2	Screw, Plastic Packing
20	03-0036	1	Pipe Plug
21	03-0002	1	Gland, Bleeder
22	03-0001	1	Plug, Bleeder
23	03-0036	3	NPT Plug

*plastic packing is not installed at the manufacturer.

Table 10: CTHU Single Shear Bonnet Seals List

ITEM #	PART #	QUANTITY	PART NAME
25s	64-6461-3	1	Operating Piston Seal
26s	03-0022-6	1	Operating Piston Wear Band
27s	64-6451-1-1	2	Operating Cylinder Seal
28	64-6465	2	Ram Change Piston seal
29	03-0022-7	2	Ram Change Piston Wear Band
30	64-6403	2	Ram Change Rod Seal to Body
31	64-6411-0	2	Ram Change Cyl. seal to Int. Flg
32	64-6411-1-1	2	Ram Change Cyl. seal to Bonnet
33	64-6410	2	Ram Change Rod Seal to Int Flg
34	03-0022-2	1	Connecting Rod Seal (Mud Seal)
35	03-0022-3	2	Back-up Ring - Connecting Rod
36	03-0022-4	1	Washer - Connecting Rod
37	03-0022-5	1	Spirolox retainer ring
38	03-0022-9	1	Plastic Energizing Ring
39	03-0022-8	1	Plastic Packing Ring
40	64-6451-1-2	1	Operating Piston Hydraulic Seal
41	64-6411	4	Bonnet Bolt O-rings
42	64-6410-1	1	Tail Shaft Wiper O-ring
43	03-0022-10	1	Tail Shaft Seal
44	74-7408-1	1	Bonnet Gasket

NOTICE

Item #23, on the back of the bonnet, can be on either side of the bonnet. The plug is installed on the open side of the body. The other side will be connected to the shear booster through the booster manifold tube

II. HORN CTHU DIMENSIONS AND PARTS

D. CTHU Single Large Bore Shear Bonnet Parts

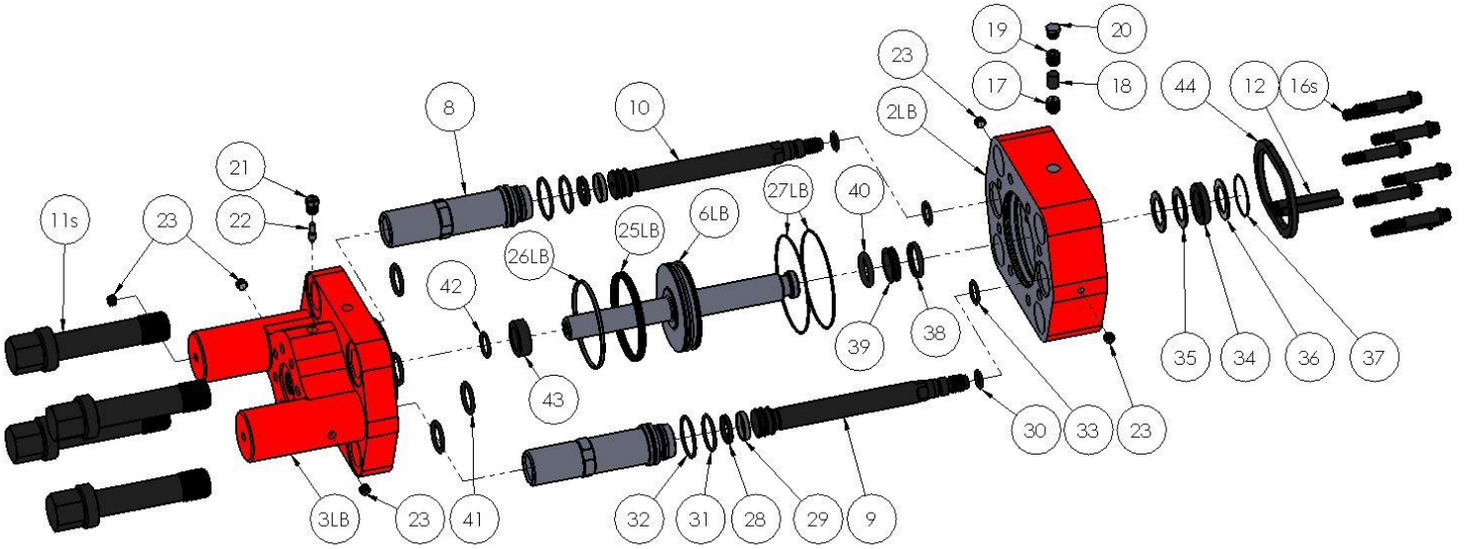

Figure 13: CTHU Single Large Bore Shear Bonnet

Table 11: CTHU Single LARGE BORE Shear Bonnet Parts List

ITEM #	PART #	QUANTITY	PART NAME
2LB	03-0012-2	1	Intermediate Flange, LB Shear
3LB	03-0013-1	1	Bonnet, LB Shear
6LB	58-5818-2	1	Operating Piston, LB Shear
8	56-5605	2	Ram Change Cylinder
9	49-4910	1	Ram Change Piston Open
10	49-4911	1	Ram Change Piston Close
11s	59-5914-1	4	Bonnet Bolts, Shear
12	00-0001-3	2	Ram Guide Pins, Shear
16s	03-0022-13	8	Int. Flange Bolts, Shear
17	03-0021-0	1	Ball Check Valve
18	03-0021-2	1	Plastic Packing
19	03-0021-1-1	2	Screw, Plastic Packing
20	03-0036	1	Pipe Plug
21	03-0002	1	Gland, Bleeder
22	03-0001	1	Plug, Bleeder
23	03-0036	5	NPT Plug

*plastic packing is not installed at the manufacturer.

