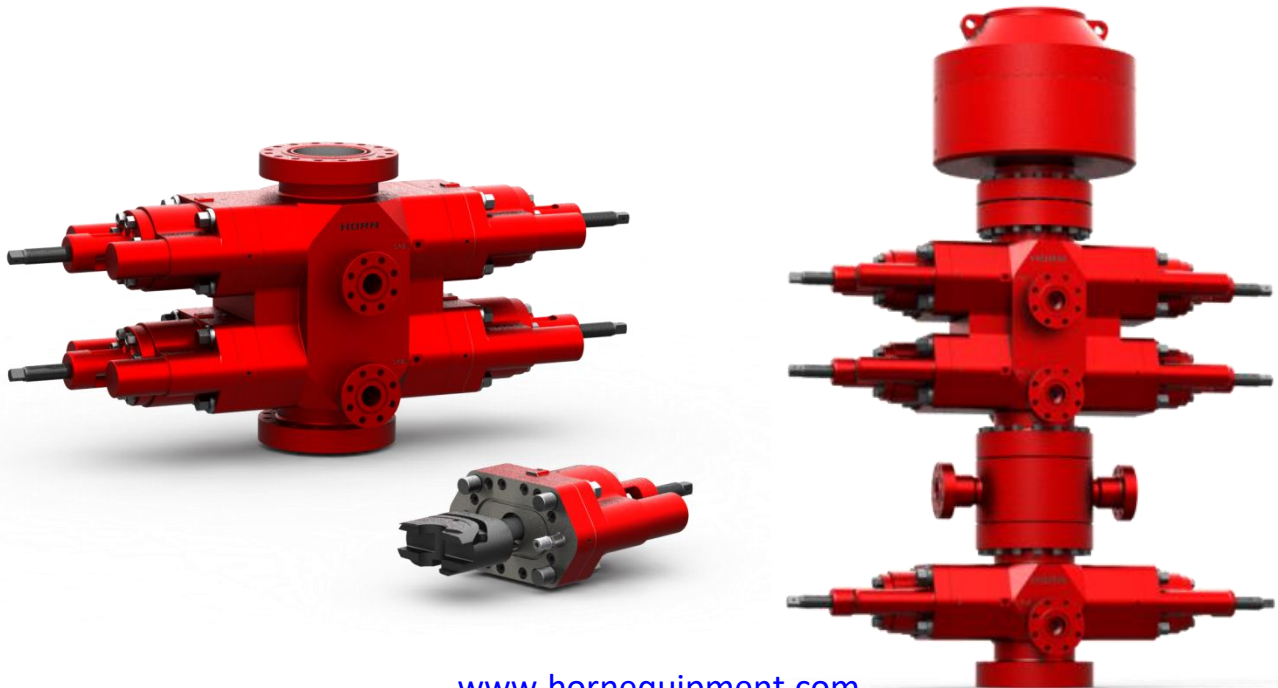




TYPE HA BLOWOUT PREVENTERS

OPERATING MANUAL



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HA OPERATION AND MAINTENANCE



HEC HA Blowout Preventers are simple to operate and proven effective at meeting the demanding pressure control requirements of today's drilling industry. It is highly recommended to perform periodic inspections of rubber, seals, and over-all integrity of the blowout preventer to reduce the risk of problems in a well control situation.

INSTALLATION INSPECTION and INSTALL RECOMMENDATIONS

It is recommended to install the HA blowout preventer using:

1. A control line to the closing (lower) port
2. A control line to the opening (upper) port
3. An accumulator bottle in the closing line for stripping. This bottle should be pre-charged to 500 psi for surface applications and 500 psi plus 45 psi per 100' of depth for sub-sea applications
4. A hydraulic regulator to allow adjustment of operating pressure
5. Hydraulic operating fluid should have a viscosity between 200 and 300 SUS @ 100°F or an water soluble oil/water mix is acceptable

Inspect for any damage to the top and bottom ring grooves. Clean the ring grooves with emery cloth and lightly oil prior to placing ring gaskets into place. ALWAYS replace ring gaskets when preventer is removed from a job site and reinstalled. Inspect studs and nuts for any damage. Replace any stud that is shorter than required to maintain full thread engagement or has thread damage. Inspect all studs and nuts for tightness when the preventer is in use.

Prolonged intervals of non-operation and no lubrication will cause seals to freeze up and possibly break or lock up the preventer.

