

Upper Occoquan Service Authority

Leader in Water Reclamation and Reuse 14631 COMPTON ROAD, CENTREVILLE, VIRGINIA 20121-2506 (703) 830-2200

January 29, 2020

TO ALL IFB RECIPIENTS:

For UOSA IFB 20-12, Knife Gate Valve Installation

SUBJECT: Addendum #1

The above numbered solicitation is amended as set forth below. The hour and date specified for receipt of offers:

- | is not extended;
- | x | is extended to February 13, 2020 at 2:00 p.m.

OFFERORS MUST ACKNOWLEDGE receipt of this Addendum by one of the following methods:

- a. By SIGNING and RETURNING (1) copy of this Addendum with the bid or proposal;
- b. By acknowledgement of this Addendum on Transmittal Form submitted with the proposal;
- c. By referencing its receipt in your Transmittal Letter

If by virtue of this Addendum if you desire to change a proposal already submitted, such change may be made by letter, provided it includes reference to the solicitation and this Addendum and is received prior to the due hour and date specified.

DESCRIPTION OF ADDENDUM:

1. To extend the due date. The due date is changed FROM 2/6/2020 TO 2/13/2020.

Date

2. To provide answers to all questions received prior to the deadline for questions. All questions and answers (along with supplemental information as part of the answers) are provided as an attachment to this Addendum.

All other Terms, Conditions, Tables, Charts and Specifications, and Drawings not otherwise changed remain as originally stated or as shown.

ISSUED BY:

ACKNOWLEDGED BY:

Upper Occoquan Service Authority

AStylton 1/29/2020

Kristen Hyltøn, Purchasing Mgr

Company/Offeror Name

Signature of Authorized Agent

Date

Printed/Typed Name

Prospective Bidder Questions for IFB 20-12

UOSA Final Effluent Valve Replacement

- 1. Do we have access overhead for a crane within 20'.
 - a. There are power lines in and around the reservoir area, recommend scheduling a site visit to assess the project area prior to submitting a bid.
 - 2. Are we replacing the inlet grating or building it.
 - a. Refer to the drawings provided with the IFB, specifically sheet P-3.
 - 3. Is the project just to replace the knife valve nothing else.
 - a. This project includes but is not limited to replacing the 36" knife gate, associated actuator and inlet grating, demolishing 6 hydraulic pipes, install 2 new hydraulic pipes, removing an 8" knife gate, associated actuator, and installing an 8" flange. Please refer to the Contract Drawings provided with the IFB.
 - 4. Is this prevailing wage job.
 - a. No
 - 5. Contract Drawings Sheet P-1, 5 of 7, Sheet Notes #2 states, "weight of the existing 36" Valve & Cylinder is approx 70,000 lbs." Is this correct? Also, the note says "the weight of the replacement Valve & Cylinder will be less than the existing, but shall be confirmed with the owner" Can you specify weight?
 a. It should be assumed that the existing valve and cylinder is approximately 7,000 lbs.
 - 6. Contract Drawing G-2 Sheet 2 of 7, Project Requirements Note #4 states, "the finishing pond waters consists of treated sewage effluent" Can you confirm that the water in the reservoir is suitable for human contact? This is important to know for the diving crew's protection, since this will allow the diver to wear a wet suit, plus using a hot water diving system, with water pumped directly from the reservoir.
 - a. UOSA's finishing pond/reservoir consists of the Regional Water Reclamation Plant's treated effluent and runoff from the surrounding urban area. The water is similar to a natural water way and historically divers and human contact has occurred, given that UOSA does not control or monitor all of the reservoir's influent sources, we cannot guarantee at the water quality into the future. It would be the responsibility and judgement of the successful bidder to determine what gear is appropriate.
 - 7. Contract Documents Section 1 Summary Information & Submission of Bids Item 1.10 Bid Submission makes no mention of a Bid Bond, thus, one would assume that a Bid Bond is not required; Is this correct?
 - a. A bid bond is not required for this project.
 - 8. Item 1.11 Performance Bond 100% and 1.12 Payment Bond 100% states these are required for the project. Is this correct?
 - a. Yes

- 9. Attachment F and G has sample Virginia Performance and Payment Bond Forms. Are these the forms the Contractor shall use if awarded?
 - a. Yes, if awarded, these forms will be required to be returned with a signed contract and insurance information.
- 10. Contract Specifications Section 2 Scope of Work Item 2.1 states, "owner shall supply One (1) 36" knife gate and actuator. Will UOSA deliver this equipment to the contractor's staging location for its marine floating equipment?
 - a. Yes, UOSA will receive the value at the plant and either unload it at the specific staging location, or deliver it from our receiving facilities to the staging location.
- 11. Contract Specification Section 3 Terms & Conditions Item 3.7 Insurance Item E Professional Liability Insurance, Errors & Omissions states detail including a minimum coverage amount of \$ 1,000,000, but Attachment H Insurance Requirements does not mention this type of Insurance. Is Professional Liability Insurance, Errors & Omissions Insurance required?
 - a. Follow the insurance requirements outlined in Attachment H, Professional Liability Insurance, Errors & Omissions Insurance is not required for this project.
- 12. Drawing P-1 Sheet of 7 and P-2 Sheet 6 of 7, refer to inspection of 12/4/2018. It would be beneficial to all bidders, rather than just the diving inspection company, that this information be available. Can this report be included in an addendum?
 a. Report is attached
- 13. Contract Drawings C-1 Sheet 3 of 7, and C-2 Sheet 4 of 7, show approx. normal pool elevation 188.0. Drawing P-1 sheet of 7 and P-2 Sheets 6 of 7 show approx. mudline at top of tee of 36" pipe and invert elevation 161.0 of 36" pipe. Are there any bottom elevations of original virgin soil line available? These would be helpful for contractor to plan on sufficient spud length needed to secure its floating marine equipment.
 - a. Original design drawings attached for reference.
- 14. Contract Drawing C-1 Sheet 3 of 7 General Demolition Notes Item 3, says in part, "support brackets and hangers and minor pieces of equipment shall also be removed". Also, the elevation view states "3 vent pipe to remain". Thus, a contractor would assume that the brackets fastening the vent pipe to the existing Hbeam do not get replaced, but out of abundance of caution, we request that this be clarified.
 - a. Support brackets restraining the vent pipe shall remain.
- 15. Contract Drawing C-1 Sheet 3 of 7 General Demolition Notes Item 7 says, " hydraulic oils shall be stored, utilized and disposed of in a lawful manor", but it doesn't say whether the existing hydraulic oil is petroleum based or biodegradable. Please specify the type of hydraulic oil that is in the system.
 - a. See attached information on the existing Food-Grade Hydraulic Vegetable Oil. Our records indicate the system holds 10 to 15 gallons.

- 16. Contract Specification Attachment E Pratt LVC Figure 193 Bonneted Metal Seated Knife Gate Valve Dimensions and Weights Chart only specifies valves up to 24". Request contractor be supplied with a chart for the subject project of 36" valve.
 - a. The attached submittal shows the dimensions & weights of the 36" valve and actuator on pages 3 & 5. Actual dimensional drawings. Yes, the standard brochure only goes up to 24" sizes.
- 17. Contract Specification says "Deadline for Questions is Friday, January 24, 2020, 5:00pm", but if any answers raise additional questions, or require clarification, can these be submitted?
 - a. January 24, 2020 is the deadline for questions, however, please provide any additional questions and the Owner will review and determine if they should be addressed and if they have an impact on the bidding duration.
- 18. Contract Specification Section 2 Scope of Work Item 2.1 states "Equipment is expected to be received at UOSA not later than May 18, 2020, and installation must be completed before June 25, 2020". If the equipment is delivered later than May 18, 2020, will UOSA work with the contractor to adjust the completion date accordingly?
 - a. Delays are addressed in Article 3 the Terms and Conditions which are provided with the IFB.

McMASTER-CARR.

Food-Grade Hydraulic Vegetable Oil ISO Grade 32/46, 5-gal Pail

\$90.36 Each 3499K24



Lubricant Type	Oil						
Base Oil	Vegetable						
Viscosity Grade							
ISO	32/46						
AGMA	1						
SAE	20						
Saybolt Seconds Universal	175 @ 100° F						
Container							
Size	5 gal.						
Туре	Pail						
Temperature Range	40° to 125° F						
Color	Yellow						
With Detergent	No						
Specifications Met	NSF Registered H1						
For Use On	Hydraulic Systems						
Additional	SDS						
Specifications							
RoHS	RoHS 3 (2015/863/EU)						
	compliant						

For use in food-processing and preparation areas, this oil is NSF registered H1 or meets FDA 21 CFR 178.3570 for incidental food contact. It has wear-resistant properties to keep hydraulic pumps and equipment working, even in high-pressure systems.

Viscosity is the thickness of an oil. The higher the grade, the thicker the oil, and the less it flows.

Vegetable oil is slicker than mineral oil but also breaks down more quickly.





January 17, 2019

Submittal No.: Project Reference:	S2632464 Rev 1 UOSA Valve Replacement 62776
Specification Section:	11280
Pratt Representative:	Flomec Inc.
PO Number:	00013721
Quote Number:	19097448
Lead-time:	Shipment 16 weeks after approval
Notes:	Pratt Non-Standard Paint – V69 True Blue

Prepared by:

Shannon Powell Quality Assurance Engineer



Manufacturer's Data:

Submittal No.: S2632464 Rev 0Item:1Size:36"Quantity:1Drawing:19-0211-CD Rev 0Part Number:LV36193W6EU-HC5-0001

Product Description:

36" Figure LVC 193-W6EU-HC-H1HXQ2 Bonneted Knife Gate Valve

- --Cast 316 Stainless Steel body
- --30" face-to-face
- --150 psi CWP design
- --Flanges drilled and tapped to ASME B16.47/1996 Class 150, Series A
- --Fabricated fully rated enclosed bonnet with 316 SS wetted parts Carbon steel bonnet flanges
- --316 SS gate

--316 SS metal to metal seat with UHMW wear strip and EPDM o-ring resilient seat for uni-directional drip-tight shut-off

- --UHMW gate wiper
- --TLSP packing rated to 500° F, 3-11 PH
- --316 SS packing gland
- --Cast 304 SS yoke
- --316 SS internal and 304 SS upper stem
- Q2 = --316 SS Hardware
- --5" On-off, double acting hydraulic cylinder actuator
- H1 = Hard chrome plated 17-4 pH SS cylinder rod
- HX = --17-4 pH tie rods

--Suitable for submersible service

Serial Number(s): 3246411

LVNONSTDPAINT

--Exterior ferrous surfaces sandblast to SSPC-SP6 and painted with 4-6 mils DFT of Tnemec Model V69 Hi-Build Epoxoline II, two component, high solids polyamidoamine epoxy, color True Blue two component, high solids solids polyamidoamine epoxy, color True Blue



	2		1		
NAME	MAT'L		QTY.		
E BODY	T-316	CASTE 36" LVC	FIG 93-A6EU, 150 PSI CWP	1	
G	EPDM	3/8" DIA RATE	D TO 300°	1	
RING	UHMW	3/8" RATED T 1	80 °F	1	
	T-304	1-3/4" PL MAC	HINED	1	
ING GLAND	T-316	FABRICATED V	V/ T-304 FASTENERS	1	
ING SET	TLSP	1/2" SQ RATED	TO 500 ° F, 3-11 PH (4 ROWS)	1	П
IET	*	FABRICATED V	V/T-304 FASTENERS	1	
	UHMW	FABRICATED R	AIED IO 180 °		
ASSEMBLY	1-316	FABRICATED, 2	2-1/2"RB		
ATOD	1-304	CASI 36 LVC	FIG 93 W/ I-304 FASTENERS	1	
AIUK		HC3 X 30.123	STROKE	1	
6 WETTED P 4 ROD ANE 7 SALES OR OMER: FLC P.C NC JECT REFER OMER P.O IGES DRILLE TEST: (O-RII COSTATIC TI 2 X WORKIN CTIONAL TE COXIMATE V AL NUMBER	DER#: 2 DER#: 2 DER#: 2 DER#: 2 DMEC, IN D BOX 7 ORTH CHI ENCE: U CONT ENCE: U CONT ST: 002 ST: 002 ST	TH A-36 EXTER DS SUITABLE FO 632464HP-1 IC. 2995 ESTERFIELD, V/ PPER OCCOC 721 TAPPED TO AS O LEAKAGE F PSI FOR 1 MIN SURE) V & CLOSE VA 4870 LBS 11	RIOR FLANGES AND GUSSET OR SUBMERSIBLE SERVICE QUAN SEWAGE AUTHORITY SME B16.47 CLASS 150 SERIE ROM 0-150PSI JUTE ALVE, TWO FULL STROKES	es a	C C
2) 3)					В
DMETRIC TOLERAN	ICING PER:	DO NOT SCALE THIED ANGLE FERD JECTION	THIS DRAWING AND THE DESCRIBED HEREON IS T PROPERTY OF HENRY PRATT COMPANY LLC AND	HE SOLE IS SUBJECT	
ICES UNLESS SE SPECIFIE IAL: <u>+</u> 1/16 CE DECIMAL: CE DECIMAL	±.015 .: ±.005	VALVE ASSE/ 36" LVC FIG	ID RETURN ON DEMAND. THIS DEAWING IS NOT REPRODUCED DISTRIBUTED OR USED FOR MANU WITHOUT THE EXPRESSED PERMISSION OF HENRY COMPANY.LLC. WBLY 193-W6EU-HC5-H1HXQ2	TO BE FACTURED PRATT	A
::± 0.5° G DATE: RD 12/12	2/2019	B 1 SCALE: 1:24	9-0211-CD WEIGHT: 4871.36 LB SHEET	0 1 OF 1	
	2		1		•

1100, Michèle-Bohec Blainville (Québec) J7C 5N5 Fax: (450) 434-0219 Tel: (450) 434-0216 Mtl. dir: (514) 990-3875		Quote Number: Issue Date:	2019-11-13
Watts: (800) 363-2264 CONTRÔLE www.rdccontrol.com	QUOTE	Page:	1 of 1
Custon 7000675	Prices valid until:	2019-12-28	
HENRY PRATT COMPANY MUELLER CO. 500 W. ELDORADO STREET P.O. BOX 671 DECATUR ILLINOIS 62525	Payment terms:	NET 30 DAYS Taxes are extra F.O.B. Blainville,	Québec
Tel:			
Fax: EMail:	Your Reference		
Your Sales Representative: DAVID GARCIA d.garcia@rdccontrol.com Cell: 514-894-4262	Quotation prepare Nathalie Primeau 450-434-0216 ex n.primeau@rdcc	d by: 1 tt 236 ontrol.com	

Please take note that our plant and offices will be closed on December 24th, 25th and 26th 2019 and on December 31st 2019, January 01st and 02nd 2020 inclusively. We will resume our normal business on January 03rd , 2020. All of our team wishes you a Merry Christmas and a wonderful Year.