Table 12: CTHU Single LARGE BORE Shear Bonnet Seals List

ITEM #	PART #	QUANTITY	PART NAME
25LB	64-6461-5	1	Oper. Piston Seal, Large Bore
26LB	03-0022-6-1	1	Oper. Piston Wear Band, Large Bore
27LB	64-6429-1	2	Operating Cylinder Seal, Large Bore
28	64-6465	2	Ram Change Piston seal
29	03-0022-7	2	Ram Change Piston Wear Band
30	64-6403	2	Ram Change Rod Seal to Body
31	64-6411-0	2	Ram Change Cyl. seal to Int. Flg
32	64-6411-1-1	2	Ram Change Cyl. seal to Bonnet
33	64-6410	2	Ram Change Rod Seal to Int Flg
34	03-0022-2	1	Connecting Rod Seal (Mud Seal)
35	03-0022-3	2	Back-up Ring - Connecting Rod
36	03-0022-4	1	Washer - Connecting Rod
37	03-0022-5	1	Spirolox retainer ring
38	03-0022-9	1	Plastic Energizing Ring
39	03-0022-8	1	Plastic Packing Ring
40	64-6451-1-2	1	Operating Piston Hydraulic Seal
41	64-6411	4	Bonnet Bolt O-rings
42	64-6410-1	1	Tail Shaft Wiper O-ring
43	03-0022-10	1	Tail Shaft Seal
44	74-7408-1	1	Bonnet Gasket

NOTICE

Item #23, on the back of the bonnet, can be on either side of the bonnet. The plug is installed on the open side of the body. The other side will be connected to the shear booster through the booster manifold tube

II. HORN CTHU DIMENSIONS AND PARTS

E. CTHU Single Shear Booster Parts

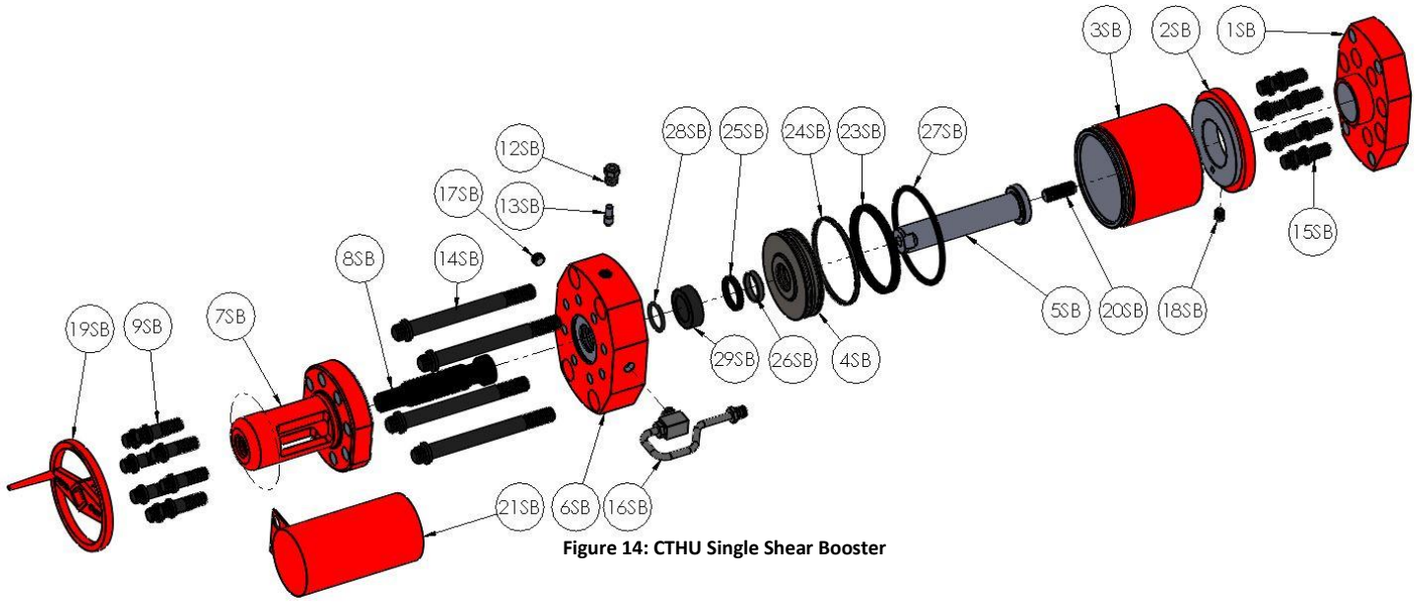

Figure 14: CTHU Single Shear Booster

Table 13: CTHU Single Shear Booster Parts List (Part No. 76-0000)

ITEM #	PART #	QUANTITY	PART NAME
1SB	76-0001	1	Booster Adapter Plate
2SB	76-0002	1	Booster Adapter Spacer
3SB	76-0003	1	Booster Operating Cylinder
4SB	76-0004	1	Booster Operating Piston
5SB	76-0005	1	Booster Tail Rod
6SB	76-0006	1	Booster Cylinder Head
7SB	80-80004	1	Lock Screw Housing
8SB	50-5008	1	Lock Screw
9SB	03-0022-11	8	Lock Screw Housing Cap Screws
12SB	03-0002	1	Gland, Bleeder
13SB	03-0001	1	Plug, Bleeder
14SB	76-0007	4	Bolts, Booster Cylinder Head
15SB	76-0008	8	Bolts, Booster Adapter Plate
16SB	76-1050	1	Booster Manifold Tube Assy.
17SB	03-0036	1	NPT Plug
18SB	03-0036	1	NPT Muffler
19SB	20777	1	Hand Wheel, Manual Lock
20SB	03-0036	1	Tail Rod Stud
21SB	76-0009	1	Booster Manifold Tube Cover

Table 14: CTHU Single Shear Booster Seals List

ITEM #	PART #	QUANTITY	PART NAME
23SB	64-6461-3	1	Oper. Piston Seal
24SB	03-0022-6	1	Oper. Piston Wear Band
25SB	64-6461-4	1	Piston I.D. Seal
26SB	03-0022-14	1	Piston I.D. Wear Band
27SB	64-6451-1-1-0	1	Operating Cylinder Seal
28SB	64-6410-1	1	Tail Shaft Wiper O-ring
29SB	03-0022-10	1	Tail Shaft Seal

NOTICE

Item's #16SB & 21SB are installed on the Close side of the Body for the booster to operate properly. Item #17SB will go the opposite side from the Manifold Tube.

NOTICE

3/8"-16-2" Bolt, Lock Nut, and Washer required to secure handwheel on to lock screw.