OPEN and CLOSE OPERATIONS

HEC HA models are designed to operate with any 1,500 psi approved hydraulic oil field system. A HA blowout preventer must be operated using hydraulic pressure. All models available from HEC can close and seal with no pressure adjustments on various casing sizes using 1,500 psi except the 13-5/8" 3,000 and 5,000 psi models. On 13-5/8" 3,000 and 5,000 psi models, it is recommended to use the table below for pressure adjustments when closing on the listed casing sizes to prevent damage to casing from sealing element segments making contact with casing.

Table 7: 13-5/8" HA Hydraulic Adjustment Pressures

13-5/8"	Adjusted psi	Casing Size (inches)					
		7	7-5/8	8-5/8	9-5/8	10-3/4	11-3/8
		1,500	1,255	890	615	415	280

When hydraulic pressure is pumped into the closing chamber, the piston rises, forcing the element up. The spherical shape causes the element to close as it moves upward. Steel segments in the rubber support both the rubber and the drill string by containing the pressure below and providing a seal around the pipe.

When there is no drill string present, the piston will continue to rise which forces the rubber element to seal on an open bore. The steel segments inside the element further aid in providing support to contain the well bore pressure.

STRIPPING

Stripping operations are one of the most severe applications for any preventer because of the extreme stress the rubber element is exposed to when the drill string is moved through the preventer. A HA blowout preventer can offer a long stripping life if maintained and operated properly. Only the top portion of the HEC HA's rubber sealing element contacts the drill Kelly or string. The large reservoir of rubber allows the user to strip in and out of deep hole without replacing the element on the job site.

The Recommended procedure for stripping is:

1. Close the preventer with a maximum of 1,500 psi closing pressure unless otherwise recommended from the above table
2. Prior to initializing the stripping operation, reduce the closing pressure to a value sufficient to allow a slight leak
3. Stripping should be done with a slight leak to provide lubrication and prevent excessive temperature buildup if conditions allow. As the sealing element wears, the closing pressure will need to be increased to prevent excessive leakage
4. If conditions do not allow leakage during stripping operations, closing pressure should be adjusted to a value sufficient to maintain a seal
5. If closing pressures approach 1,500 psi on the hydraulic close line, consideration should be given to switch to a different preventer or new sealing element as the rubber may be worn and could cause further damage to the valve. Keep in mind, the minimum pressure required to maintain a seal during stripping, may vary depending on the sealing element and its service history.

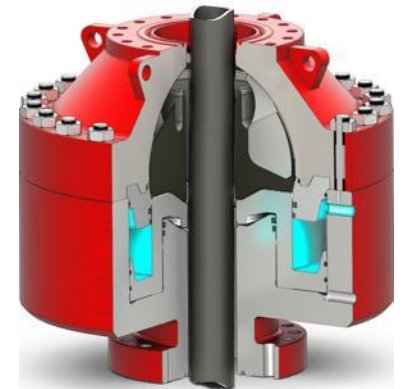


Figure 10: OPEN

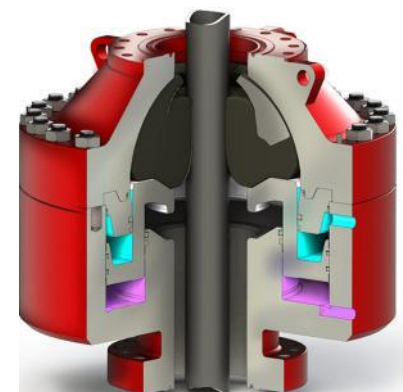


Figure 11: SEALED AROUND PIPE

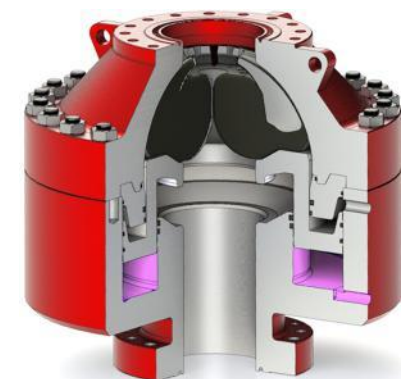


Figure 12: COMPLETE SHUT OFF

HA OPERATION AND MAINTENANCE



MAINTENANCE

After 6 months or at the end of drilling of well, operate the packing element by pumping hydraulic oil into the close port and wash grease and mud from around the packing element. Continue to operate the packing element (open & close hydraulic) while washing out packing element and through the bore of the BOP stack. Grease top of the packing element if possible and open completely.