Line	Quantity	Part Number / Description	Ref.	Unit Price	Total Price
1	1 UN	HP3000KJ8NE5CK9Z-3700-PPG			
		SERIES : HYDRAULIC HP3000 SERIES 3000PSI BORE SIZE : 5" DIAMETER ROD SIZE :2" DIAMETER ROD THREADS : FEMALE NO. 4 TYPE : 1 1/2-12UNF-2B LENGTH : 2,25 CUSHIONS : NONE MOUNTING : RECTANGULAR HEAD EN OPTION 1 : DIMENSIONS CHANGE OPTION 2 : PISTON ROD MATERIAL CHA OPTION 4 : MATERIAL CHANGE FINISH : EPOXY-URETHANE COLOR : BLACK STROKE : 37	NOMINAL PRES	SURE RATED	
		BB=1.81" EE=3/8" PORTS SUBMERSIBLE SEALS SS17-4 PISTON ROD, POLISHED ONLY SS17-4 TIE RODS			
		* PRODUCTION LEAD TIME : 5 WEEKS			

Total:

* Our lead time is based on availability of material at time of quote and is subject to previous sales.

** Please take note that the above production lead time starts upon the receipt of the approved drawing.



-MODEL: HP3000KJ4NE5CK9-3700-PPG		$A. \pm 1/32$ DD. -0.00" W	-1/32"	CONTRÔLE	RECTANOULARI	LAD(L3)					
-STROKE = 37"	CUSTOMER'S APPROVAL	A = Thread length BB = Extend, tie rod length		Drawing: 02HP3000KJ4NE5CK9-3700-PPG							
-WF = 2"	APPROVED REJECTED	W = Dist. between head and rod end before	re threads	#Job: 37664-1	Customer: HENRY	Y_PRATT					
-EE = NPT 3/8" PORT -17-4 PH STAINLESS STEEL TIE RODS	APPROVED WITH	STROKE Up to 24"	Over 24''	Series: HP3000 Bo	ore: Ø 5" Rod: Ø 2" R	tef: LV14092					
-17-4 PH STAINLESS STEEL POLISH ONLY PISTON ROD	SIGNATURE:	Up to Ø12" bore : ±1/32"	±1/16"	Drawn by: DRIV	EWORKS	Date: 18/12/2019					
-SPECIAL PAINT PROCEDURE	SIGNATORE.	Over Ø12" bore : ±1/16"	±1/16"	Verified by: #VAL	UE!	Date: 18/12/2019					
-SUBMERSIBLE SEALS	DATE:	All other non-specific tolerences :	±1/16"	Scale: 5	5:16 Weight: 226 lbs	Rev: 00 P.1/1					

PRATT®

LVC Figure 193 Bonneted Metal Seated Knife Gate Valve

675 Mitchell Avenue Woodland, WA 98674 Phone: 360-225-1230 888-256-5779 Fax: 360-225-1235 www.henrypratt.com



Features

- Bonneted knife gate valves are ideally suited to reduce fugitive emissions and packing leakage.
- Cast stainless steel body, gland and yoke.
- Wiper between body and bonnet prevents solids from entering bonnet.
- Bonnet design pressure same as valve pressure rating of 150 PSI.
- Standard TFE lubricated synthetic packing (TLSP) rated for 500° F and a pH range of 3-11.
- Heavy duty body design resists deflection from line loads and internal pressure.
- Gate design withstands full 150 PSI rated pressure as required by MSS SP-81.
- Body cavity, seat configuration, and beveled gate design provide shut off capa-bility in thick media such as pulp stock and slurries, or solid media like pellets and powders.
- Heavy duty cast stainless steel yoke prevents bending or twisting under ex treme loads.
- Easy conversion from handwheel operator to pneumatic or hydraulic cylinder, bevel gear, or electric motor operator using existing cast yoke.
- Enclosed bronze stem bushing reduces operating torque and protects the stem bushing in harsh environments.
- Hard faced seat available to prevent galling in high cycle and/or high end pres-sure or abrasive applications.
- V-Port or O-Ring resilient seats available to suit specific applications.
- Precision machined stainless steel gate provides superior seating capability.
- Stainless steel stem provides corrosion resistance.
- Flange drilling meets ANSI B16.5-150 LB standards with all tapped holes and serrated gasket faces.
- Full port ID.
- MSS SP-81 Stainless Steel, Bonnetless, Flanged Knife Gate Valves.
- AWWA C520-10 Knife Gate Valves, 2in.—96in.

PRATY®

LVC Figure 193 Bonneted Metal Seated Knife Gate Valve

Materials of Construction

Model	193							
1 Gate	SS							
2 Body	SS							
3 Seat	SS							
4 Wiper	UHMW							
5 Bonnet	SS/CS							
6 Packing	TLSP*							
7 Bolts	SS							
8 Gland	SS							
9 Stem	SS							
10 Yoke	SS							
11 Stem Nut	Bronze							
12 Handwheel	DI							

*TLSP = TFE Lubricated Synthetic Packing. SS = Standard with 304 or 316 stainless steel. Other alloys available.

Normally supplied with handwheel for manual operation, but can be modified for chainwheel, bevel gear, fail safe spring cylinder, electric motor, hydraulic or pneumatic cylinder operator.



Dimensions (Inches) and Weights

	Size	2	3	4	6	8	10	12	14	16	18	20	24	
Face-to-Face	ce-to-Face F-F 1-7/8 2 2 2		2-1/4	2-3/4	2-3/4	3	3	3-1/2	3-1/2	4-1/2	4-1/2			
Flange OD	OD	6	7-1/2	9	11	13-1/2	16	19	21	23-1/2	25	27-1/2	32	
Bolt Circle	BC	4-3/4	6	7-1/2	9-1/2	11-3/4	14-1/4	17	18-3/4	21-1/4	22-3/4	25	29-1/2	
Flanged Raised Face	RF	3-5/8	5	6-3/16	8-1/2	10-5/8	12-3/4	15	16-1/4	18-1/2	21	23	27-1/4	
Inside Diameter	ID	2	3	4	6	8	10	12	13-1/4	15-1/4	17-1/4	19-1/4	23-1/4	
No. of Bolt Holes	Ν	4	4	8	8	8	12	12	12	16	16	20	20	
Hole D&T Size	d	5/8"-11	5/8"-11	5/8"-11	3/4"-10	3/4"-10	7/8"-9	7/8"-9	1"-8	1"-8	1-1/8"-7	1-1/8"-7	1-1/4"-7	
C/L to Top-Closed	H-CLS	19	21-3/4	25-3/8	30-1/4	35-9/16	41-3/8	47-3/4	58	64	70-1/4	74-1/2	88-1/2	
C/L to Top-Open	H-OPN	21	25-1/4	29-7/8	37	44-1/8	51-7/8	61-1/2	72-1/4	80-1/2	88-1/4	94-1/4	112-1/4	
Handwheel Dia.	H/W	12	12	12	12	12	16	16	20	20	20	20	20	
Weight - Ibs	WT	39	64	75	109	160	251	295	335	470	740	990	1400	
Stroke	S	2-1/2	3-1/2	4-1/2	6-1/2	8-1/2	10-1/2	12-1/2	13-7/8	16	18	20-1/8	24-3/16	

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OPERATION AND MAINTENANCE MANUAL:

The LVC Fig 193 is a bonneted knife gate valve. It has either a metal to metal or a metal to o-ring seat. In either case it is a unidirectional valve, meaning that there is a preferred seating direction. 4 rows of packing are used to seal between the stem and the bonnet. Refer to the serial number tag for the pressure rating of the valve. A wiper is used between the body and the bonnet to prevent particles from migrating into the bonnet.

SHIPPING & STORAGE:

For shipment the valve will be in the closed position. Small valves (3", 4", and 6") may be shipped in individual boxes. Larger valves and large quantities will be shipped on pallets, skids or in boxes, all of which will require a forklift for moving. Storage should be in a clean dry environment such as a warehouse.

MAINTENANCE:

The only maintenance required on the Fig 193 knife gate valve are the packing and the lubrication of the stem. The packing gland may require adjustment after installation, especially if the valve has been in storage for a long period of time. When adjusting packing, tighten bolts on both sides evenly. Normally just a small amount of tightening per bolt is required. Do not tighten the bolts more than is necessary to stop the leaks.

Lubricate the stem nut and stem by using a grease gun on the grease fitting at the top of the yoke and apply a small amount of grease to the stem threads.





INSTALLATION:

Find the marking on the valve body or the top flange that says "SEAT SIDE". This is the downstream side of the valve. Be sure to install the valve so that pressure enters the upstream side of the valve and flows out of the downstream side of the valve. Failure to install the valve properly can result in damage to the valve gate.

Install the valve to the mating pipe flange using proper size bolts. See Chart 1 for bolt size. Bolt length is not included on Chart 1 since different flanges will require different length bolts. It is very important to choose the proper length of bolt for the bolt holes in the chest of the valve. These holes are bottom drilled and tapped holes and in some cases contain less than a bolt diameter of threads. Be careful not to bottom out bolts in the chest during installation. If necessary use washers to shorten the penetration of the bolt into the chest holes. Chart 2 gives recommended bolt torques to be used during installation, however, depending on the type of gaskets being used the required torques may be higher or lower. Use the cross torque pattern method for tightening the bolts. Mating flanges must be parallel and true with each other and the valve. Do not use the valve to pull together or force apart the two mating pipes.

After installation, open and close the valve at least once to assure smooth operation.

VALVE SIZE (IN)BOLT SIZE (IN)NUMBER OF BOLTS3"5/8-1144"5/8-1186"3/4-1088"3/4-10810"7/8-91212"7/8-91214"1-81216"1-81618"1-1/8-71620"1-1/8-72024"1-1/4-72030"1-1/4-72836"1-1/2-63242"1-1/2-63648"1-1/2-644			1
(IN) (IN) (IN) 3" 5/8-11 4 4" 5/8-11 8 6" 3/4-10 8 8" 3/4-10 8 10" 7/8-9 12 12" 7/8-9 12 14" 1-8 16 18" 1-1/8-7 16 20" 1-1/8-7 20 24" 1-1/4-7 20 30" 1-1/4-7 28 36" 1-1/2-6 32 42" 1-1/2-6 36 48" 1-1/2-6 44	VALVE SIZE	BOLT SIZE	NUMBER OF BOLTS
3" $5/8-11$ 4 $4"$ $5/8-11$ 8 $6"$ $3/4-10$ 8 $8"$ $3/4-10$ 8 $10"$ $7/8-9$ 12 $12"$ $7/8-9$ 12 $12"$ $7/8-9$ 12 $14"$ $1-8$ 12 $16"$ $1-8$ 16 $18"$ $1-1/8-7$ 16 $20"$ $1-1/8-7$ 20 $24"$ $1-1/4-7$ 20 $30"$ $1-1/4-7$ 28 $36"$ $1-1/2-6$ 32 $42"$ $1-1/2-6$ 36 $48"$ $1-1/2-6$ 44	(IN)	(IN)	OF BOLLIS
4" $5/8-11$ 8 $6"$ $3/4-10$ 8 $8"$ $3/4-10$ 8 $10"$ $7/8-9$ 12 $12"$ $7/8-9$ 12 $14"$ $1-8$ 12 $14"$ $1-8$ 12 $16"$ $1-8$ 16 $18"$ $1-1/8-7$ 16 $20"$ $1-1/8-7$ 20 $24"$ $1-1/4-7$ 20 $30"$ $1-1/4-7$ 28 $36"$ $1-1/2-6$ 32 $42"$ $1-1/2-6$ 36 $48"$ $1-1/2-6$ 44	3"	5/8-11	4
6" $3/4-10$ 8 $8"$ $3/4-10$ 8 $10"$ $7/8-9$ 12 $12"$ $7/8-9$ 12 $14"$ $1-8$ 12 $16"$ $1-8$ 16 $18"$ $1-1/8-7$ 16 $20"$ $1-1/8-7$ 20 $24"$ $1-1/4-7$ 20 $30"$ $1-1/4-7$ 28 $36"$ $1-1/2-6$ 32 $42"$ $1-1/2-6$ 36 $48"$ $1-1/2-6$ 44	4"	5/8-11	8
8" $3/4-10$ 8 $10"$ $7/8-9$ 12 $12"$ $7/8-9$ 12 $14"$ $1-8$ 12 $16"$ $1-8$ 16 $18"$ $1-1/8-7$ 16 $20"$ $1-1/8-7$ 20 $24"$ $1-1/4-7$ 20 $30"$ $1-1/4-7$ 28 $36"$ $1-1/2-6$ 32 $42"$ $1-1/2-6$ 36 $48"$ $1-1/2-6$ 44	6"	3/4-10	8
10" $7/8-9$ 12 $12"$ $7/8-9$ 12 $14"$ $1-8$ 12 $16"$ $1-8$ 16 $18"$ $1-1/8-7$ 16 $20"$ $1-1/8-7$ 20 $24"$ $1-1/4-7$ 20 $30"$ $1-1/4-7$ 28 $36"$ $1-1/2-6$ 32 $42"$ $1-1/2-6$ 36 $48"$ $1-1/2-6$ 44	8"	3/4-10	8
12" $7/8-9$ 12 $14"$ $1-8$ 12 $16"$ $1-8$ 16 $18"$ $1-1/8-7$ 16 $20"$ $1-1/8-7$ 20 $24"$ $1-1/4-7$ 20 $30"$ $1-1/4-7$ 28 $36"$ $1-1/2-6$ 32 $42"$ $1-1/2-6$ 36 $48"$ $1-1/2-6$ 44	10"	7/8-9	12
14" $1-8$ 12 $16"$ $1-8$ 16 $18"$ $1-1/8-7$ 16 $20"$ $1-1/8-7$ 20 $24"$ $1-1/4-7$ 20 $30"$ $1-1/4-7$ 28 $36"$ $1-1/2-6$ 32 $42"$ $1-1/2-6$ 36 $48"$ $1-1/2-6$ 44	12"	7/8-9	12
16" $1-8$ 16 $18"$ $1-1/8-7$ 16 $20"$ $1-1/8-7$ 20 $24"$ $1-1/4-7$ 20 $30"$ $1-1/4-7$ 28 $36"$ $1-1/2-6$ 32 $42"$ $1-1/2-6$ 36 $48"$ $1-1/2-6$ 44	14"	1-8	12
18"1-1/8-71620"1-1/8-72024"1-1/4-72030"1-1/4-72836"1-1/2-63242"1-1/2-63648"1-1/2-644	16"	1-8	16
20"1-1/8-72024"1-1/4-72030"1-1/4-72836"1-1/2-63242"1-1/2-63648"1-1/2-644	18"	1-1/8-7	16
24"1-1/4-72030"1-1/4-72836"1-1/2-63242"1-1/2-63648"1-1/2-644	20"	1-1/8-7	20
30" 1-1/4-7 28 36" 1-1/2-6 32 42" 1-1/2-6 36 48" 1-1/2-6 44	24"	1-1/4-7	20
36" 1-1/2-6 32 42" 1-1/2-6 36 48" 1-1/2-6 44	30"	1-1/4-7	28
42" 1-1/2-6 36 48" 1-1/2-6 44	36"	1-1/2-6	32
48" 1-1/2-6 44	42"	1-1/2-6	36
	48"	1-1/2-6	44

CHART 1	
---------	--

CHART 2

VALVE SIZE (IN)	RECOMMENDED TIGHTENING TORQUE (FT-LBS)
2"-3"	55 +/- 5
4"-8"	65 +/- 5
10"-12"	110 +/- 10
14"-16"	135 +/- 10
18"-24"	150 +/- 10
30"	200 +/- 10
36"-48"	250 +/- 10



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O-RING REPLACEMENT PROCEDURE FOR FIGURE 193 BONNETED KNIFE GATE VALVE

NOTE: TO CHANGE THE O-RING SEAT SEAL, ACCESS TO THE VALVE SEAT IS REQUIRED EITHER BY REMOVING THE VALVE FROM THE LINE OR BY ACCESS TO THE VALVE SEAT IN THE LINE.