F. CTHU Bodies

Table 15: CTHU Bodies

ITEM #	PART #	PART NAME
1A	515SCTHU	5-1/8" 15M CTHU Single Body
1B	515DCTHU	5-1/8" 15M CTHU Double Body
1C	515QCTHU	5-1/8" 15M CTHU Quad Body

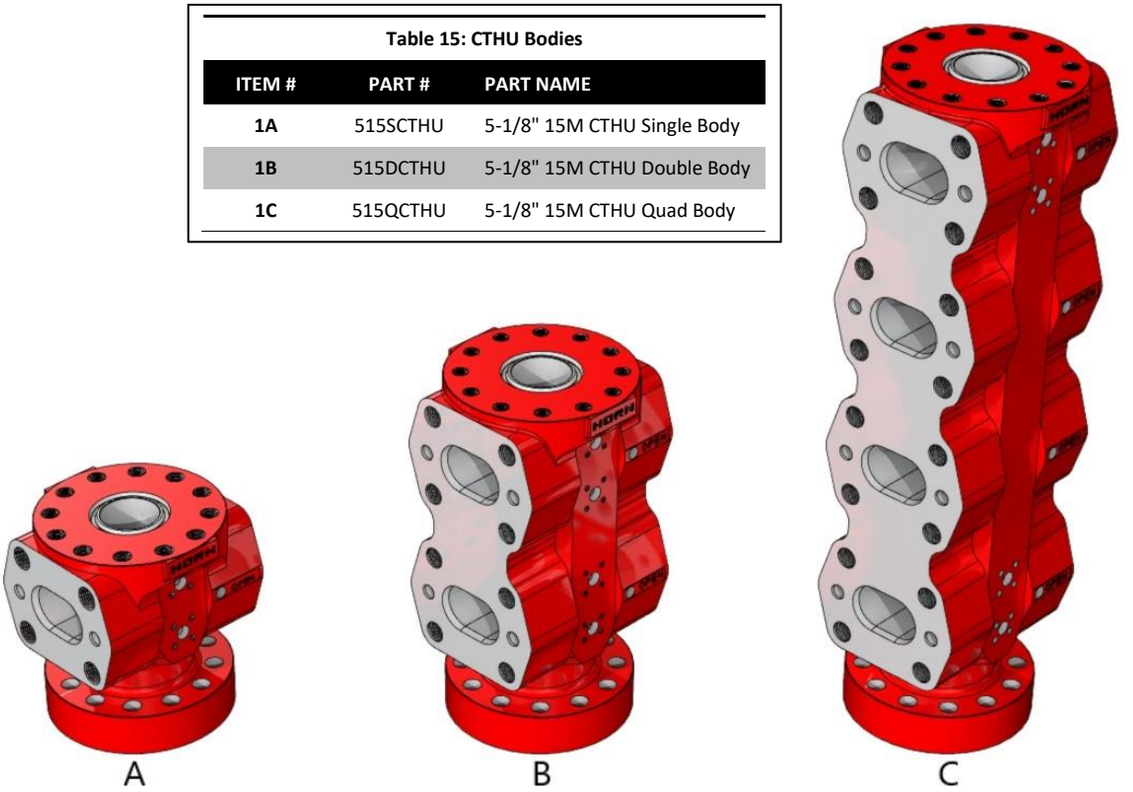

Figure 15: CTHU Bodies

NOTICE

5-1/8” 15M CTHU comes with a 2-1/16” 15M Outlet on the Close side of the body.

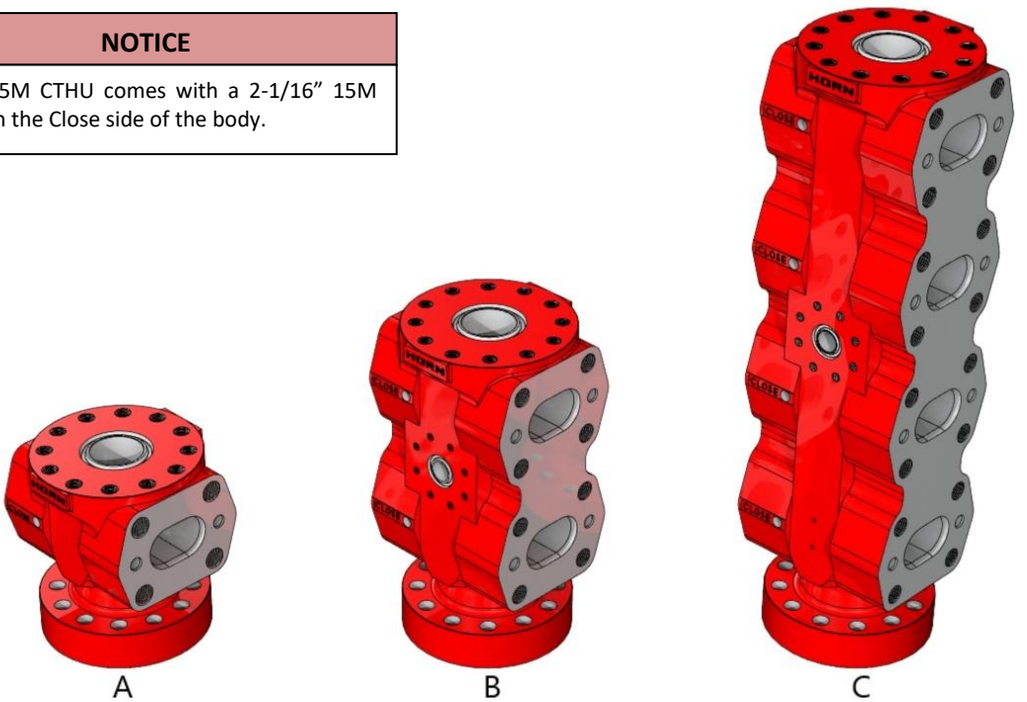

Figure 16: CTHU Bodies

II. HORN CTHU DIMENSIONS AND PARTS

G. CTHU Equalizing Block

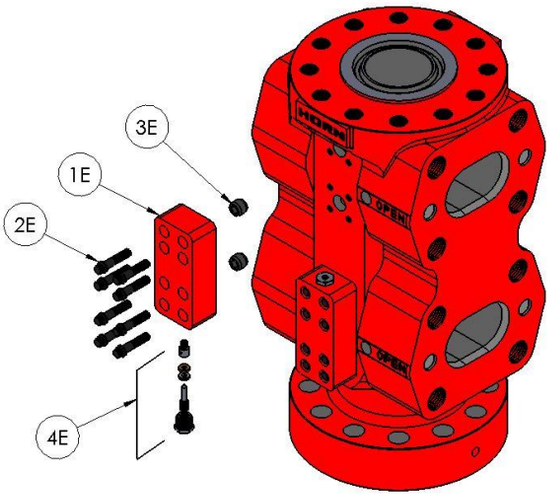

Figure 17: CTHU Equalizing Block

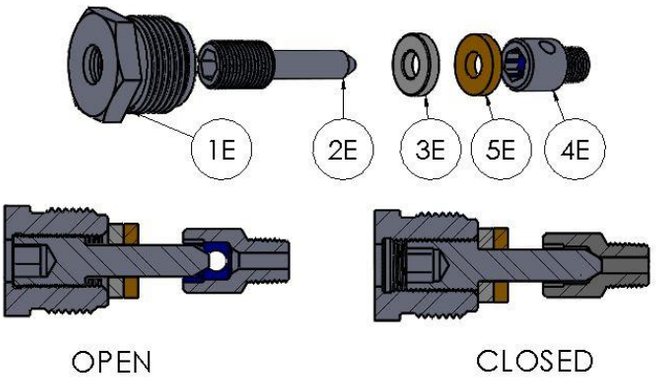

Figure 18: CTHU Equalizing Valve

Table 16: CTHU Equalizer Block

ITEM #	PART #	QUANTITY	PART NAME
1E	82-8208	1	Equalizer Block
2E	82-8209	8	Bolts, Equalizer Block
3E	82-8200	2	Equalizer Block Ring Gasket
4E	82-8207	1	Equalizer Valve Assy.