OPERATING CAPACITY

HA Blowout Preventers can be operated via hydraulic connection ports located on each side of the lower body. Fluid capacities and body fitting sizes are listed in table 8. All are reduced to a 1" NPT hydraulic connection.

Table 8: HA HYDRAULIC OPERATING CAPACITIES

Bore and Working Pressure (psi)	7-1/16" – 5M	11" – 3M	11" – 5M	11" – 5M w/ 10M Bottom Flange	13-5/8" – 5M	13-5/8" – 5M w/ 10M Bottom Flange
Hydraulic Body Port:NPT	1"	1"	1-1/4"	1-1/4"	1-1/2"	1-1/2"
Hydraulic Connection: NPT	1"	1"	1"	1"	1"	1"
Hydraulic Fluid: Open:	3.21	6.78	14.59	14.59	17.41	17.41
Close:	4.57	11.00	18.67	18.67	23.58	23.58
Operating Pressure (psi)	1500	1500	1500	1500	1500	1500
Lid Nut Torque (lbf-ft)	900	1500	2200	2200	3100	3100

STUD TORQUE

When installing lid on HA Blowout Preventer, the bolts should be torqued in the order shown in Figure 13. After the first 4 nuts are tightened, start back at 1 and tighten the nuts by going in a clockwise circle

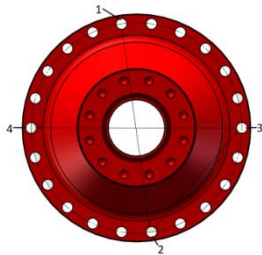


Figure 13: HA TORQUE PATTERN

PHYSICAL DESCRIPTION and ENGINEERING DATA

The following dimensions are for reference on all new manufactured HEC Blowout Preventers.

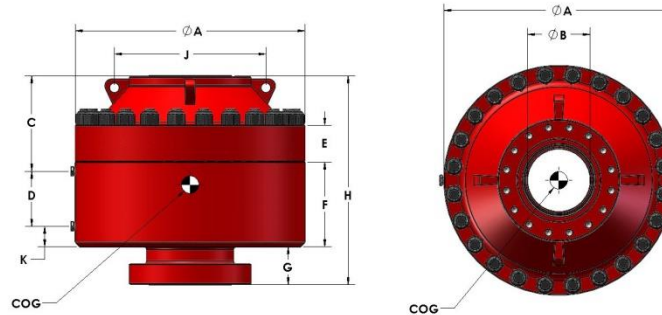


Figure 14: HA DRAWINGS

Table 9: HA DIMENSIONS

Bore and Working Pressure (psi)	7-1/16" – 5M	11" – 3M	11" – 5M	11" – 5M w/ 10M Bottom Flange	13-5/8" – 5M	13-5/8" – 5M w/ 10M Bottom Flange
A: (in.)	29.000	39.875	44.750	44.750	50.000	50.000
B: (in.)	7.063	11.000	11.000	11.000	13.625	13.625
C: (in.)	13.813	23.875	18.000	18.000	20.625	20.625
D: (in.)	7.750	9.125	11.500	11.500	13.250	13.250
E: (in.)	6.313	5.000	6.885	6.885	8.000	8.000
F: (in.)	11.750	13.188	17.500	17.500	18.500	18.500
G: (in.)	6.750	6.500	8.750	9.750	8.250	11.250
H: (in.)	31.000	42.310	42.500	43.500	45.375	48.375
J: (in.)	20.500	28.000	30.250	30.250	33.000	33.000
K: (in.)	2.6875	2.81	4.25	4.25	3.25	3.25
Weight (lbs.)	3,170	5,750	9,410	9,950	14,300	14,800