- 1. Stroke the valve to the full open position.
- 2. Loosen the bonnet bolts enough so that when the bonnet is raised the gate will clear the top of the seat as indicated in the next step.
- 3. Lift the bonnet up until the tip of the gate clears the top edge of the O-ring groove in the seat.
- 4. Place supports between the bonnet flange and the body flange to hold the bonnet in this position during the removal and installation of the O-ring.
- 5. Remove old O-ring and scrape out any residue that has accumulated in the O-ring groove in the seat. Be sure the O-ring groove is completely cleaned out before proceeding.
- 6. Install the new O-ring as follows:
 - a. Note that the new O-ring diameter is somewhat smaller than the O-ring groove diameter. This allows the O-ring to be slightly stretched when it is installed in the groove. Lubricate the groove with some light oil. The O-ring will have a bonded joint. Be sure the joint is installed at about the 6:00 o'clock position.
 - b. Push an approximate 1" to 2" section of the O-ring into the groove at the 12:00 o'clock position. The groove is a dovetail shape so it is wider at the bottom of the groove than at the top. The O-ring may be a little tight at the top.
 - c. Gently stretch out the O-ring, and find the point on the O-ring that is exactly one half the distances from the 12:00 o'clock position. Push an approximate 1" to 2" of that part of the O-ring into the groove at the 6:00 o'clock position. Be sure that there are equal lengths of the O-ring between 12:00 and 6:00 o'clock positions, on both sides.
 - d. Now do the same at the 3:00 o'clock positions and then at the 9:00 o'clock position, always being sure that the lengths are equal on both sides of the points where the O-ring is pushed into the seat.
 - e. Keep doing this by pushing the O-ring into the groove half way between the two points where the O-ring as already been installed until you get to the point where the entire O-ring is installed into the groove.
 - f. After the O-ring has been completely installed in the groove, check that it is evenly distributed in the groove. If there are places where the O-ring seems to be thicker than in others, then using something like a smooth round piece of wood or plastic, even out the inconsistencies.
 - g. Lubricate the face of the seat and the O-ring with silicone grease.



- 7. Lower the bonnet into place. Note: as you lower the bonnet, be sure the tip of the gate moves over the top of the O-ring without damaging it. It may be necessary to pry the gate away from the seat while the bonnet is being lowered.
- 8. Loosely snug up the bonnet bolts.
- 9. Operate the gate into the closed position. For the last 1" to 2", use the handwheel on the operator rather than the electric power. Be sure the gate contacts the wedges at the bottom of the valve and is pushed tight against the seat.
- 10. Using 3 to 4, wood wedges, at the top of the port of the valve, (10:00 to 2:00 o'clock positions), drive the wedges between the gate and the body. This is on the BACK SIDE of the gate on the side OPPOSITE the seat. Drive the wedges in until they push the gate tight into the seat.
- 11. Loosen the bonnet bolts to finger tight. Using a piece of flat bar, pound the UHMWPE wiper, (located between the bonnet flange raised face and the body raised face), against the gate from the same side of the valve that the wooden wedges are in. Snug up the bonnet bolts with a wrench.
- 12. Using the handwheel, move the gate open about ½" to 1" to pull the gate out of the wedges. Note: the stem has a ¼" pitch and a ½" lead so about one complete turn of the stem nut will lift the gate about ½".
- 13. Tighten the bonnet bolts on the seat side of the bonnet to 100-foot pounds. Start tightening from the bolt in the center of the bonnet, alternately to the outside.
- 14. Then tighten the bonnet bolts on the other side of the bonnet to 100-foot pounds. Again, start tightening from the bolts in the center of the bonnet, alternately to the outside.
- 15. Now tighten all of the bonnet bolts to 200-foot pounds suing the cross torque method.
- 16. Remove the wood wedges. They may have already dropped out. If so, that is fine.
- 17. Operate the valve several times and check that the O-ring has remained in position.



REPLACEMENT PACKING PROCEDURE

WITH NO PRESSURE IN VALVE:

- 1. Confirm that there is no line pressure or head on the valve.
- 2. Remove packing gland nuts and bolts.
- 3. Pull up the packing gland up to expose the packing.
- 4. Using a packing hook, (or screw driver), remove all the old packing.
- 5. Carefully clean the packing box.
- 8. Using a pre-cut packing kit, insert packing one row at a time into packing box. Tap down each row of packing into place using a flat bar tool. Packing joints should be located 180° apart.
- Pull packing gland down and tighten nuts and bolts using cross torque method.
 <u>DO NOT OVERTIGHTEN</u>
- Bring valve up to working pressure and tighten the packing gland just enough to stop any leaks or drips. Over tightening of the gland will result in reduced packing life.

TROUBLE SHOOTING PROCEDURE

1) LEAKAGE FROM STEM PACKING: SOLUTION:

Tighten the two packing gland bolts/nuts evenly and slowly. Usually only 1/8 to ¼ turn on the bolts/nuts will stop the leakage. Only tighten bolts/nuts enough to stop the leak.

2) SEAT LEAKAGE: SOLUTION:

The gate may not be completely closed due to an obstruction between the gate and the seat. Open the gate to $\frac{1}{4}$ open and then close to fully closed position. Check for seat leakage.

- 3) VALVE DIFFICULT TO OPERATE SOLUTION:
 - a. Lubricate stem and stem nut. Check for improvement.
 - b. Loosen packing gland bolts a small amount (not enough to cause a leak around the stem packing). Check for improvement.
 - c. If problem persists consult the factory.



HEAVY DUTY HYDRAULIC CYLINDERS

Bore size: 1 1/2" - 14" 3,000 PSI (20.5 MPA) N.F.P.A. Interchangeable



CONSTRUCTION

The HP 3000 series hydraulic cylinders are designed to operate in the most demanding conditions at nominal pressures of 3,000 psi. The cylinders are available in bore sizes ranging from 1 1/2" to 14" in 18 different N.F.P.A. mountings. They are perfectly interchangeable with any other cylinders in the same product category. Consult factory for larger bores.

The materials used to manufacture RDC Contrôle Ltée cylinders are selected from the best quality available. The HP 3000 series components are manufactured with the latest sophisticated precision equipment. Each cylinder is assembled and individually tested under strict quality conditions.

CUSHION PLUNGER HEADANDCAP CUSHIONSEALS (OPTIONAL) (OPTIONAL) Numerically controlled ma-Made from mild steel, the plunger is free floating chined from hot rolled steel Provides deceleration and for proper centering and consistent alignment. A plates ASTM A36 or better. helps eliminate shock. stepped sleeve cushion design provides superior cycling rates and increased performance in re-**GLAND BUSHING** ducing hydraulic shock. **BARREL SEAL** Ports a Made of SAE 660 bronze, the gland bushing is designed to provide maxi-**CYLINDERBARREL** SAE standard, NPT and A teflon seal provides a extrumum support to the piston rod, prosion-proof and positive leak Oversized ports available. tect rod against side load and resist Extra heavy wall steel tubing with tight seal. Also available in wear. The gland is easily removed a highly polished interior, honed to fluorocarbon (viton) for higher and permits seal and wiper replacea micro finish surface, provides low temperatures. ment without dismantling the cylinfriction and long seal life. der tie rods in most of our N.F.P.A. mountings. PISTON SEAL It consists of a bi-directional seal and wear band filled with particles

of glass and bronze for smoother piston operation and high lateral forces. It eliminates metal-to-metal contact and prevents the possibility of scoring expensive barrel tubing. The piston's perfect seal minimizes stroke friction and prevents piston by-pass. Consult factory for other sealing arrangement per your application.

PISTON

Standard extra heavy duty cast iron piston designed to withstand high lateral forces. The one piece design provides maximum strength, reliability and extended piston life.

TIERODANDNUTS

High strength, made from 100,000 PSI minimum yield steel along with Grade 8 zinc plated steel nuts for corrosion resistance.

SEALSANDPACKINGS

The sealing of the piston rod is assured by a double urethane lip-seal. These standard seals can resist temperatures ranging from -34°C to 80°C (-30°F to 180°F). Fluorocarbon (viton) seals and packings are available for temperatures up to 250°C (450°F). Low temperature seals option to -50°C (-58°F).

ROD WIPER

Prevents dust and other contaminants from entering into the cylinder as well as a back-up rod seal. Standard material is polyurethane. It can be replaced by fluorocarbon (viton) for higher temperature applications. A heavy duty urethane rod scraper or metalic scraper is also available for severe applications.

PISTON ROD

High yield strength alloy steel rod, hard chrome-plated, and polished to 10 RMS finish. Solidly screwed into the piston and firmly retained by an anaerobic adhesive. The O-ring assures a leak tight seal between the piston and the piston rod. Stainless steel 316 and 17-4 PH chrome plated rods also available.



FEATURES

Туре Construction Operating pressure Operating temperature Standard rods Stroke Cushions

High pressure hydraulic cylinder conformed to N.F.P.A. specifications and ANSI B93.15-1981. Square steel head and cap, steel barrel tubing with polished i.d., tie rod assembled, removable bronze cartridge type gland bushing. 3000 PSI (restrictions on some mountings). erating temperature -30°C to 80°C (-30°F to 180°F). Up to 250°C (450°F) for viton seals. Low temperature seals also available. Standard bore size 9 bore sizes from 1 1/2" to 8"*. Larger bore sizes to 14". Consult factory for dimensions. 5/8", 1", 1 3/8", 1 3/4", 2", 2 1/2", 3", 3 1/2", 4", 4 1/2", 5", 5 1/2" *. All increments up to 120"*

Both cushions are optional and are available at either one end or both ends. End of stroke cushioning is fully adjustable.

* Other dimensions available on request.

Basic forms



18 Standard mounting styles



Gland bushing configuration chart

	1'	1/2		2		2 1/2			3 1/4			4			Ę	5			(5			2	7		8			
MOUNTINGS	5/8	1	1	1 ³ /8	1	1 ³ /8	13/4	1 ³ /8	13/4	2	1 ³ /4	2	21/2	2	21/2	3	31/2	21/2	3	31/2	4	3	31/2	4	41/2	31/2	4	41/2	5
A0	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	RD	RD	CD	RD	RD	RD	CD	RD	RD	RD	CD	RD	RD	RD	RD	RD	RD	RD	ND
A0D	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	RD	RD	RD	RD	RD
E5	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	RD	ND
E6	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	RD	RD	RD	RD	ND
F1	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	RD	RD	RD	RD	ND
F2	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	RD	RD	RD	RD	ND
F5	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	RD	RD	RD	RD	ND
F6	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	RD	RD	RD	RD	ND
P1	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	RD	RD	RD	RD	ND
P3	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	RD	RD	RD	RD	ND
P5	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	RD	RD	RD	RD	ND
S2	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	RD	RD	CD	RD	RD	RD	CD	RD	RD	RD	CD	RD	RD	RD	RD	RD	RD	RD	ND
S4	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	RD	RD	CD	RD	RD	RD	CD	RD	RD	RD	CD	RD	RD	RD	RD	RD	RD	RD	ND
S7	CF	Х	CF	Х	CF	CF	Х	CF	CF	CF	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	CF	Х	Х	Х	Х	Х	Х	Х	Х
T1	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	RD	RD	CD	RD	RD	RD	CD	RD	RD	RD	CD	RD	RD	RD	RD	RD	RD	RD	ND
T2	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	RD	RD	CD	RD	RD	RD	CD	RD	RD	RD	CD	RD	RD	RD	RD	RD	RD	RD	ND
T4	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	RD	RD	RD	RD	ND
X1	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	RD	RD	RD	RD	ND
X2	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	RD	RD	CD	RD	RD	RD	CD	RD	RD	RD	CD	RD	RD	RD	RD	RD	RD	RD	ND
X3	CF	CF	CF	CF	CF	CF	CF	CF	CF	CF	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	CF	RD	RD	RD	RD	RD	RD	RD	ND

CD : The gland bushing is maintained by a detachable square plate. CF : The gland bushing is maintained by a fixed square plate. RD : The gland bushing is maintained by a detachable round plate.

HEAVY DUTY HYDRAULIC CYLINDERS

BASIC CYLINDER

A0 mounting



Bushing Configuration (See chart on page 3)



RD Type



CD Type CF Type

BORE SIZE	MM ROD DIA.	В	RD	v	WF	Y	ZB	E	EE	F	G	J	К	LB	Р
1 1/2	⁵ /8 STD.	1.124	*	1/4	1	2	6	2 1/2	SAE-10	3/8	1 3/4	1 1/2	3/8	4 5/8	27/8
1 /2	1″	1.499	*	1/2	1 ³ /8	2 ³ /8	6 ³ /8	- 12		/0	1 /7	1 /2	70	- 70	2 /0
2	1" STD.	1.499	*	1/4	13/8	2 ³ /8	6 ¹ /2	3	SAF-10	5/8	1 3/4	1 1/2	1/2	4 5/8	2 7/8
-	1 ³ /8	1.999	*	3/8	1 ⁵ /8	2 ⁵ /8	6 ³ /4		OT LE TO	70	• ,•	. 72	72	1 /0	2 /0
	1" STD.	1.499	*	1/4	1 ³ /8	2 ³ /8	6 ⁵ /8								
2 ¹ /2	1 ³ /8	1.999	*	3/8	1 ⁵ /8	2 ⁵ /8	6 ⁷ /8	3 ¹ /2	SAE-10	5/8	1 ³ /4	1 ¹ /2	1/2	4 ³ /4	3
	1 ³ /4	2.374	Ť	1/2	17/8	2 7/8	7 ¹ /8								
a 1/	1 ³ /8 STD.	1.999	*	1/4	15/8	2 ³ /4	7 ³ /4	. 1.(27			F.(- 1/	a 1/
3 1/4	1 ³ /4	2.374	*	3/8	17/8	3	8	4 ¹ /2	SAE-12	3/4	2	1 3/4	5/8	5 1/2	3 1/2
	2"	2.624	*	3/8	2	3 1/8	8 1/8								
4	1 ³ /4 STD.	2.374	4	1/4	1//8	3	8 ⁵ /16	-	CAE 10	7/2	2	1 3/.	11/10	F 3/4	23/.
4	2"	2.624	4 1/4	1/4	2	3 1/8	8 //16	5	SAE-12	//8	2	T 3/4	''/16	5 3/4	3 3/4
	21/2	3.124	*	³ /8	21/4	3 3/8	8 1 / 16								
	2" STD.	2.624	4 1/4	1/4	2	3 1/8	9 ³ /16	-							
5	21/2	3.124	4 1/16	3/8	21/4	3 3/8	9 //16	6 ¹ /2	SAE-12	⁷ /8	2	1 ³ /4	¹⁵ /16	6 ¹ /4	4 ¹ /4
	3"	3./49	5 ³ /8	3/8	21/4	3 ³ /8	97/16								
	31/2	4.249	* 4 11/	3/8 1/.	21/4	3 ³ /8	97/16								
	2 1/2 STD.	3.124	4 · 1/16	1/4	21/4	<u>3'/2</u>	10 5/8								
6	3 ¹	3./49	5 ³ /8	1/4	2'/4	3 '/2 2 1/2	10 5/8	7 1/2	SAE-16	1	$2^{1/4}$	2 1/4	1	7 3/8	4 7/8
	<u> </u>	4.249	3'/8 *	1/4	21/4	3 '/2 2 1/2	10 5/8	,				,		,	· ·
	2″ CTD	3 7/9	F 3/0	1/4	21/4	2 3/4	117/0								
	3 310.	4 249	57/8	3/9	21/4	3 3/4	117/9								
7	$\frac{J'}{\Delta''}$	4,749	6 ^{3/8}	3/8	21/4	3 3/4	117/8	8 1/2	SAE-20	1	2 ³ /4	2 ³ /4	1 ¹ /8	8 ¹ /2	5 ¹ /2
	$\frac{1}{41/2}$	5.249	*	1/2	21/4	3 3/4	117/8								
	3 ¹ /2 STD	4.249	5 7/8	1/4	21/4	37/8	13								
	4"	4.749	6 ³ /8	3/8	21/4	37/8	13								
8	$\frac{1}{2}$	5.249	$7^{3/8}$	3/8	$2^{1/4}$	37/8	13	9 ¹ /2	SAE-24	1	3	3	1 ¹ /4	9 ¹ /2	6 ¹ /4
	5″	5.749	*	1/2	$2^{1/4}$	3 7/8	13								

*Refer tp specific mounting configuration



PISTON ROD END STYLES

RDC Contrôl Ltée offers 8 different standard piston rod end models.