Table 17: CTHU Equalizer Block Valve

ITEM #	PART #	QUANTITY	PART NAME
1V	82-8201	1	Gland Nut
2V	82-8202	1	Stem
3V	82-8203	1	Backup Ring
4V	82-8204	1	Seat
5V	82-8205	1	Seal Ring

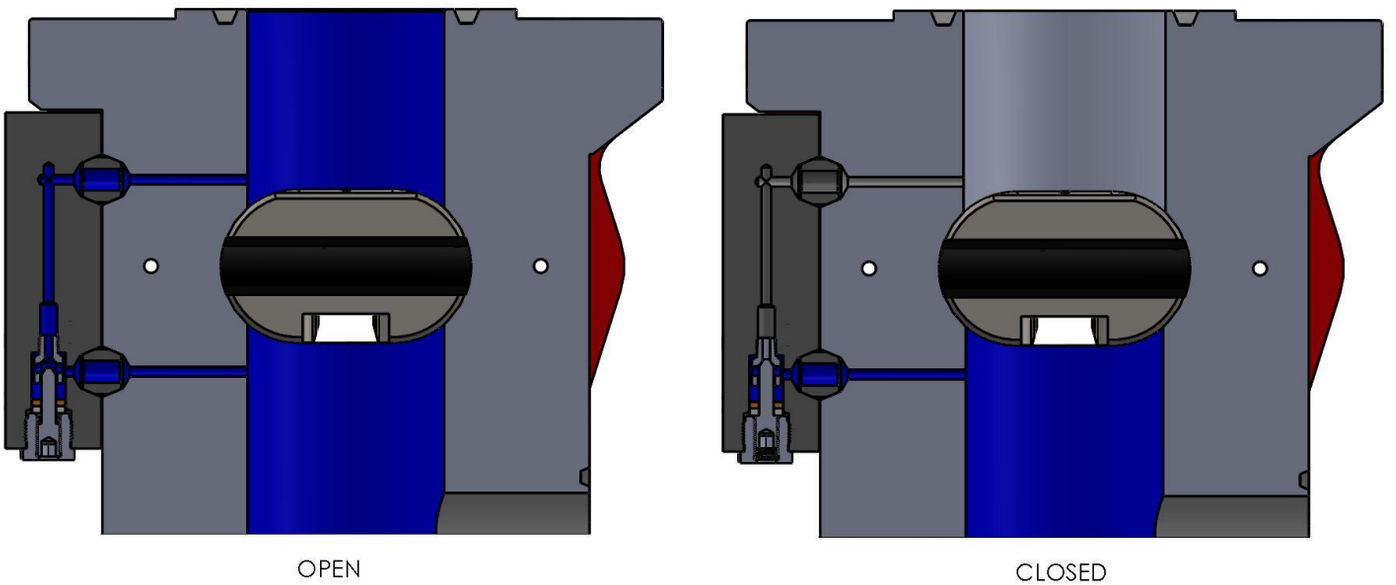

Figure 19: CTHU EQ Block Flow

III. HORN CTHU RAMS AND PACKERS

A. Blind Rams

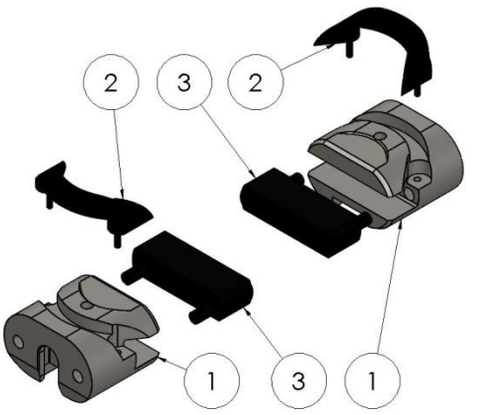

Figure 20: CTHU Blind Rams Exploded

Table 18: CTHU Blind Ram Parts

ITEM #	PART #	PART NAME	# Required for Set
1	06-0000	5-1/8" CTHU CSO Ram Block	2
2	36-0008	5-1/8" CTHU Top Seal	2
3	36-0000	5-1/8" CTHU CSO Front Packer	2

B. Shear & Seal Rams

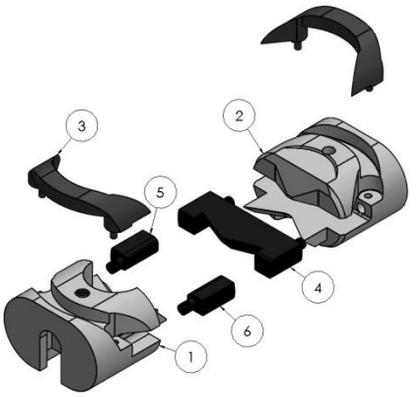

Figure 21: CTHU Shear & Seal Rams Exploded

Table 19: CTHU Shear & Seal Ram Parts

ITEM #	PART #	PART NAME	# Required for Set
1	06-0009U	5 1/8" CTHU Shear & Seal Ram Upper	1
2	06-0009L	5 1/8" CTHU Shear & Seal Ram Lower	1
3	35-3463	5-1/8" CTHU Shear Top Seal	2
4	35-3460	5-1/8" CTHU Shear Front Packer	1
5	35-3461	5-1/8" CTHU Shear Left Pad Packer	1
6	35-3462	5-1/8" CTHU Shear Right Pad Packer	1

Note: Shear and Seal rams can be used as just Shear rams. For just shear rams item# 4, 5, and 6 are not needed.