Figure 15: HA EXPLODED VIEW

Table 10: HA PARTS LIST

Item	Description	Qty.	7 - 1/16" - 5M	11" - 3M	11" - 5M
1	Body	1	10-0005	10-0009	10-0013
2	Lid	1	10-0006	10-0010	10-0014
3	Piston	1	10-0007	10-0011	10-0015
4	Adapter Ring	1	10-0008	10-0012	10-0016
5	Packing Element	1	39-3900	36-3601	37-3700
6	Adapter Ring to Body O-Ring	1	81-8123-1	81-8130-1	81-8137
7	Adapter Ring Lid O-Ring	1	81-8121	81-8130	81-8133-1
8	Inner Adapter Ring Wiper	1	81-8100-1	81-8104	81-8108
9	Inner Adapter Ring Seal	1	81-8124	81-8126	81-8131
10	Outer Piston Seal	2	81-8125	81-8127	81-8137-1
11	Piston Wear Band	2	03-0030	03-0030	03-0030
12	Stump Seal	1	81-8102-2	81-8130-2	81-8137-2
13	Stump Wiper	1	81-8102-1	81-8106	81-8110
14	Hydraulic Ports	2	1" NPT	1" NPT	1 1/4 x 1" NPT
15	Lid Studs	24	1.50x10	1.750x9.5	2.0x11.50
16	Lid Nuts	24	1 1/2	1 3/4	2
17	Flange Stud	12	1 3/8 - 8 x 7.50	1 3/8 - 8 x 7.0	1 7/8 - 8 x 9.50
18	Flange Nut	12	1 3/8 - 8	1 3/8 - 8	1 7/8 - 8
19	Adapter Ring Wear Band	1	03-0031	N/A	03-0031
20	Stump Wear Band	1	03-0030	03-0030	03-0030

Item	Description	Qty.	11" - 5M w/ 10M Bottom	13 5/8" - 5M	13 5/8" - 5M w/ 10M Bottom
1	Body	1	10-0013-1	10-0001	10-0001-1
2	Lid	1	10-0014	10-0002	10-0002
3	Piston	1	10-0015	10-0003	10-0003
4	Adapter Ring	1	10-0016	10-0004	10-0004
5	Packing Element	1	37-3700	38-3800	38-3800
6	Adapter Ring to Body O-Ring	1	81-8137	81-8138	81-8138
7	Adapter Ring Lid O-Ring	1	81-8133-1	81-8141	81-8141
8	Inner Adapter Ring Wiper	1	81-8108	81-8112	81-8112
9	Inner Adapter Ring Seal	1	81-8131	81-8139	81-8139
10	Outer Piston Seal	2	81-8137-1	81-8141-1	81-8141-1
11	Piston Wear Band	2	03-0030	03-0030	03-0030
12	Stump Seal	1	81-8137-2	81-8140	81-8140
13	Stump Wiper	1	81-8110	81-8114	81-8114
14	Hydraulic Ports	2	1 1/4x1" NPT	1 1/2x1" NPT	1 1/2X1" NPT
15	Lid Studs	24	2.0x11.50	2.25x13.25	2.25x13
16	Lid Nuts	24	2	2 1/4	2 1/4
17	Flange Stud	12*	1 7/8 - 8 x9.50	1 5/8 - 8 x8.5	1 5/8 - 8 x8.5
18	Flange Nut	12*	1 7/8 - 8	1 5/8 - 8	1 5/8 - 8
19	Adapter Ring Wear Band	1	03-0031	03-0031	03-0031
20	Stump Wear Band	1	03-0030	03-0030	03-0030

*13-5/8-5M requires 16 flange nuts and stubs

HA OPERATION AND MAINTENANCE



PACKERS and SEALS

- 11" and 13-5/8" HA BOP's use a Nitrile (70 Shore A) for the packing material
- 7-1/16" uses a Natural (70 Shore A) for the packing material

Note: Natural or Nitrile is available upon request for all HA BOP's

OPERATIONAL CHARACTERISTICS

- Packer access
 - 200 cycles
 - Pressure test every 20th cycle.
 - 20 Pressure test
- Temperature Range
 - Metallic: -20° to 250°F
 - Elastomers 20° to 200°F
- Fatigue Test
 - 364 open and close cycles
 - 52 pressure test
- Operating Range
 - 7-1/16"
 - 0" to 5-1/2"
 - 11"
 - 0" to 8-5/8"
 - 13-5/8"
 - 0" to 10-3/4"
- Stripping
 - 1 tool joint (3-1/2" OD test mandrel with 18° API 5-inch tool-joint profile)



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 1 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 1 harmless from and against all claims, demands, losses, damages and causes of action of whatever kind or 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, PREEXISTING CONDITIONS (WHETHER SUCH CONDITIONS BE PATENT OR LATENT).

H₂S Disclosure. Buyer has disclosed to HEC all exposures of the Product serviced by 1 to H₂S and understands the following: Carbon and low alloy steels and cast irons selected using NACE 15156-2 P1 are resistant to cracking under "defined" H₂S 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 H₂S history of the equipment cannot be or is not disclosed.