Dimension chart

MM ROD DIA.	A	B000 002	с	сс	PP	КК	NA	AD	AE +.000 +.002	AF DIA.	AC
5/8″	3/4″	1.124″	3/8″	1/2 - 20 UNF	5/8 - 18 UNF	7/16 - 20 UNF	⁹ /16″	5/8″	1/4″	3/8″	1 ¹ /8″
1″	1 ¹ /8″	1.499″	1/2″	7/8 - 14 UNF	1 - 14 UNS	3/4 - 16 UNF	15/16″	15/16″	3/8″	11/16″	1 ¹ /2″
1 ³ /8″	1 ⁵ /8″	1.999″	5/8″	1 1/4 - 12 UNF	1 3/8 - 12 UNF	1 - 14 UNS	1 ⁵ /16″	1 ¹ /16"	3/8″	⁷ /8″	1 ³ /4″
1 ³ /4″	2″	2.374″	³ /4″	1 1/2 - 12 UNF	1 3/4 - 12 UNF	1 1/4 - 12 UNF	1 ¹¹ /16"	1 ⁵ /16"	1/2″	1 ¹ /8″	2″
2″	2 ¹ /4″	2.624″	7/8″	1 3/4 - 12 UNF	2 - 12 UNF	1 1/2 - 12 UNF	1 ¹⁵ /16"	1 ¹¹ /16"	5/8″	1 ³ /8″	2 ⁵ /8″
2 1/2″	3″	3.124″	1″	2 1/4 - 12 UNF	2 1/2 - 12 UNF	1 7/8 - 12 UNF	2 ³ /8″	1 ¹⁵ /16″	3/4″	1 ³ /4″	3 ¹ /4″
3″	3 ¹ /2″	3.749″	1″	2 3/4 - 12 UNF	3 - 12 UNF	2 1/4 - 12 UNF	2 ⁷ /8″	2 ⁷ /16"	⁷ /8″	2 ¹ /4″	3 ⁵ /8″
3 1/2"	3 ¹ /2″	4.249″	1″	3 1/4 - 12 UNF	3 1/2 - 12 UNF	2 1/2 - 12 UNF	3 ³ /8″	2 ¹¹ /16"	1″	2 ¹ /2″	4 ³ /8″
4″	4″	4.749″	1″	3 3/4 - 12 UNF	4 - 12 UNF	3 - 12 UNF	3 ⁷ /8″	2 ¹¹ /16"	1″	3″	4 1/2″
4 ¹ /2″	4 ¹ /2″	5.249″	1″	4 1/4 - 12 UNF	4 1/2 - 12 UNF	3 1/4 - 12 UNF	4 ³ /8″	3 ³ /16"	1 ¹ /2″	3 1/2″	5 ¹ /4″
5″	5″	5.749″	1″	4 3/4 - 12 UNF	5 - 12 UNF	3 1/2 - 12 UNF	4 7/8″	3 ³ /16"	1 1/2″	3 7/8″	5 ³ /8″
5 ¹ /2″	5 ¹ /2″	6.249″	1″	5 1/4 - 12 UNF	5 1/2 - 12 UNF	4 - 12 UNF	5 ³ /8″	3 ¹⁵ /16"	1 ⁷ /8″	4 ³ /8″	6 ¹ /4″

RDC Contrôle Ltée can also manufacture a piston rod end adapted to customer specifications through a detailed sketch. In this case, we will use #8 for the female special and #9 for the male special end styles

RECTANGULAR HEAD OR CAP MOUNTINGS

BORE SIZE	MM ROD DIA.	RD	WF	ZJ	FB	R	TF	UF
1 ¹ /2	⁵ /8 STD. 1	2 ³ /8 2 ⁵ /8	1 1 ³ /8	5 ⁵ /8 6	7/16	1.63	3 7/16	4 ¹ /4
2	1″ STD. 1 ³ /8	2 ⁵ /8 3 ⁵ /8	1 ³ /8 1 ⁵ /8	6 6 ¹ /4	⁹ /16	2.05	4 ¹ /8	5 ¹ /8
2 1/2	1" STD 1 3/8 1 3/4	2 5/8 3 5/8 3 7/8	1 3/8 1 5/8 1 7/8	6 1/8 6 3/8 6 5/8	9/16	2.55	4 ⁵ /8	5 ⁵ /8
3 1/4	1 ³ /8 STD. 1 ³ /4 2	3 ⁵ /8 3 ⁷ /8 4 ¹ /4	1 ⁵ /8 1 ⁷ /8 2	7 ¹ /8 7 ³ /8 7 ¹ /2	11/16	3.25	5 ⁷ /8	7 1/8
4	$\frac{1}{2''}$ 3/4 STD. 2''	$\frac{4}{4 \frac{1}{4}}$	$\frac{1}{7/8}$ 2 2 $\frac{1}{4}$	7 5/8 7 3/4 8	11/16	3.82	6 ³ /8	7 ⁵ /8
5	2'' STD. $2 \frac{1/2}{3''}$ $3 \frac{1}{2}$	4 1/4 4 11/16 5 3/8 5 7/8	$ \begin{array}{r} 2 \\ 2 \\ 1/4 \\ 2 \\ 1/4 \\ 2 \\ 1/4 \end{array} $	8 1/4 8 1/2 8 1/2 8 1/2 8 1/2	15/16	4.95	8 ³ /16	9 ³ /4
6	2 ¹ / ₂ STD. 3" 3 ¹ / ₂ 4"	4 ¹¹ /16 5 ³ /8 5 ⁷ /8 6 ³ /8	2 1/4 2 1/4 2 1/4 2 1/4 2 1/4	9 ⁵ /8 9 ⁵ /8 9 ⁵ /8 9 ⁵ /8	1 ¹ /16	5.73	9 ⁷ /16	11 ¹ /4
7	3" STD. 3 1/2 4" 4 1/2	5 3/8 5 7/8 6 3/8 7 1/2	2 1/4 2 1/4 2 1/4 2 1/4 2 1/4	10 ³ /4 10 ³ /4 10 ³ /4 10 ³ /4	1 ³ /16	6.58	10 ⁵ /8	12 ⁵ /8
8	3 1/2 STD. 4" 4 1/2 5"	5 7/8 6 ³ /8 7 ¹ /2 8	2 1/4 2 1/4 2 1/4 2 1/4 2 1/4	11 ³ /4 11 ³ /4 11 ³ /4 11 ³ /4	1 ⁵ /16	7.50	11 ¹³ /16	14



E5 – Rectangular head mounting



DIFFERENT OPTIONS AVAILABLE

The HP Series hydraulic cylinders offered by RDC Contrôle Ltée can be adapted to accept a wide range of options and accessories to meet your specific needs. Please contact our customer service department for more details on the options mentioned below or about other special applications.

OPTIONS

- Multi-stage cylinder (Duplex, Tandem)
- Double rod cylinder
- Spring return cylinder
- Water operated cylinder (A.W.W.A.)
- Stroke adjustment device
- Stainless Steel piston rod #17-4PH
- Protective rod boot
- Piston rod scraper
- High temperature seals
- NPT, BST ports

ACCESSORIES

- Mounting accessories (see page 16)
- Self-alignment rod
- coupler
- Manual control valve
- Solenoid valve
- Flow control
- Proximity switch
- Limit switch
- Position transducer

HEAVY DUTY HYDRAULIC CYLINDERS

FLANGE MOUNTINGS

BORE SIZE	MM ROD DIA.	WF	ZF	F	FB	R	TF	UF
1 ¹ /2	⁵ /8 std. 1	1 1 ³ /8	6 6 ³ /8	3/8	7/16	1.63	3 7/16	4 ¹ /4
2	1″ STD. 1 ³ /8	1 ³ /8 1 ⁵ /8	6 ⁵ /8 6 ⁷ /8	⁵ /8	⁹ /16	2.05	4 ¹ /8	5 ¹ /8
2 1/2	1" STD 1 3/8 1 3/4	1 ³ /8 1 ⁵ /8 1 ⁷ /8	6 ³ /4 7 7 ¹ /4	5/8	9/16	2.55	4 5/8	5 ⁵ /8
3 1/4	1 ³ /8 STD. 1 ³ /4 2	1 5/8 1 7/8 2	7 7/8 8 1/8 8 1/4	3/4	^{11/} 16	3.25	5 ⁷ /8	7 1/8
4	1 ³ /4 STD. 2" 2 ¹ /2	1 ⁷ /8 2 2 ¹ /4	8 1/2 8 5/8 8 7/8	7/8	11/16	3.82	6 ³ /8	7 5/8
5	2" STD. 2 1/2 3" 3 1/2	2 2 1/4 2 1/4 2 1/4 2 1/4	9 1/8 9 3/8 9 3/8 9 3/8 9 3/8	7/8	15/16	4.95	8 ³ /16	9 ³ /4
6	2 1/2 STD. 3" 3 1/2 4"	2 1/4 2 1/4 2 1/4 2 1/4 2 1/4	10 ⁵ /8 10 ⁵ /8 10 ⁵ /8 10 ⁵ /8	1	1 ¹ /16	5.73	9 7/16	11 ¹ /4
7	3" STD. 3 1/2 4" 4 1/2	2 1/4 2 1/4 2 1/4 2 1/4 2 1/4	11 ³ /4 11 ³ /4 11 ³ /4 11 ³ /4	1	1 ³ /16	6.58	10 ⁵ /8	12 ⁵ /8
8	3 1/2 STD. 4" 4 1/2 5"	$\begin{array}{c} 2 & \frac{1}{4} \\ 2 & \frac{1}{4} \\ 2 & \frac{1}{4} \\ 2 & \frac{1}{4} \\ 2 & \frac{1}{4} \end{array}$	$ \begin{array}{r} 12 \ \frac{3}{4} \\ 12 \ \frac{3}{4} \\ 12 \ \frac{3}{4} \\ 12 \ \frac{3}{4} \\ 12 \ \frac{3}{4} \end{array} $	1	1 ⁵ /16	7.50	11 ¹³ /16	14



F1 - Head end rectangular flange



F2 - Cap end rectangular flange



F5 - Hea<mark>d end square flange</mark>



F6 - Cap end square flange

Flange mountings - pressure use restrictions

The F1 and F5 flanges are susceptible to bending during stroke extention if used under very high pressures. The same restrictions for F2 and F6 mountings are applied during stroke retraction and must be used with caution. Refer to restriction chart below. The E5 and E6 mountings are strongly recommended for applications of 3,000 PSI.

	Pressure u	use restrictions o	chart (PSI)	
BORE SIZE	F1 EXTENSION	F5 EXTENSION	F2 EXTENSION	F6 RETRACTION
1 1/2	2000	3000	3000	3000
2	2000	3000	3000	3000
2 ¹ /2	2000	3000	2800	3000
3 1/4	1800	3000	2500	2800
4	1500	2500	2200	2500
5	1200	2200	2000	2200
6	1000	2000	1800	2000
7	800	1500	1200	1800
8	800	1500	1200	1800

HEAVY DUTY HYDRAULIC CYLINDERS

EXTENDED TIE ROD MOUNTINGS





X3 - Head end extended tie rods

BORE SIZE	MM ROD DIA.	w	WF	ZJ	BB	DD	F	R
1 ¹ /2	⁵ /8 std. 1″	5/8 1	1 1 ³ /8	5 ⁵ /8 6	1 ³ /8	³ /8 - 24	³ /8	1.63
2	1″ STD. 1 ³ /8	³ /4 1	1 ³ /8 1 ⁵ /8	6 6 ¹ /4	1 ¹³ /16	1/2 - 20	5/8	2.05
2 ¹ /2	1" STD. 1 3/8 1 3/4	$\frac{3/4}{1}$	1 ³ /8 1 ⁵ /8 1 ⁷ /8	6 ¹ /8 6 ³ /8	1 ¹³ /16	¹ /2 - 20	⁵ /8	2.55
3 1/4	$1^{3/8}$ $1^{3/4}$ 2''	7/8 1 1/8 1 1/4	1 5/8 1 7/8 2	7 1/8 7 3/8 7 1/2	2 ⁵ /16	⁵ /8 - 18	3/4	3.25
4	1 ³ /4 STD. 2" 2 1/2	$1 \frac{1}{1/8}$	$\frac{2}{1.7/8}$ 2 2.1/4	7 5/8 7 3/4 8	2 ⁵ /16	⁵ /8 - 18	7/8	3.82
5	$ \begin{array}{r} 2'' \\ 2 1/2 \\ 3'' \\ 3 1/2 \end{array} $	1 ¹ /8 1 ³ /8 1 ³ /8 1 ³ /8	$ \begin{array}{r} 2 \\ 2 \\ 1/4 \\ 2 \\ 1/4 \\ 2 \\ 1/4 \end{array} $	8 1/4 8 1/2 8 1/2 8 1/2 8 1/2	3 ³ /16	7/8 - 14	7/8	4.95
6	$ \begin{array}{r} 2 & \frac{1}{2} \\ 3'' \\ 3 & \frac{1}{2} \\ 4'' \end{array} $	$ \begin{array}{r} 1 & 1/4 \\ 1 & 1/4 \\ 1 & 1/4 \\ 1 & 1/4 \\ 1 & 1/4 \\ 1 & 1/4 \\ \end{array} $	$ \begin{array}{r} \hline 2 & 1/4 \\ 2 & 1/4 \\ 2 & 1/4 \\ 2 & 1/4 \\ 2 & 1/4 \end{array} $	9 5/8 9 5/8 9 5/8 9 5/8 9 5/8	3 ⁵ /8	1 - 14	1	5.73
7*	3" STD. 3 1/2 4" 4 1/2	2 1/4 2 1/4 2 1/4 2 1/4 2 1/4	-	10 ³ /4 10 ³ /4 10 ³ /4 10 ³ /4	4 1/8	11/8 - 12	-	6.58
8*	3 1/2 STD. 4" 4 1/2 5"	2 1/4 2 1/4 2 1/4 2 1/4 2 1/4	- - -	11 ³ /4 11 ³ /4 11 ³ /4 11 ³ /4	4 ¹ /2	1 ¹ /4 - 12	-	7.50