C. Non-Sealing Shear Rams

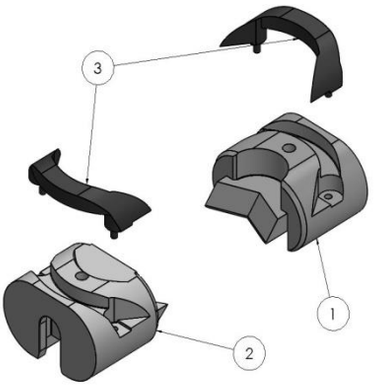

Figure 22: CTHU Non-Sealing Shear Rams Exploded

Table 20: CTHU Non-Sealing Shear Rams Parts

ITEM #	PART #	PART NAME	# Required for Set
1	06-0008U	5-1/8" CTHU Non-Sealing Shear Ram Upper	1
2	06-0008L	5-1/8" CTHU Non-Sealing Shear Ram Lower	1
3	35-3463	5-1/8" CTHU Shear Top Seal	2

D. Pipe Rams

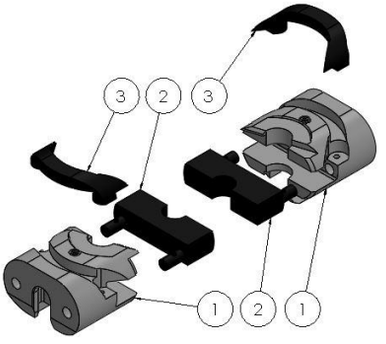

Figure 23: CTHU Pipe Rams Exploded

Table 21: CTHU Pipe Ram Parts

ITEM #	PART #	PART NAME	# Required for Set
1a	06-0003	5-1/8" CTHU Pipe Ram Block 2"	2
1b	06-0004	5-1/8" CTHU Pipe Ram Block 2-3/8"	2
1c	06-0005	5-1/8" CTHU Pipe Ram Block 2-5/8"	2
1d	06-0006	5-1/8" CTHU Pipe Ram Block 2-7/8"	2
2a	36-0003	5-1/8" CTHU Pipe Ram Packer 2"	2
2b	36-0004	5-1/8" CTHU Pipe Ram Packer 2-3/8"	2
2c	36-0005	5-1/8" CTHU Pipe Ram Packer 2-5/8"	2
2d	36-0006	5-1/8" CTHU Pipe Ram Packer 2-7/8"	2
3	36-0008	5-1/8" CTHU Top Seal	2

E. Sealing Slip Rams V2.0

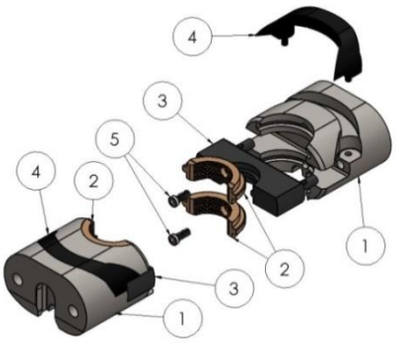

Figure 24: CTHU Sealing Slip Rams V2.0 Exploded

NOTICE

When testing Sealing Slip Rams use tubing test plug, **DO NOT TEST WITH SOLID TEST PLUG.**

Table 22: CTHU Sealing Slip Rams V2.0

ITEM #	PART #	PART NAME	# Required per set
1	06-0013	5-1/8" CTHU Sealing Slip Ram V2.0 Block	2
2a	06-0014	5-1/8" CTHU Sealing Slip Ram V2.0 Insert 2"	4
2b	06-0015	5-1/8" CTHU Sealing Slip Ram V2.0 Insert 2-3/8"	4
2c	06-0016	5-1/8" CTHU Sealing Slip Ram V2.0 Insert 2-5/8"	4
2d	06-0017	5-1/8" CTHU Sealing Slip Ram V2.0 Insert 2-7/8"	4
3a	36-0010	5-1/8" CTHU Sealing Slip Ram V2.0 Packer 2"	2
3b	36-0011	5-1/8" CTHU Sealing Slip Ram V2.0 Packer 2-3/8"	2
3c	36-0012	5-1/8" CTHU Sealing Slip Ram V2.0 Packer 2-5/8"	2
3d	36-0013	5-1/8" CTHU Sealing Slip Ram V2.0 Packer 2-7/8	2
4	36-0008	5-1/8" CTHU Top Seal	2
5	06-0018	5-1/8" CTHU Slip Ram V2.0 Insert Retaining Screw	4

F. Slip Non-Sealing Rams V2.0

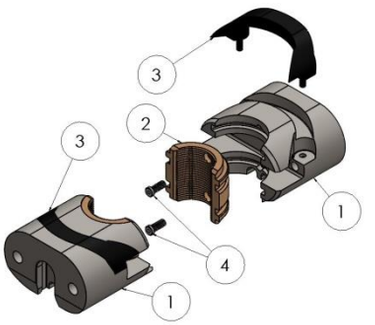

Figure 25: CTHU Slip Non-Sealing Rams V2.0 Exploded

Table 23: CTHU Slip Non-Sealing Ram V2.0 Parts

ITEM #	PART #	PART NAME	# Required for Set
1	06-0013	5-1/8" CTHU Slip Non-Sealing Ram V2.0 Block	2
2a	06-0020	5-1/8" CTHU Slip Non-Sealing Ram V2.0 Insert 2"	2
2b	06-0021	5-1/8" CTHU Slip Non-Sealing Ram V2.0 Insert 2-3/8"	2
2c	06-0022	5-1/8" CTHU Slip Non-Sealing Ram V2.0 Insert 2-5/8"	2
2d	06-0023	5-1/8" CTHU Slip Non-Sealing Ram V2.0 Insert 2-7/8"	2
3	36-0008	5-1/8" CTHU Top Seal	2
4	06-0018	5-1/8" CTHU Slip Ram V2.0 Insert Retaining Screw	4

IV. HORN CTHU HYDRAULIC FLOW

A. CTHU 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

CLOSE HYDRAULICS

OPEN HYDRAULICS

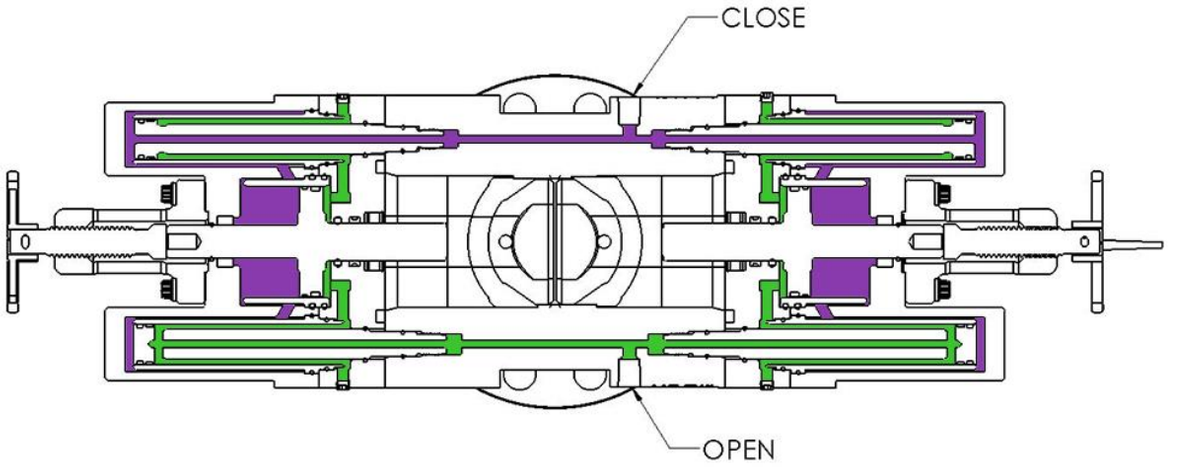

Figure 27: CTHU Hydraulics Close Rams Path

Opening Rams:

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

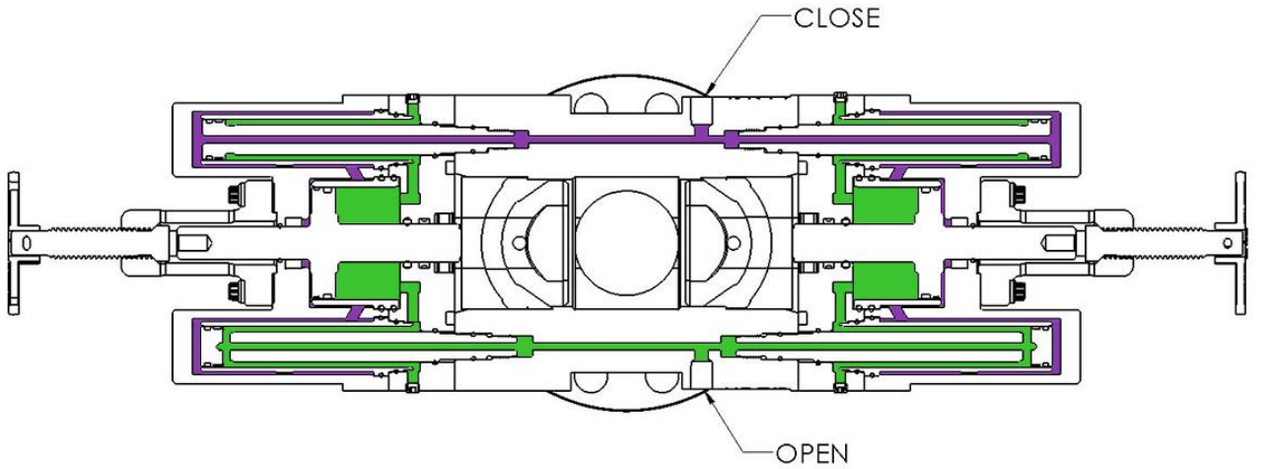

Figure 28: CTHU Hydraulics Open Rams Path

IV. HORN CTHU HYDRAULIC FLOW

B. CTHU Hydraulic Diagrams For Open/Close Bonnets

CLOSE HYDRAULICS

OPEN HYDRAULICS

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)

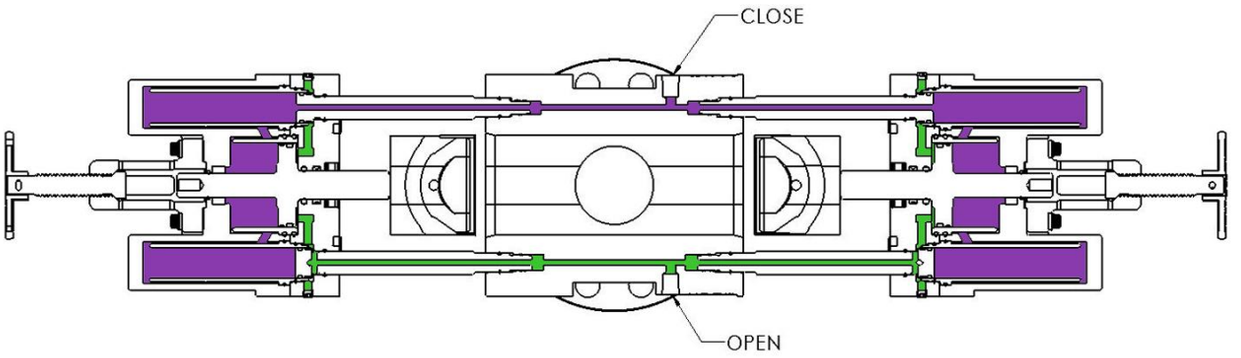

Figure 29: CTHU Hydraulics Opening Bonnets Hydraulic Path

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.

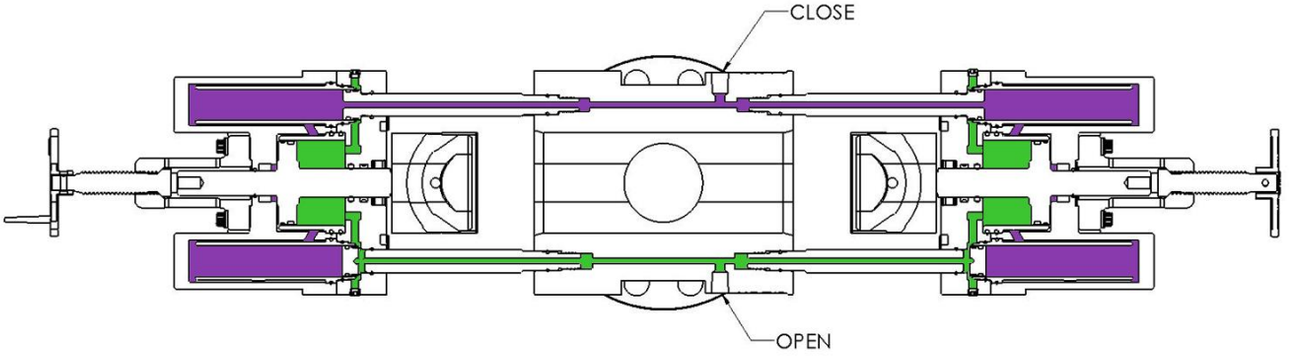

Figure 30: CTHU Hydraulics Closing Bonnets Hydraulic Path

IV. HORN CTHU HYDRAULIC FLOW

C. CTHU Booster Hydraulic Diagrams For Open/Close

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.