* Comes withou front flange: BB and W measured from head



SIDE BASE MOUNTINGS

BORE SIZE	MM ROD DIA.	xs	LH	SB	SS	ST	sw	TS	US
1 ¹ /2	⁵ /8 std. 1″	1 ³ /8 1 ³ /4	1 1/4	7/16	3 ⁷ /8	1/2	3/8	3 ¹ /4	4
2	1″ std. 1 ³ /8	1 ⁷ /8 2 ¹ /8	1 ¹ /2	9/16	3 ⁵ /8	3/4	1/2	4	5
2 1/2	1" STD. 1 3/8 1 3/4	2 1/16 2 5/16 2 9/16	1 ³ /4	13/16	3 ³ /8	1	11/16	4 ⁷ /8	6 ¹ /4
3 1/4	1 ³ /8 STD. 1 ³ /4 2″	2 5/16 2 9/16 2 11/16	2 ¹ /4	¹³ /16	4 ¹ /8	1	¹¹ /16	5 ⁷ /8	7 ¹ /4
4	1 ³ /4 STD. 2" 2 ¹ /2	2 3/4 2 7/8 3 1/8	2 1/2	1 ¹ /16	4	1 ¹ /4	7/8	6 ³ /4	8 ¹ /2
5	2" STD. 2 1/2 3" 3 1/2	2 7/8 3 1/8 3 1/8 3 1/8	3 1/4	1 ¹ /16	4 1/2	1 1/4	7/8	8 1/4	10
6	2 1/2 STD. 3" 3 1/2 4"	3 ³ /8 3 ³ /8 3 ³ /8 3 ³ /8	3 ³ /4	1 ⁵ /16	5 1/8	1 1/2	1 ¹ /8	9 ³ /4	12
7	3" STD. 3 1/2 4" 4 1/2	3 5/8 3 5/8 3 5/8 3 5/8	4 1/4	1 9/ 16	5 ³ /4	1 ³ /4	1 ³ /8	11 ¹ /4	14
8	3 1/2 STD. 4" 4 1/2 5"	3 5/8 3 5/8 3 5/8 3 5/8 3 5/8	4 ³ /4	1 %16	6 ³ /4	1 ³ /4	1 ³ /8	12 ¹ /4	15



S2 - Side lugs mounting

Thrust key for side base mountings (optional)

It is recommended to use a thrust key for side base mountings (S2, S4 and S7) to avoid any shear stress force on the mounting bolts.



BORE SIZE	KW +.000 003	KD
1 1/2	.312	³ /16
2 - 2 ¹ /2	.562	⁵ /16
3 1/4	.687	3/8
4-5	.812	7/16
6-7-8	.937	1/2



SIDE BASE MOUNTINGS (cont'd)



S4 - Side tapped holes mounting

BORE SIZE	MM ROD DIA.	хт	ND	NT UNC	TN	SN	тн	
1 1/2	5/8 STD.	2	3/8	3/8-16	3/4	27/8	1 1/4	
1.72	1″	2 ³ /8	/0	/0 10	,.	2 /0	• /•	
2	1" STD.	2 ³ /8	7/10	1/2 12	15/10	2.7%	1 1/2	
4	1 ³ /8	2 5/8	2/16	'/2-13	13/16	2 ' /8	I '/2	
	1" STD.	2 ³ /8						
2 ¹ /2	1 ³ /8 STD.	2 5/8	1/2	5/8-11	1 5/16	3	1 ³ /4	
	1 3/4	2 7/8						
	1 ³ /8 STD.	2 ³ /4						
3 1/4	<u>1 3/4</u>	3	11/16	3/4 - 10	1 ¹ /2	3 ¹ /2	2 1/4	
	2″	3 ¹ /8						
	1 ³ /4 STD.	3						
4	2″	3 ¹ /8	11/16	1 - 8	2 ¹ /16	3 ³ /4	2 1/2	
	2 ¹ /2	3 ³ /8						
	2" STD.	3 ¹ /8				5 4 ¹ /4		
F	2 1/2	3 ³ /8	1	1 - 8	2 15/10		2 1/4	
5	3″	3 ³ /8	I		2 .0/16		5./4	
	3 1/2	3 ³ /8						
	2 ¹ /2 STD.	3 ¹ /2						
C	3″	3 ¹ /2	1 1/4	11/4 7	2 5/10	5 4 ¹ /4	2 3/4	
0	3 1/2	3 ¹ /2	1.74	1./4-/	5 %10	5./0	5 %	
	4″	3 ¹ /2						
	3″ std.	3 ¹³ /16						
7	3 1/2	3 ¹³ /16	1 1/0	11/2 6	2 3/4	5 7/o	1 1/4	
/	4″	3 ¹³ /16	I '/0	1 1/2 - 0	5 5/4	5 //0	4 1/4	
	4 1/2	3 ¹³ /16						
	3 1/2 STD.	3 ¹⁵ /16						
0	4″	3 ¹⁵ /16	1 1/2	11/2 0	4 1/4	6.5%	1 3/4	
ð	4 ¹ /2	3 ¹⁵ /16	1 1/2	1 1/2 - 6	4 '/4	3 3 1/2 3 3/4 4 1/4 5 1/8 5 7/8 6 5/8	4 7/4	
	5″	3 15/16						

BORE SIZE	MM ROD DIA.	XE	GH	EB	EL	EO	ET	ES	R	SE
1 1/2	⁵ /8 std. 1″	6 ¹ /2 6 ⁷ /8	1 ¹ /4	7/16	7/8	3/8	3/4	7/8	1.63	6 ³ /4
2	1″ std. 1 ³ /8	6 ¹⁵ /16 7 ³ /16	1 ¹ /2	9/16	^{15/} 16	1/2	¹³ /16	15/16	2.05	7 1/8
2 ¹ /2	1" STD. 1 ³ /8 1 ³ /4	7 ¹ /16 7 ⁵ /16 7 ⁹ /16	1 ³ /4	9/16	^{15/} 16	1/2	¹³ /16	^{15/} 16	2.55	7 1/4
3 1/4	1 ³ /8 STD. 1 ³ /4 2″	8 1/4 8 1/2 8 5/8	2 ¹ /4	11/16	1 ¹ /8	5/8	1 ¹ /8	1 ¹ /4	3.25	8 ¹ /2
4	1 ³ /4 STD. 2" 2 ¹ /2	8 ³ /4 8 ⁷ /8 9 ¹ /8	2 1/2	11/16	1 ¹ /8	5/8	1 ¹ /16	1 ¹ /4	3.82	8 ⁷ /8
5	2'' STD. $2 \frac{1}{2}$ 3'' $3 \frac{1}{2}$	9 ³ / ₄ 10 10 10	3 1/4	15/16	1 ¹ /2	3/4	1 ⁷ /16	1 1/2	4.95	10 ¹ /8
6	2 1/2 STD. 3" 3 1/2 4"	11 5/8 11 5/8 11 5/8 11 5/8 11 5/8	3 ³ /4	1 ¹ /16	1 ¹¹ /16	7/8	1 5/8	1 ³ /4	5.73	11 ³ /4



S7 - End lugs mounting

Not available in 7" and 8" bore sizes



DOUBLE ROD CYLINDERS

Basic dimensions



MOU	NTING	ALL			F1D F5D	E5D	S7	'D	S2D	T1D	X1D X3D
BORE	MM	+STROKE	+ STROKE	+ 2 X + STROKE	+ STROKE	+ STROKE	+ STROKE	+ STROKE	+ STROKE	+ STROKE	+ STROKE
SIZE	ROD DIA.	LD	ZL	ZM	ZR	ZG	SU	XU	SV	XR	ZO
1 1/2	5/8 STD.	4 ⁷ /8	6 ⁵ /8	6 ⁷ /8	6 ¹ /4	5 ⁷ /8	7 ³ /8	7 ¹ /8	4 ¹ /8	5	6 ¹ /4
T 1/2	1″	4 ⁷ /8	7	7 ⁵ /8	6 ⁵ /8	6 ¹ /4	7 ³ /8	7 ¹ /2	4 ¹ /8	5 ³ /8	6 ⁵ /8
h	1" STD.	4 ⁷ /8	7 ³ /8	7 ⁵ /8	6 ⁷ /8	6 ¹ /4	8	7 ¹³ /16	3 ⁷ /8	5 ³ /8	6 ⁷ /8
2	1 ³ /8	4 ⁷ /8	7 ⁵ /8	8 ¹ /8	7 ¹ /8	6 ¹ /2	8	8 ¹ /16	3 ⁷ /8	5 ⁵ /8	7 ¹ /8
	1" STD.	5	7 ¹ /2	7 ³ /4	7	6 ³ /8	8 ¹ /8	7 ¹⁵ /16	3 ⁵ /8	5 ¹ /2	7
2 1/2	1 ³ /8	5	7 ³ /4	8 ¹ /4	7 ¹ /4	6 ⁵ /8	8 ¹ /8	8 ³ /16	3 ⁵ /8	5 ³ /4	7 ¹ /4
	1 ³ /4	5	8	8 ³ /4	7 ¹ /2	6 ⁷ /8	8 ¹ /8	8 ⁷ /16	3 ⁵ /8	6	7 1/2
	1 ³ /8 STD	5 ³ /4	8 ³ /4	9	8 1/8	7 ³ /8	9 ¹ /2	9 ¹ /4	4 ³ /8	6 ³ /8	8 ¹ /8
3 1/4	1 ³ /4	5 ³ /4	9	9 ¹ /2	8 ³ /8	7 ⁵ /8	9 ¹ /2	9 ¹ /2	4 ³ /8	6 ⁵ /8	8 ³ /8
	2″	5 ³ /4	9 ¹ /8	9 ³ /4	8 1/2	7 ³ /4	9 ¹ /2	9 ⁵ /8	4 ³ /8	6 ³ /4	8 1/2
	1 ³ /4 STD.	6	8 %/16	9 ³ /4	8 ³ /4	7 ⁷ /8	10	9 ⁷ /8	4 ¹ /4	6 ⁷ /8	8 ³ /4
4	2″	6	8 ¹¹ /16	10	8 ⁷ /8	8	10	10	4 ¹ /4	7	8 ⁷ /8
	2 1/2	6	9 ¹³ /16	10 ¹ /2	9 ¹ /8	8 ¹ /4	10	10 ¹ /4	4 ¹ /4	7 ¹ /4	9 ¹ /8
	2" STD.	6 ¹ /2	9 ⁷ /16	10 ¹ /2	9 ³ /8	8 ¹ /2	11 ¹ /4	11 ⁷ /8	4 ³ /4	7 ¹ /2	9 ³ /8
_	2 1/2	6 ¹ /2	9 ¹¹ /16	11	9 ⁵ /8	8 ³ /4	11 ¹ /4	12 ¹ /8	4 ³ /4	7 ³ /4	9 ⁵ /8
5	3″	6 ¹ /2	9 ¹¹ /16	11	9 ⁵ /8	8 ³ /4	11 ¹ /4	12 ¹ /8	4 ³ /4	7 ³ /4	9 ⁵ /8
	3 1/2	6 ¹ /2	10 ⁹ /16	11	9 ⁵ /8	8 ³ /4	11 ¹ /4	12 ¹ /8	4 ³ /4	7 ³ /4	9 ⁵ /8
	2 1/2 STD.	7 ³ /8	10 ⁵ /8	11 ⁷ /8	10 ⁵ /8	9 ⁵ /8	12 ³ /4	11 ⁵ /16	5 ¹ /8	8 ¹ /2	10 ⁵ /8
C	3″	7 ³ /8	10 ⁵ /8	11 ⁷ /8	10 ⁵ /8	9 ⁵ /8	12 ³ /4	11 ⁵ /16	5 ¹ /8	8 ¹ /2	10 ⁵ /8
0	3 1/2	7 ³ /8	10 ⁵ /8	11 ⁷ /8	10 ⁵ /8	9 ⁵ /8	12 ³ /4	11 ⁵ /16	5 ¹ /8	8 ¹ /2	10 ⁵ /8
	4″	7 ³ /8	11 ⁵ /8	11 ⁷ /8	10 ⁵ /8	9 ⁵ /8	12 ³ /4	11 ⁵ /16	5 ¹ /8	8 ¹ /2	10 ⁵ /8
	3" STD.	8 1/2	11 ⁷ /8	13	11 ³ /4	10 ³ /4	N/D	N/D	5 ³ /4	9 ³ /8	11 ³ /4
7	3 1/2	8 ¹ /2	11 ⁷ /8	13	11 ³ /4	10 ³ /4	N/D	N/D	5 ³ /4	9 ³ /8	11 ³ /4
/	4″	8 ¹ /2	11 ⁷ /8	13	11 ³ /4	10 ³ /4	N/D	N/D	5 ³ /4	9 ³ /8	11 ³ /4
	4 ¹ /2	8 ¹ /2	12 ⁷ /8	13	11 ³ /4	10 ³ /4	N/D	N/D	5 ³ /4	9 ³ /8	11 ³ /4
	3 ¹ /2 STD.	9 ^{1/2}	13	14	12 ³ /4	11 ³ /4	N/D	N/D	6 ³ /4	10 ¹ /4	12 ³ /4
0	4″	9 ¹ /2	13	14	12 ³ /4	11 ³ /4	N/D	N/D	6 ³ /4	10 ¹ /4	12 ³ /4
0	4 ¹ /2	9 ¹ /2	13	14	12 ³ /4	11 ³ /4	N/D	N/D	6 ³ /4	10 ¹ /4	12 ³ /4
	5″	9 ^{1/2}	14	14	12 ³ /4	11 ³ /4	N/D	N/D	6 ³ /4	10 ¹ /4	12 ³ /4