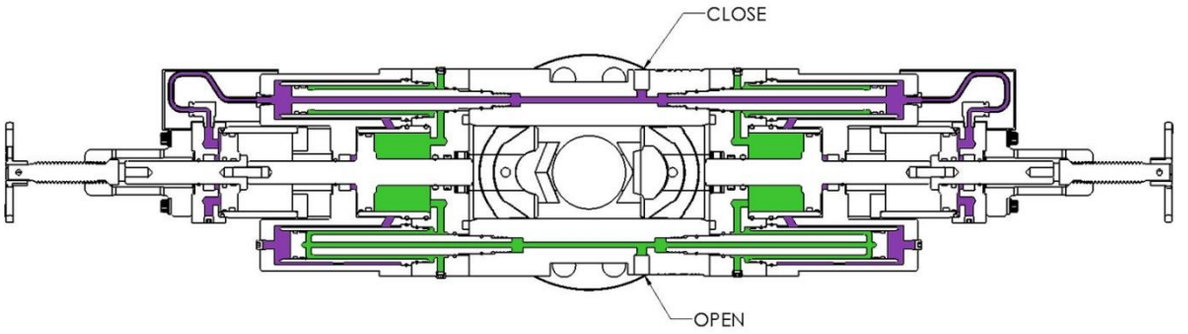

Figure 31: CTHU Booster Hydraulics Open Path

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 held on the close port

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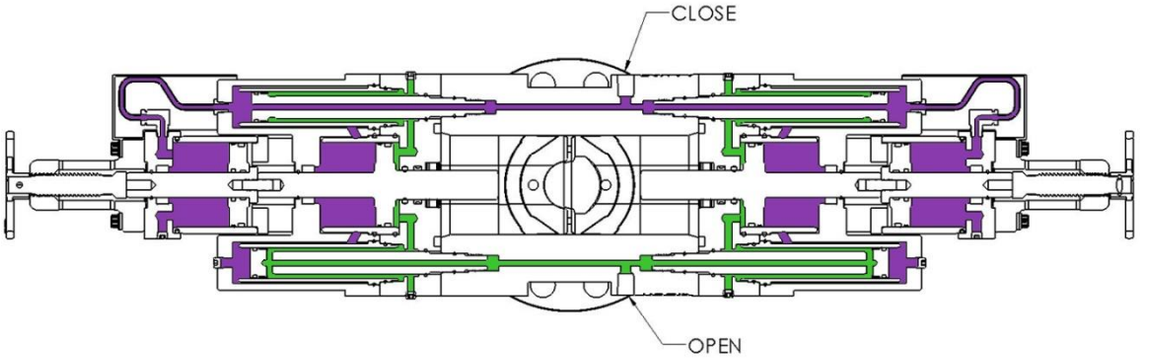

Figure 32: CTHU Booster Hydraulics Close Path

V. REVISIONS

REVISION	SECTION	SUB-SEC	CHANGE	DATE	Completed By:	Review by:
1	II	K	Added Sealing Slip Rams V2.0 parts list	2-18-2019	Bryson Simer	KH, SS, & DB
	II	F	Updated Eq. Block Valve Exploded view	2-18-2019	Bryson Simer	KH, SS, & DB
	I	E	Updated Gallons to open and close, and added tandem boosters	3-6-2019	Bryson Simer	KH, SS, & DB
	IV	A, B, C	Added hydraulic flow	3-8-2019	Bryson Simer	KH, SS, & DB
	III	A-G	Added "# Required for Set" to tables for rams	3-12-2019	Bryson Simer	KH, SS, & DB
	II	D	Added Large Bore Bonnets	3-25-2019	Bryson Simer	SS
	II	A-G	Redid item #'s to match up with HU manual.	4-18-2019	Bryson Simer	SS
2	III	F	Removed Slip and Seal Rams and replaced with Slip Non-Sealing Rams V2.0	6-25-2020	Bryson Simer	SS
	I	D	Removed Slip and Seal Rams and added Slip Non-Sealing V2.0 and Shear Non-Sealing Rams.	6-25-2020	Bryson Simer	SS
	III	B	Changed Part Names for Shear and Seal Rams to make uniform with other part names	6-25-2020	Bryson Simer	SS

NOTICE

This product is covered by U.S. Patent 10,689,937

V. TERMS AND CONDITIONS

Prices, Taxes and Payment. The price for the product manufactured, remanufactured or tested (collectively referred to as "Equipment" or "Work") by Horn Equipment ("HEC") is that reflected in the Purchase Order. All prices shown are in U.S. dollars and are F.O.B. HEC's shipping point. Any tax or other charges imposed by law on the sale or production of goods or the performance of services shall be paid by the Buyer, unless the law specifically provides that such payment must be made by HEC, in which case Buyer shall reimburse HEC for such payment as part of the purchase price. Custom duties, consular fees, insurance charges and other comparable charges will be borne by Buyer. HEC reserves the right to place a service charge on past due accounts at the highest rate permitted by law. Terms of payment are thirty (30) days from date of invoice unless otherwise stated in the quotation of HEC's order acknowledgment.

Warranty of Work. HEC Warrants to Buyer (and no other person or entity) its materials and workmanship for 12 months from the date of completion of the Work Order if the product manufactured is used in the manner it was intended, within the pressure range for which it was manufactured and is properly maintained. HEC warrants its materials and workmanship on remanufactured products for 12 months from the date of completion of the Work Order. Liability pertaining to products or parts not wholly of HEC's manufacture shall be limited to the extent of HEC's recovery from the manufacturer of such products or parts under its liability to HEC. Buyer's exclusive remedies for damages, failure to perform, or breach of this Work Order or warranty claim shall be (i) correction of same by retesting, adjustment or repair, at HEC's option, or (ii) refund of the amount paid by Buyer for that portion alleged to be defective not to exceed the total amount paid HEC for the Product or Work. HEC has no liability for Buyer's removal or reinstallation of products or equipment or for labor costs, expenses resulting of defects, recovery under general tort law or strict liability or for damages resulting from delays, loss of use, or other direct, indirect or consequential damages of any kind. THIS LIMITED WARRANTY AND REMEDY IS EXCLUSIVE AND IS IN LIEU OF ALL OTHER REMEDIES AND WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY, WORKMANSHIP OR FITNESS FOR ANY PARTICULAR PURPOSE, ALL OF WHICH ARE HEREBY DENIED BY HEC AND WAIVED BY BUYER, EXCEPT AS EXPRESSLY SET FORTH IN THIS AUTHORIZATION. Buyer acknowledges and agrees that HEC is only responsible for the specific services agreed upon in the Work Order, and HEC SHALL NOT BE LIABLE FOR ANY CONDITIONS, CONTAMINANTS OR INDEPENDENT SOURCES THAT IN THE OPINION OF HEC HAVE AFFECTED THE PRODUCT OR WORK PERFORMED. HEC shall not be responsible for any undisclosed conditions or contaminants to which the Product has been exposed, including any defective, pre-existing, concealed, hidden or not visible conditions, and Buyer shall notify HEC before it begins any work of any knowledge or information that may assist HEC in the performance of services. This warranty shall terminate and be of no further force or effect in the event Buyer or any person or entity other than HEC attempts or undertakes to remedy any of the Work performed by HEC that is claimed to be not as warranted or represented without first giving HEC written notice at of such claim and a reasonable opportunity to correct same.