TRUNNION MOUNTINGS



T1 - Head end trunnion mounting



TD^{+.000}

T2 - Cap end trunnion mounting

BORE SIZE	MM ROD DIA.	XG	XJ	E	TD +.000 002	TL	UT	
1.1/2	⁵ /8 STD.	1 7/8	4 7/8	2 1/2	1 000	1	4 1/2	
1 1/2	1″	2 1/4	5 1/4	2 1/2	1.000	-	4 1/2	
2	1" STD.	2 1/4	5 1/4 5 1/2 3	3	1 375	$1 \frac{3}{8}$	5 3/4	
2	<u>1 ³/8</u>	2 1/2	5 ¹ /2	J	1.373	1 /0	5 /4	
	1" STD.	2 1/4	5 ³ /8			<u>.</u>		
2 1/2	<u>1 ³/8</u>	$2^{1/2}$	<u> </u>	$3^{1/2}$	1.375	1 ³ /8	6 ⁻¹ /4	
	<u>1 3/4</u>	2 3/4	5 7/8					
	1 ³ /8 STD.	2 5/8	6 1/4			4.27		
3 ¹ /4	<u>1 ³/4</u>	2 7/8	6 ¹ /2	4 ¹ /2	1.750	1 ³ /4	8	
	2″	3	6 ⁵ /8					
	1 ³ /4 std.	2 7/8	6 ³ /4			1 27		
4	2″	3	6 ⁷ /8	5	1.750	I ³ /4	8 ¹ /2	
	2 1/2	3 1/4	7 1/8					
	2″ std.	3	7 ³ /8					
F	2 ¹ /2	3 ¹ /4	7 ⁵ /8	6.1/2	1 750	1 ³ /4 1 ³ /4 1 ³ /4 2	10	
5	3″	3 ¹ /4	7 ⁵ /8	0 1/2	1./50		10	
	3 1/2	3 1/4	7 5/8					
	2 ^{1/2} STD.	3 ³ /8	8 3/8					
C	3″	3 3/8	8 ³ /8	7 1/2	2 000	2	1116	
0	3 ¹ /2	3 ³ /8	8 ³ /8	/ '/2	2.000	-	11 '/2	
	4″	3 ³ /8	8 ³ /8					
	3″ std.	3 5/8	9 ³ /8					
7	3 1/2	3 5/8	9 ³ /8	0.1/2	2 500	2 1/2	12 1/2	
/	4″	3 5/8	9 ³ /8	0 1/2	2.500	2 12	13 1/2	
	4 ¹ /2	3 5/8	9 ³ /8					
	3 ^{1/2} STD.	3 ³ /4	10 ¹ /4					
0	4″	3 3/4	10 1/4	0.1/2	2 000	3	1 - 1/2	
ŏ	4 ¹ /2	3 3/4	10 1/4	9 1/2	3.000	5	15 1/2	
0	5″	3 3/4	10 1/4					

INTERMEDIATE TRUNNION MOUNTING

BORE SIZE	MM ROD DIA.	XI MIN.	TD ^{+.000} 002	TL	тм	тw	UM	UW	
1 ¹ /2	⁵ /8 std. 1″	3 ⁷ /16 3 ¹³ /16	1.000	1	3	1 1/4	5	3 1/2	
2	1″ std. 1 ³ /8	3 ^{15/16} 4 ³ /16	1.375	1 ³ /8	3 1/2	1 ¹ /2	6 ¹ /4	4 ⁵ /8	
2 1/2	1" STD. <u>1 ³/8</u> 1 ³ /4	3 ^{15/16} 4 ^{3/16} 4 ^{7/16}	1.375	1 ³ /8	4	1 1/2	6 ³ /4	4 ⁷ /8	
3 1/4	1 ³ /8 STD. 1 ³ /4 2″	$4 \frac{11}{16}$ $4 \frac{15}{16}$ $5 \frac{1}{16}$	1.750	1 ³ /4	5	2	8 ¹ /2	5 ¹³ /16	
4	1 ³ /4 STD. 2" 2 1/2	4 ¹⁵ /16 5 ¹ /16	1.750	1 3/4	5 1/2	2	9	6 ³ /8	¢
5	2" STD. 2 1/2 3" 3 1/2	5 ¹ /16 5 ⁵ /16 5 ⁵ /16 5 ⁵ /16	1.750	1 ³ /4	7	2	10 ¹ /2	7 7/8	¢
6	2 ¹ / ₂ std. 3" 3 ¹ / ₂ 4"	6 ¹ /16 6 ¹ /16 6 ¹ /16 6 ¹ /16	2.000	2	8 ¹ /2	3	12 ¹ /2	10	-
7	3" STD. 3 1/2 4" 4 1/2	6 9/16 6 9/16 6 9/16 6 9/16	2.500	2 1/2	9 ³ /4	3	14 ³ /4	11 ¹ /2	
8	3 1/2 STD. 4" 4 1/2 5"	7 1/16 7 1/16 7 1/16 7 1/16 7 1/16	3.000	3	11	3 1/2	17	13 ³ /8	



T4 - Intermediate trunnion mounting

* Customer must specify the XI dimension when ordering.

CLEVIS MOUNTINGS



P1 - Fixed clevis mounting



P5 - Spherical bearing mounting

P1, P3 MOUNTING							P5 MOUNTING										
BORE	MM	NG	C.D.	+ 002 001	GIV					+ 0000 0005	F Y	146	NID	MM	WIT	TH ROD EYE	N
SIZE	KODDIA.	xc	СВ	CD	CW	L	LK	м	мк	CX	EX	MS	NK	KODDIA,	PARI #	CE	XL
1 ¹ /2	⁵ /8 STD. 1″	6 ³ /8 6 ³ /4	3/4	.501	1/2	3/4	9/16	1/2	5/8	.5000	7/16	15/16	5/8	⁵ /8 STD. 1″	72-AAADP5 72-AAAEP5	7/8 1 ¹ /4	7 1/4 8
2	1" STD. 1 ³ /8	7 1/4 7 1/2	1 1/4	.751	5/8	1 1/4	1	3/4	15/16	.7500	21/32	1 ³ /8	1″	1" STD. 1 ³ /8	72-AAAEP5 72-AAAGP5	1 ¹ /4 1 ⁷ /8	8 1/2 9 3/8
2 1/2	$1^{"}$ STD. $1^{3}/8$ $1^{3}/4$	7 ³ /8 7 ⁵ /8 7 ⁷ /8	1 ¹ /4	.751	5/8	1 ¹ /4	¹⁵ /16	3/4	¹⁵ /16	.7500	21/32	1 ³ /8	1″	1" STD. 1 ³ /8 1 ³ /4	72-AAAEP5 72-AAAGP5 72-AAAHP5	1 ¹ / ₄ 1 ⁷ / ₈ 2 ¹ / ₈	8 5/8 9 1/2 10
3 1/4	1 ³ /8 STD. 1 ³ /4 2″	8 ⁵ /8 8 ⁷ /8 9	1 1/2	1.001	3/4	1 ¹ /2	1 ¹ /4	1	1 ³ /16	1.0000	7/8	1 ¹¹ /16	1 ¹ /4	1 ³ /8 STD. 1 ³ /4 2"	72-AAAGP5 72-AAAHP5 72-AAAIP5	$1\frac{7}{8}$ 2 $1/8$ 2 $1/2$	$10 \frac{1}{2}$ 11 11 $\frac{1}{2}$
4	$\frac{1^{3/4} \text{ STD.}}{2''}$	9 ³ /4 9 ⁷ /8 10 ¹ /8	2	1.376	1	2 1/8	1 ³ /4	1 ³ /8	1 5/8	1.3750	1 ³ /16	2 7/16	1 5/8	1 ³ /4 STD. 2" 2 ¹ /2	72-AAAHP5 72-AAAJP5 72-AAAKP5	$2 \frac{1}{8}$ $2 \frac{1}{8}$ $2 \frac{1}{2}$ $2 \frac{3}{4}$	$11 \frac{7}{8}$ $12 \frac{3}{8}$ $12 \frac{7}{8}$
5	2'' STD. $2 \frac{1}{2}$ 3'' $3 \frac{1}{2}$	10 ¹ / ₂ 10 ³ / ₄ 10 ³ / ₄ 10 ³ / ₄	2 1/2	1.751	1 1/4	2 1/4	2 ¹ /16	1 ³ /4	2 1/8	1.7500	1 ¹⁷ /32	2 7/8	2 ¹ /16	2'' STD. $2 \frac{1}{2}$ 3'' $3 \frac{1}{2}$	72-AAAJP5 72-AAAKP5 72-AAALP5 72-AAAMP5	2 ^{1/2} 2 ^{3/4} C/E C/E	13 13 ^{1/2} C/E C/E
6	$2 \frac{1}{2} \text{ STD.}$ 3'' $3 \frac{1}{2}$ 4''	12 ¹ /8 12 ¹ /8 12 ¹ /8 12 ¹ /8	2 1/2	2.001	1 1/4	2 1/2	2 ⁵ /16	2	2 ³ /8	2.0000	1 ³ /4	3 5/16	2 ³ /8	2 ¹ /2 STD. 3" 3 ¹ /2 4"	72-AAAKP5 72-AAALP5 72-AAAMP5 C/E	2 ³ /4 C/E C/E C/E	14 ⁷ /8 C/E C/E C/E
7	3" STD. 3 1/2 4" 4 1/2	13 ³ /4 13 ³ /4 13 ³ /4 13 ³ /4	3	2.501	1 1/2	3	2 3/4	2 1/2	2 7/8	C/E	C/E	C/E	C/E	3" STD. 3 1/2 4" 4 1/2	72-AAALP5 72-AAAMP5 C/E C/E	C/E C/E C/E C/E	C/E C/E C/E C/E C/F
8	3 ¹ / ₂ std. 4" 4 ¹ / ₂ 5"	15 15 15 15	3	3.001	1 1/2	3 1/4	3 1/4	2 ³ /4	3 1/8	C/E	C/E	C/E	C/E	3 ¹ / ₂ std. 4" 4 ¹ / ₂ 5"	72-AAAMP5 C/E C/E C/E	C/E C/E C/E C/E	C/E C/E C/E C/E

C/E: Dimensions available on request, consult engineering.

HEAVY DUTY HYDRAULIC CYLINDERS

SPHERICAL ROD EYE ACCESSORIES



70-AAAKP5 1.9996 4 15/16

70-AAALP5 C/E C/E

C/E

70-AAAMP5 C/E





SHOULDER ROD END RETAINING COUPLING



ROD DIA.	FLANGE PART NO.	PLATE PART NO.	B	С	D	E	F	G	J	К	м	N	Р	X	Y	Z
⁵ /8	83-AAAD7	84-AAAD7	.406	1 ¹ /2	⁹ /16	.500	2	.250	7/32	#10 - 24	1.125	.250	21/32	4	45°	90°
1″	83-AAAE7	84-AAAE7	.750	2	7/8	.500	2 ¹ /2	.250	9/32	¹ /4 - 20	1.500	.375	1 ¹ /16	6	30°	60°
1 ³ /8	83-AAAG7	84-AAAG7	.938	2 ¹ /2	1	.625	3	.250	11/32	⁵ /16 - 18	2.000	.375	1 ⁷ /16	6	30°	60°
1 ³ /4	83-AAAH7	84-AAAH7	1.187	3	1 ¹ /4	.625	4	.250	11/32	⁵ /16 - 18	2.375	.500	1 ¹³ /16	8	22.5°	45°
2″	83-AAAJ7	84-AAAJ7	1.438	3 ¹ /2	1 ⁵ /8	.750	4	.375	13/32	³ /8 - 16	2.688	.625	2 ¹ /16	12	15°	30°
2 ¹ /2	83-AAAK7	84-AAAK7	1.875	4	1 ⁷ /8	.750	4 ¹ /2	.375	13/32	³ /8 - 16	3.188	.750	2 ⁵ /8	12	15°	30°
3″	83-AAAL7	84-AAAL7	2.375	5	2 ³ /8	1.000	5 ¹ /2	.375	17/32	¹ /2-13	4.000	.875	3 ¹ /8	12	15°	30°
3 ¹ /2	83-AAAM7	84-AAAM7	2.625	5 ⁷ /8	2 ⁵ /8	1.000	7	.375	21/32	⁵ /8- 11	4.688	1.000	3 ⁵ /8	12	15°	30°

SELF-ALIGNMENT ROD COUPLER



PART NO.	ROD Dia.	A	В	С	D	E	G	н	MAX. LOAD
78-AAAD1	5/8	⁷ /16- 20	1 ¹ /4	2	1/2	³ /4	⁹ /16	1 ¹ /8	3200
78-AAAD2	⁵ /8	¹ /2- 20	1 ¹ /4	2	1/2	3/4	9/16	1 ¹ /8	4000
78-AAAE1	1	³ /4 - 16	1 ³ /4	2 ⁵ /16	⁵ /16	1 ¹ /8	7/8	1 ¹ /2	9800
78-AAAE2	1	⁷ /8 - 14	1 ³ /4	2 ⁵ /16	⁵ /16	1 ¹ /8	7/8	1 ¹ /2	9800
78-AAAG1	1 ³ /8	1 - 14	2 ¹ /2	2 ¹⁵ /16	1/2	1 ⁵ /8	1 ¹ /4	2 ¹ /4	20000
78-AAAH1	1 ³ /4	1 ¹ /4 - 12	2 ¹ /2	2 ¹⁵ /16	1/2	1 ⁵ /8	1 ³ /8	2 ¹ /4	20000
78-AAAJ1	2	1 ¹ /2 - 12	3 ¹ /4	4 ³ /8	¹³ /16	2 ¹ /4	1 ¹ /2	3	34000
78-AAAK1	2 ¹ /2	1 ⁷ /8-12	3 ³ /4	5 ⁷ /16	¹¹ /16	3	1 7/8	3 1/2	65000

Other dimensions available on request.



CLEVIS MOUNTING ACCESSORIES

ROD DIA.	ROD END THREADS	ROD CLEVIS	ROD EYE	CLEVIS PIN	CLEVIS BRACKET	EYE BRACKET	BORE SIZE
5/8	7/16 - 20	71 - AAAD	72 - AAAD	70 - AAAD	75 - AAAD	76 - AAAD	1 1/2
1	³ /4 - 16	71 - AAAE	72 - AAAE	70 - AAAE	75 - AAAE	76 - AAAE	2 - 2 ¹ /2
1 ³ /8	1 - 14	71 - AAAG	72 - AAAG	70 - AAAG	75 - AAAG	76 - AAAG	2 - 3 ¹ /4
1 ³ /4	1 ¹ /4 - 12	71 - AAAH	72 - AAAH	70 - AAAH	75 - AAAH	76 - AAAH	2 ¹ /2 - 4
2	1 ¹ /2 - 12	71 - AAAJ	72 - AAAJ	70 - AAAJ	75 - AAAJ	76 - AAAJ	3 ¹ /4 - 5
2 ¹ /2	17/8-12	71 - AAAK	72 - AAAK	70 - AAAK	75 - AAAK	76 - AAAK	4 - 6
3	21/4 - 12	71 - AAAL	72 - AAAL	70 - AAAL	-	-	5 - 7
3 ¹ /2	2 ¹ /2 - 12	71 - AAAM	72 - AAAM	70 - AAAM	-	-	6 - 8



71-KOD CLEVIS												
PART NO. A CB CD CE CW ER KK												
71 - AAAD	3/4	3/4	1/2	1 ¹ /2	1/2	1/2	⁷ /16 - 20					
71 - AAAE	1 ¹ /8	1 ¹ /4	3/4	2 ³ /8	5/8	3/4	³ /4 - 16					
71 - AAAG	15/8	1 ¹ /2	1	31/8	3/4	1	1 - 14					
71 - AAAH	2	2	1 ³ /8	4 ¹ /8	1	1 ³ /8	1 ¹ /4 - 12					
71 - AAAJ	21/4	21/2	13/4	4 ¹ /2	11/4	13/4	1 ¹ /2 - 12					
71 - AAAK	1 - AAAK 3 2 ¹ / ₂ 2 5 ¹ / ₂ 1 ¹ / ₄ 2 1 ⁷ / ₈ -12											
71 - AAAL 3 ¹ / ₂ 3 2 ¹ / ₂ 6 ¹ / ₂ 1 ¹ / ₂ 2 ¹ / ₂ 2 ¹ / ₄ - 12												
71 - AAAM 31/2 3 3 63/4 11/2 23/4 21/2 - 12												





11/8 - 12 81/2

3 1 1/2 11/4 - 12 91/2

1 4 2 5/8

1

4 1/4 2 7/8

2 1/2 6.59

2 3/4 7.50

Rod accessories 4" - 4 1/2" - 5" available on request.

75 - AAAL

75 - AAAM

3 21/2 1 1/2

3

76-EYE BRACKET



PART NO.	CB	CD	DD	E	F	FL	LR	MR	R
76 - AAAD	3/4	1/2	13/32	2 ¹ /2	3/8	1 ¹ /8	3/4	9/16	1.63
76 - AAAE	1 ¹ /4	3/4	17/32	31/2	5/8	1 ⁷ /8	11/4	7/8	2.55
76 - AAAG	1 ¹ /2	1	21/32	41/2	3/4	21/4	11/2	11/4	3.25
76 - AAAH	2	1 ³ /8	21/32	5	7/8	3	21/8	1 ⁵ /8	3.82
76 - AAAJ	2 ¹ /2	1 ³ /4	29/32	6 ¹ /2	7/8	3 ¹ /8	2 ¹ /4	2 ¹ /8	4.95
76 - AAAK	2 ¹ /2	2	1 ¹ /16	71/2	1	31/2	21/2	2 ⁷ /16	5.73
76 - AAAL	3	2 ¹ /2	1 ³ /16	81/2	1	4	3	3	6.59
76 - AAAM	3	3	1 ⁵ /16	91/2	1	41/4	31/4	3 1/4	7.50

HEAVY DUTY HYDRAULIC CYLINDERS

FORCE AND VOLUME CHART

Technical data

EXTENSION THRUST IN LBS												VOLUI	ME PER
BORE	PISTON					PRESSU	re in PSI					INCH OF	STROKE
SIZE	AREA	500	750	1000	1250	1500	1750	2000	2250	2500	3000	SQUARE FEET	US GAL.
1 1/2	1.77	884	1,325	1,767	2,209	2,651	3,093	3,534	3,976	4,418	5,301	0.00102	0.0076
2	3.14	1571	2,356	3,142	3,927	4,712	5,498	6,283	7,069	7,854	9,425	0.00182	0.0136
2 1/2	4.91	2,454	3,682	4,909	6,136	7,363	8,590	9,817	11,045	12,272	14,726	0.00284	0.0212
3 1/4	8.30	4,148	6,222	8,296	10,370	12,444	14,518	16,592	18,665	20,739	24,887	0.00480	0.0359
4	12.57	6,283	9,425	12,566	15,708	18,850	21,991	25,133	28,274	31,416	37,699	0.00727	0.0544
5	19.63	9,817	14,726	19,635	24,544	29,452	34,361	39,270	44,179	49,087	58,905	0.01136	0.0850
6	28.27	14,137	21,206	28,274	35,343	42,412	49,480	56,549	63,617	70,686	84,823	0.01636	0.1224
7	38.48	19,242	28,863	38,485	48,106	57,727	67,348	76,969	86,590	96,211	115,454	0.02227	0.1666
8	50.27	25,133	37,699	50,265	62,832	75,398	87,965	100,531	113,097	125,664	150,796	0.02909	0.2176

RETRACTION THRUST IN LBS Subtract corresponding value to obtain resulting pulling force in LB										ce in LBS	VOLUME PER		
ROD	ROD					PRESSU	re in psi						SIKUKE
DIA.	AREA	500	750	1000	1250	1500	1750	2000	2250	2500	3000	SQUARE FEET	US GAL.
5/8	0.31	153	230	307	383	460	537	614	690	767	920	0.00018	0.0013
1	0.79	393	589	785	982	1,178	1,374	1,571	1,767	1,963	2,356	0.00045	0.0034
1 3/8	1.48	742	1,114	1,485	1,856	2,227	2,599	2,970	3,341	3,712	4,455	0.00086	0.0064
1 3/4	2.41	1,203	1,804	2,405	3,007	3,608	4,209	4,811	5,412	6,013	7,216	0.00139	0.0104
2	3.14	1,571	2,356	3,142	3,927	4,712	5,498	6,283	7,069	7,854	9,425	0.00182	0.0136
2 1/2	4.91	2,454	3,682	4,909	6,136	7,363	8,590	9,817	11,045	12,272	14,726	0.00284	0.0212
3	7.07	3,534	5,301	7,069	8,836	10,603	12,370	14,137	15,904	17,671	21,206	0.00409	0.0306
3 1/2	9.62	4,811	7,216	9,621	12,026	14,432	16,837	19,242	21,648	24,053	28,863	0.00557	0.0416
4	12.57	6,283	9,425	12,566	15,708	18,850	21,991	25,133	28,274	31,416	37,699	0.00727	0.0544
4 1/2	15.90	7,952	11,928	15,904	19,880	23,856	27,833	31,809	35,785	39,761	47,713	0.00920	0.0688

PORTS

As a standard, the HP Series cylinder ports are built to accept SAE-O-ring connectors. As optional equipment, the cylinder can also be supplied with NPTF type ports at no extra charge. Oversized ports are available for both types of connections allowing higher fluid flow rates. For these applications, the coupling connections are welded on both ends of the cylinder, as shown below.



				OVERSIZED PORTS						
BORE SIZE	STD. SAE	OPT. NPTF	XX SAE	XX NPTF	BD	BH	Р			
1 1/2	-10	1/2	-12	3/4	1 ³ /8	1	3			
2	-10	1/2	-12	3/4	1 ³ /8	1	3			
2 ¹ /2	-10	1/2	-12	3/4	1 ³ /8	1	3 ³ /8			
3 1/4	-12	3/4	-16	1	1 3/4	1 1/4	3 1/2			
4	-12	3/4	-16	1	1 ³ /4	1 ¹ /4	3 ³ /4			
5	-12	3/4	-16	1	1 ³ /4	1 1/4	4 ¹ /4			
6	-16	1	-20	1 ¹ /4	2 ¹ /4	1 ¹ /2	5 ¹ /4			
7	-20	1 1/4	-24	1 ¹ /2	2 1/2	1 3/4	5 ¹ /2			
8	-24	1 ¹ /2	-24	2	3	1 ³ /4	6 ¹ /4			

HEAVY DUTY HYDRAULIC CYLINDERS

PISTON ROD DIMENSION AND STOP TUBE SELECTION

Applications that require long extended (push) stroke or an extended piston rod may require an oversized piston rod to avoid any buckling. Furthermore, if the cylinder is working under extension, or if it is installed horizontally, the installation of a stop tube might be necessary to avoid premature wear of the end stroke guides.

How to select the piston rod diameter

- 1) Determine the cylinder extension thrust by using the force chart on page 17.
- 2) Select the mounting for your application from the diagrams below.
- Use the dimension diagrams below to help you calculate the dynamic length "D".
- 4) Locate the intersection point where the thrust and the "D" length meet on the selection chart to the right. The minimum piston rod diameter required is indicated on the diagonal line immediately above the point.



How to calculate the stop tube

The stop tube is a spacer between the head end and the piston. The separation reduces the lateral force on the piston preventing premature barrel and gland bushing wear. We recommend a stop tube when the "D" length is over 40 inches. One inch of stop tube length is recommended for every 10 inches (or fraction thereof) of "D" length. The stop tube is not required for vertically mounted cylinders or applications working under pulling forces (retraction) only.



HEAVY DUTY HYDRAULIC CYLINDERS

REPLACEMENT PARTS

The spare parts and seal kits can be ordered, using part number prefix followed by the cylinder model number. Ex.: $20 - HP 3000 \text{ GG1BE5} - 12 \longrightarrow Piston.$ It is recommended to provide the cylinder serial number to facilitate inquiries for part replacement.



Recommended torque chart for tie rods

BORE	TIE RODS	TORQUE (FT-LBS)
SIZE	DIA.	TIE RODS
1 1/2	3/8	15
2 - 2 ¹ /2	1/2	45
3 ¹ /4 - 4	⁵ /8	125
5	7/8	310
6	1	525
7	1 ¹ /8	810
8	1 ¹ /4	1180

WARRANTY

RDC Contrôle Ltée, hereinafter referred to as The Seller, warrants products of its manufacture to be free from defects in material or workmanship under normal use for 12 months after the date of original shipment from the factory.

The liability of The Seller is limited to the repair or replacement of the defective component or product, at The Seller's option, during the warranty period only if factory inspection shows no external affects or customer repair has altered the functioning of the product. All transportation costs are for the buyer's account.

All defective parts must be returned to RDC Contrôle Ltée within the warranty period after shipment by RDC Contrôle Ltée. Written permission for such return must first be obtained. A complete explanation is required of the defect and circumstances.

Any alteration or repair of the goods by the party not authorized by RDC Contrôle Ltée without specific written consent shall automatically terminate the warranty obligations.

In no event shall The Seller be liable for any incidental, consequential or special damages or any kind or nature whatsoever, including but not limited to lost profits arising from or in any way connected with this agreement or items sold hereunder, whether alleged to arise from breach of contract express or implied warranty, or in tort,

	Description	Quy
10	Head	1
11	Сар	1
13	Barrel	1
14*	Barrel seal	2
17	Tie rod	4
18	Tie rod nuts	4
20	Piston	1
21*	Piston packing	1
22*	Piston wear strip	1
23*	Piston O-ring	1
25	Piston rod	1
30	Gland bushing	1
31*	Gland packing	1
33*	Gland O-ring & Backup Ring	1
35*	Rod wiper	1
40	Gland retainer plate	1
41	Retainer plate screws	6
52	Head end cushion plunger	1
54	Cushion adjustment screw	2
55*	Adjustment screw seal (O-ring)	2
57	Cap end cushion plunger	1

	Seal repair Kit
19	For barrel (part #14)
29	For piston (parts #21 and 22)
39	For gland bushing (parts #31, 33, 35)
38	Bushing and seals (parts #30, 31, 33, 35)
99	Complete (parts marked with an *)

Please request out IOM manual for more detailed maintenance instructions on the HP Series Cylinders.

including without limitation, negligence, failure to warn or strict liability.

This warranty shall be rendered null and void when, in the judgement of RDC Contrôle Ltée, the equipment has been subject to abnormal or abusive use or lack of proper care and maintenance by the buyer, or when it has been determined that environmental or application conditions have exceeded those specified for normal use of a specific product.

Notwithstanding the foregoing, there are no warranties whatsoever on items built wholly or partially, to buyer's design or specifications.

Finished materials and accessories purchased from other manufacturers are warranted only to the extent of the manufacturers' warranty to the seller.

The Seller makes no warranty of any kind whatsoever, expressed or implied, other than as specifically stated herein; and there are no warranties of merchantability and/or fitness for a particular purpose which exceed the obligations and warranties specifically stated herein.

Parts furnished without charge as replacements for original parts under warranty are warranted for the remainder of the original warranty period.
HP 3000 SERIES

HEAVY DUTY HYDRAULIC CYLINDERS

	Product Code											
Series	Bore (ir) ^R	od Diameter (in)	Thread	Cushion			Mounting			Optio	n
HP 3000	C - 1 1/2 D - 2 E - 2 1/2 G - 3 1/4 H - 4 K - 5 L - 6 M - 7 N - 8 P - 10 R - 12 S - 14		D - 5/8 E - 1 G - 1 3/8 H - 1 3/4 J - 2 K - 2 1/2 L - 3 M - 3 1/2 N - 4 P - 4 1/2 R - 5 Z - Other	 Small male Intermediate male Full male Female Metric Special female Special male 	B - Both en F - Cap end H - Head e N - None	ids 1 ind	VR - RDU VF - Cusi E3 - Squi E4 - Squi E5 - Rect F1 - Hea F2 - Cap F5 - Hea F6 - Cap P1 - Cap P2 - Cap P3 - Cap P3 - Cap P3 - Cap P3 - Cap F3 - Cap F4 - Intel X3 - Exter X3 - Exter X4 - Two F9 - Spec F9 - Spec F3 - Sp	C valve mount tomer valve mo are head are cap angular head d end retangula end rectangula d end square fla end square fla fixed clevis detachable cle fixed eye detachable eye detachable eye detachable eye detachable eye lilel base mount tapped holes lugs mount d trunnion t	ount ar flange r flange ange ye vis e t on oth ends ap end ead end ded both o mount nt e rods nt	A - B - B - C - C - C - C - D - E - I J - R K1 - K4 - N - P - I N - P - I N - T - S Y - Z - J - R - T - S S - N - N - R - X - S - S - S - S - S - S - S - S	Stroke adjusment Rod boot Dimension of Extended tie rods head Port dimension is EE Dimension between hion nor dithreads : W Extended tie rods cap of Double rod Eyebolt 4 wrench flats tod extention Material cha Piston rod - Head, cap, piston roc on, barrel: stainless ste - Viton seals - Others (can be equal bination) Permanent lubrication Magnetic piston Four supplementary n Port position change Rod scraper Stop tube Manual override AWWA specification Spring to extend Spring to retract Other special option Mechanical switch Transducer Solenoid valve Positionner	change I end : BB ead and beginning of end : K unge I, tie rods, nuts, el to other K uts
Exam	ole 1											
HP 3000 Hydrauli Cylinder 3000 psi	c C		E 2.5″ Rod DIA	4 Female Threads	N None Cushions	X3 Exte rods end	nded tie head	E Eyebolt	N Four supplem tary nuts	en-	-	10.00 10″ Stroke
Exam	ole 2											
HP 3000 Hydrauli Cylinder 3000 psi	c L 6″ Bore		E 2.5″ Rod Dia	4 Female Threads	N None Cushions	E5 Rect head	angular 1	C -> Dim. Change -> W = 6.5"	E Eyebolt		K1 Piston rod -> Material Change -> 17-4SS rod	10.00 10″ Stroke