Engineering and Service. Upon request, HEC will provide engineering and/or technical information regarding its products and uses and, if leasable, will provide personnel to assist Buyer in effecting field installations and/or field service. Any such information, service or assistance so provided, whether with or without charge, shall be advisory only.

Dispute Resolution. Any controversy arising or relating to this Lease shall be settled by arbitration in accordance with the rules of the Oklahoma Revised Uniform Arbitration Act, and judgment on the award rendered by the arbitrator(s) may be entered in any court having jurisdiction. Arbitration shall be held in Cleveland County, State of Oklahoma, and any question of law shall be decided in accordance with the laws of Oklahoma. Any language herein deemed invalid shall not affect any other clause, provision or paragraph herein.

Certificate of Completion. Buyer agrees to specify the Work it desires to have HEC perform in the Work Order and to inspect the Product or Work upon HEC's completion. Buyer agrees to notify HEC in writing of any clam, damage, defects, deficiencies, or failures in performance within 30 days of the event giving rise to the claim, damage, defects, deficiencies, or failures. To the extent they may validly do so, the parties agree that the Work will be deemed to be fully accepted without defect if no notice as required herein is received by HEC within 12 months of the completion of Work.

Final Inspection, Delivery and Acceptance. Inspection and acceptance of Product or Work must be made at HEC's plant or other shipping or receiving point designated by HEC and shall be conclusive except as regards latent defects. Delivery shall be in acceptance with the requirements in the Work Order, provided, in the event Buyer is unable to accept delivery upon completion of the Work in accordance with such requirements, Buyer agrees that (i) title and risk of ownership shall pass to Buyer on date of HEC's invoice, and (ii) Buyer will make payments within thirty (30) days after date of such invoice. HEC shall retain custodial risk of loss until delivery is made in accordance with such requirements. Shipment schedules are given as accurately as conditions permit and every effort will be made to make shipments as scheduled. HEC will not be responsible for deviations in meeting shipping schedules nor for any losses or damages to Buyer (or any third party) occasioned by deviations in the shipping schedule, whether due to Acts of God, orders bearing priority ratings established pursuant to law, fire, flood, shortages or failure of raw materials, supplies, fuel, power or transportation, breakdown of equipment or any other cause beyond HEC's reasonable control whether of similar or dissimilar nature than those enumerated. HEC shall have additional time within which to perform as may be reasonably necessary under the circumstances and shall have the right to apportion its production among its Buyers in such a manner as it may consider to be equitable. HEC reserves the right to furnish commercially equivalent or better substitutes for materials or to subcontract the Buyer's order or portions thereof as HEC deems necessary. In no event shall HEC be liable for any consequential damages resulting from failure or delay in shipment. If Buyer requires drawings, procedures, standards, or similar material for approval, shipping schedules are based on HEC having all required information and a firm order from Buyer which is enterable into production. Any hold points, witness points or the need for inspection by Buyer's representatives must be identified by Buyer at the time of quotation (if any) and/or placement in order that the effect on the prices or shipping schedules (if any) can be taken into account. Additional inspection or testing required by Buyer which affects normal production sequence will be considered as extending the shipping dates accordingly.

Limitation of Liability. Buyer acknowledges that it is the Buyer's responsibility to maintain the product manufactured, remanufactured or tested by HEC in accordance with the industry standards including but not limited to function testing of the Product. Buyer acknowledges that in the event any defect or damage occurs from Buyer's use of the product serviced by HEC, Buyer holds HEC harmless for any and all failures and agrees to indemnify HEC against claims by third parties for damages that are not resulting from the acts or negligence of HEC. Buyer agrees to hold HEC harmless from and against all claims, demands, losses, damages and causes of action of whatever kind or nature for loss of or damage to property arising from or attributable to the negligence of Buyer. Buyer agrees to hold HEC harmless from and against all claims, demands, losses, damages and causes of action of whatever kind of nature for the death(s) of or personal injury(ies) arising from or attributable to the negligence of Buyer. Buyer shall hold HEC harmless from and against all claims (including clean-up costs and loss(es) of oil, gas or hydrocarbons) arising from pollution, contamination, dumping or spilling of any substance resulting from the negligence of Buyer. HEC's total responsibility, if any, for any claims, damages, losses or liability arising out of or related to its performance of the Work Order or the Work covered hereunder shall not exceed the purchase price.

Indemnity. IN NO EVENT SHALL HEC, ITS OFFICERS, AGENTS, OWNERS, REPRESENTATIVES OR EMPLOYEES BE LIABLE UNDER ANY THEORY OR REMEDY (CONTRACT, IMPLIED WARRANTY, TORT, NEGLIGENCE, STRICT LIABILITY, OR OTHER LEGAL OR EQUITABLE THEORY) FOR ANY PUNITIVE, ANTICIPATED OR LOST PROFITS, DELAYS, LOSS OF USE, LOSS OF BUSINESS OPPORTUNITY, OR DIRECT, INDIRECT, INCIDENTAL OR CONSEQUENTIAL LOSS, DAMAGES OR EXPENSE OF ANY KIND. HEC is not responsible for failures or damages resulting from Buyer's alteration, lack of proper maintenance or lack of compliance with recommended maintenance procedures, or which in HEC's judgment affect the Product. As a condition to bringing suit to enforce HEC's obligations hereunder, Buyer must give HEC written notice or any breach or failure of HEC within 30 days of its discovery. ALL INDEMNITY OBLIGATIONS AND/OR LIABILITIES HEREBY ASSUMED BY THE PARTIES SHALL BE: (I) SUPPORTED BY INSURANCE; (II) WITHOUT LIMIT; (III) AND WITHOUT REGARD TO THE CAUSE OR CAUSES THEREOF, INCLUDING, BUT NOT LIMITED TO, PREEXISITING CONDITIONS (WHETHER SUCH CONDITIONS BE PATENT OR LATENT).

H_2S Disclosure. Buyer has disclosed to HEC all exposures of the Product serviced by HEC to H_2S and understands the following: Carbon and low alloy steels and cast irons selected using NACE 15156-2 P1 are resistant to cracking under "defined" H_2S conditions containing environments in oil and gas production but not necessarily immune to cracking under all sure conditions. Lab testing can only approximate field source conditions. HEC can only issue a limited certificate of compliance if the complete H_2S history of the equipment cannot be or is not disclosed.

NOTES:

NOTES:

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