CONTRÔLE

MANUFACTURER INDUSTRIAL CYLINDERS VALVE ACTUATORS THERMOCOUPLES

1100 Michèle-Bohec, Blainville (Quebec) J7C 5N5 Tel: 450.434.0216 • Fax: 450.434.0219 • Watts: 1 800 363.2264

www.rdccontrol.com



HI-BUILD EPOXOLINE® II SERIES V69

PRODUCT DATA SHEET

PRODUCI PROFILE						
GENERIC DESCRIPTION	Polvamidoamine Epoxy					
COMMON USAGE	An advanced generation epoxy and is suitable for immersion as chemicals. This product can als	for protection and finishing of well as chemical contact exponents of the used for lining storage to	of steel and concrete. It has exc posure. Contact your local Tner anks that contain demineralized	ellent resistance to abrasion nec representative for a list of deionized or distilled water		
COLORS	Refer to Tnemec Color Guide. I mixing, miscatalyzation or the u stages of curing may cause vell	Note: Epoxies chalk with extense of heaters that emit carbo pwing to occur.	ended exposure to sunlight. Lac n dioxide and carbon monoxid	k of ventilation, incomplete e during application and initial		
FINISH	Satin	0				
SPECIAL QUALIFICATIONS	A two-coat system at 4.0-6.0 dry 4556F for fuel storage.	7 mills (100-150 dry microns)	per coat passes the performance	e requirements of MIL-PRF-		
PERFORMANCE CRITERIA	Extensive test data available. Co	ontact your Tnemec represent	tative for specific test results.			
COATING SYSTEM						
SURFACER/FILLER/PATCHER	215					
PRIMERS	Steel: Self-priming or Series 1, 2 H ₂ O, 135, 161, 394, 530 Galvanized Steel and Non-Ferro Concrete: Self-priming or 130, 215	 7, 37H, 66, L69, L69F, N69F, xus Metal: Self-priming or Seri 130, 215, 218 	V69F, 90E-92, 90-97, H90-97, 90 ies 66, L69, L69F, N69F, V69F, 1)G-1K97, 90-98, 91-H ₂ O, 94- 161		
TOPCOATS	 22, 46H-413, 66, L69, L69F, N69 740, 750, 1028, 1029, 1070, 1070 COLORS on applicable topcoat V69: Immersion Service—Surface epoxy tie-coat is required. When Contact your Themee represent 	, N69F, V69, V69F, 72, 73, 84 V, 1071, 1071V, 1072, 1072V data sheets for additional infi- ce must be scarified after 60 c n topcoating with Series 740 ative for specific recommend	, 104, 113, 114, 141, 156, 157, 1 , 1074, 1074U, 1075, 1075U, 10 ormation. Note: The following lays. Atmospheric Service—Afte or 750, recoat time for V69 is 2 ations.	.61, 175, 180, 181, 287, 446, 77, 1078, 1080, 1081. Refer to recoat times apply for Series er 60 days, scarification or an 1 days for atmospheric service.		
SURFACE PREPARATION						
PRIMED STEEL	Immersion Service: Scarify the e	epoxy prime coat surface by a	abrasive blasting with fine abras	sive before topcoating if it has		
CTEEI	been exterior exposed for 60 da	ays or longer and V69 is the s	specified topcoat.	anchor profile of 1.5 mile		
JIEL	Non-Immersion Service: SSPC-SPT0/J	P6/NACE 3 Commercial Blast	Cleaning with a minimum angular	ular anchor profile of 1.5 mils.		
GALVANIZED STEEL & NON- Ferrous Metal	Surface preparation recommend representative or Tnemec Tech	lations will vary depending o nical Services.	n substrate and exposure cond	itions. Contact your Tnemec		
CAST/DUCTILE IRON	Contact your Tnemec represent	ative or Tnemec Technical Se	ervices.			
CONCRETE	Allow new concrete to cure 28	days. For optimum results an	d/or immersion service, abrasiv	ve blast referencing SSPC-		
CMU	Allow mortar to cure for 28 day	s. Level protrusions and mor	tar spatter.	on and application outde.		
PAINTED SURFACES	Non-Immersion Service: Ask your Themec representative for specific recommendations					
ALL SURFACES	Must be clean, dry and free of o	oil, grease, chalk and other co	ontaminants.			
TECHNICAL DATA						
VOLUME SOLIDS Recommended DFT Curing time at 5 mils det	67.0 ± 2.0% (mixed) † 2.0 to 10.0 mils (50 to 255 micro microns) per coat. Otherwise, ti method and exposure. Contact Without 44-700 Accelerator	ons) per coat. Note: MIL-PRF- he number of coats and thick your Tnemec representative.	4556F applications require two ness requirements will vary wit	coats at 4.0-6.0 mils (100-150 th substrate, application		
	Temperature	To Handle	To Recoat	Immersion		
	90°F (32°C)	5 hours	7 hours	7 days		
	80°F (27°C)	7 hours	9 hours	7 days		
	70°F (21°C)	9 hours	12 hours	7 days		
	60°F (16°C)	16 hours	22 hours	9 to 12 days		
	50°F (10°C) Curing time varies with surface	24 hours temperature, air movement, l	32 hours humidity and film thickness. No	12 to 14 days Ste: For faster curing and low-		
/OLATILE ORGANIC COMPOUNDS	Unthinned: 1.95 lbs/gallon (234	vo. 44-700 Epoxy Accelerator; grams/litre)	; see separate product data she	et for cure information.		
HAPS	Thinned 2.5% (No. 4 Thinner): Unthinned: 2.05 lbs/gal solids Thinned 2.5% (No. 4 Thinner):	2.08 lbs/gallon (250 grams/lit 2.30 lbs/gal solids)	re) †			
THEORETICAL COVERAGE	1,074 mil sq ft/gal (26.4 m ² /L at	25 microns). See APPLICATI	ON for coverage rates. †			
NUMBER OF COMPONENTS PACKAGING	Two: Part A (amine) and Part B 5 gallon (18.9L) pails and 1 gall	(epoxy) — One (Part A) to o on (3.79L) cans — Order in r	one (Part B) by volume. nultiples of 2.			

Published technical data and instructions are subject to change without notice. The online catalog at www.tnemec.com should be referenced for the most current technical data and instructions or you may contact your Tnemec representative for current technical data and instructions.

PRODUCT DATA SHEET

HI-BUILD EPOXOLINE® II | SERIES V69

NET WEIGHT PER GALLON STORAGE TEMPERATURE **TEMPERATURE RESISTANCE** SHELF LIFE FLASH POINT - SETA **HEALTH & SAFETY**

 14.01 ± 0.25 lbs (6.36 ± .11 kg) (mixed) †

Minimum 20°F (-7°C) Maximum 110°F (43°C)

(Dry) Continuous 250°F (121°C) Intermittent 275°F (135°C)

Part A: 24 months; Part B: 12 months at recommended storage temperature.

Part A: 82°F (28°C) Part B: 86°F (30°C)

Paint products contain chemical ingredients which are considered hazardous. Read container label warning and Material Safety Data Sheet for important health and safety information prior to the use of this product. **Keep out of the reach of children**.

A

			Dry Mils (Micro	ns) W	et Mils (Microns)	Sq Ft/0	Gal (m ² /Gal)
	Suggeste	d (1)	6.0 (150)		9.0 (230)	17	79 (16.6)
	Minimu	um	2.0 (50)		3.0 (75)	53	37 (49.9)
	Maxim	Maximum 10.0 (250) 15.0		15.0 (375)	10	07 (10.0)	
	CMU: From 75 to (1) Note for Steel Series V69 can be microns) or 11.5 t is rounded to the dry film thickness	100 sq ft (7.0 : Roller or brus e spray applied to 14.5 wet mi nearest 0.5 mi	to 9.3 m ²) per gallon, sh application require t to an optional high- ls (209 to 370 wet mi il or 5 microns. Appli	es two or more c build film thickn crons). Allow for cation of coating	oats to obtain reco ess range of 8.0 to overspray and sur below minimum o	mmended film th 10.0 dry mils (20) face irregularities or above maximum	ickness. Also, 5 to 255 dry . Film thickne m recommeno
MIXING	 I. Start with equal Using a power (For accelerate Add four (4) fluid Add Part A to 1 Both compone between 50°F to 0 mixed material to For optimum a Note: The use of 	l amounts of b mixer, separat d version. If ne l ounces of 44 Part B under a foo°F (10°C to o stand 30 minu pplication pro more than the	ooth Parts A & B. tely stir Parts A & B. ot using 44-700, skip -700 per gallon of Par gitation, stir until tho oove 50°F (10°C) prio 16°C) or the accelerat utes and restir before perties, the material t recommended amou	to No. 4.) rt A while Part A roughly mixed. or to mixing. For ted version to sur using. emperature shou up of 44-700 will	is under agitation. application of the 1 faces between 35° Id be above 60°F (adversely affect p	unaccelerated ver. F to 50°F (2°C to (16°C). erformance	sion to surfac 10°C), allow
THINNING	A maximum of 2	5% of No. 4 T	hinner may be used t	o comply with V	OC regulations		
POT LIFE	Without 44-700: 6 With 44-700: 2 ho	6 hours at 50°F ours at 50°F (10	7 (10°C) 4 hours at 7 0°C) 1 hour at 75°	75°F (24°C) 1 h F (24°C) 30 mir	our at 100°F (38°C autes at 100°F (38°C)) C)	
SPRAY LIFE	Without 44-700: 1 Note: Sprav appli	l hour at 75°F cation after lis	(24°C) With 44- ted times will adverse	-700: 30 minutes ely affect ability t	at 75°F (24°C) o achieve recomm	ended dry film th	ickness.
PPLICATION EQUIPMENT	Air Spray ‡				1	r	1
PPLICATION EQUIPMENT	Air Spray ‡ Gun	Fluid Tip	Air Cap	Air Hose ID	Mat'l Hose ID	Atomizing Pressure	Pot Pressu
PPLICATION EQUIPMENT	Air Spray ‡ Gun DeVilbiss JGA	Fluid Tip E	Air Cap 765 or 704	Air Hose ID 5/16" or 3/8" (7.9 or 9.5 mm)	Mat'l Hose ID 3/8" or 1/2" (9.5 or 12.7 mm)	Atomizing Pressure 75-100 psi (5.2-6.9 bar)	Pot Pressu 10-20 ps (0.7-1.4 ba
PPLICATION EQUIPMENT	Air Spray ‡ Gun DeVilbiss JGA Low temperatures	Fluid Tip E s or longer hos	Air Cap 765 or 704 ses require higher po	Air Hose ID 5/16" or 3/8" (7.9 or 9.5 mm) t pressure.	Mat'l Hose ID 3/8" or 1/2" (9.5 or 12.7 mm)	Atomizing Pressure 75-100 psi (5.2-6.9 bar)	Pot Pressu 10-20 ps (0.7-1.4 ba
PPLICATION EQUIPMENT	Air Spray ‡ Gun DeVilbiss JGA Low temperatures Airless Spray ‡	Fluid Tip E s or longer hos	Air Cap 765 or 704 ses require higher por	Air Hose ID 5/16" or 3/8" (7.9 or 9.5 mm) t pressure.	Mat'l Hose ID 3/8" or 1/2" (9.5 or 12.7 mm)	Atomizing Pressure 75-100 psi (5.2-6.9 bar)	Pot Pressu 10-20 ps (0.7-1.4 ba
PPLICATION EQUIPMENT	Air Spray ‡ Gun DeVilbiss JGA Low temperatures Airless Spray ‡ Tip Orif	Fluid Tip E s or longer hos	Air Cap 765 or 704 ses require higher por	Air Hose ID 5/16" or 3/8" (7.9 or 9.5 mm) t pressure.	Mat'l Hose ID 3/8" or 1/2" (9.5 or 12.7 mm) Mat'l Hose ID	Atomizing Pressure 75-100 psi (5.2-6.9 bar) Man	Pot Pressu 10-20 ps (0.7-1.4 ba
PPLICATION EQUIPMENT	Air Spray ‡ Gun DeVilbiss JGA Low temperatures Airless Spray ‡ Tip Orif 0.015"-0.	Fluid Tip E s or longer hos fice	Air Cap 765 or 704 ses require higher pot Atomizing Press 3000-4800 ps	Air Hose ID 5/16" or 3/8" (7.9 or 9.5 mm) t pressure.	Mat'l Hose ID 3/8" or 1/2" (9.5 or 12.7 mm) Mat'l Hose ID 1/4" or 3/8"	Atomizing Pressure 75-100 psi (5.2-6.9 bar) Man 6	Pot Pressu 10-20 ps (0.7-1.4 bz
PPLICATION EQUIPMENT	Air Spray ‡ Gun DeVilbiss JGA Low temperatures Airless Spray ‡ Tip Orif 0.015*-0. (380-485 mi	Fluid Tip E s or longer hos fice 019" icrons)	Air Cap 765 or 704 ses require higher por Atomizing Press 3000-4800 ps (207-330 bar)	Air Hose ID 5/16" or 3/8" (7.9 or 9.5 mm) t pressure. i	Mat'l Hose ID 3/8" or 1/2" (9.5 or 12.7 mm) Mat'l Hose ID 1/4" or 3/8" (6.4 or 9.5 mm)	Atomizing Pressure 75-100 psi (5.2-6.9 bar) Man 6 (250	Pot Pressa 10-20 ps (0.7-1.4 ba ifold Filter 0 mesh microns)
PPLICATION EQUIPMENT	Air Spray ‡ Gun DeVilbiss JGA Low temperatures Airless Spray ‡ Tip Orif 0.015"-0. (380-485 mi) Use appropriate t \$ Spray application primers: Apply a wet coat at specif Roller: Use 3/8" of rough or porous 3 Brush: Recomment	Fluid Tip E s or longer hos fice 019" icrons) iip/atomizing p on of first coat wet mist coat fied mil thickno r 1/2" (9.5 m surfaces. nded for small	Air Cap 765 or 704 ses require higher por Atomizing Press 3000-4800 ps: (207-330 bar) pressure for equipmer on CMU should be fa and allow tiny bubble ess. n or 12.7 mm) synthe areas only. Use high	Air Hose ID 5/16" or 3/8" (7.9 or 9.5 mm) t pressure. ure i nt, applicator tech blowed by back es to form. When tic woven nap re quality natural c	Mat'l Hose ID 3/8" or 1/2" (9.5 or 12.7 mm) Mat'l Hose ID 1/4" or 3/8" (6.4 or 9.5 mm) nnique and weather olling. Note: Applit bubbles disappea oller cover. Use low or synthetic bristle	Atomizing Pressure 75-100 psi (5.2-6.9 bar) Man (5.2-6.9 bar) Man (250 er conditions. cation over inorger r in 1 to 2 minute ager nap to obtain brushes.	Pot Pressu 10-20 ps (0.7-1.4 ba ifold Filter 0 mesh microns) anic zinc-rich rs, apply a ful a penetration of
PPLICATION EQUIPMENT	Air Spray ‡ Gun DeVilbiss JGA Low temperatures Airless Spray ‡ Tip Orif 0.015°-0. (380-485 mi) Use appropriate t \$ Spray application primers: Apply a wet coat at specif Roller: Use 3/8° c rough or porous 3 Brush: Recommen Minimum 50°F (1 point. Coating wi	Fluid Tip E s or longer hos fice 019" icrons) iip/atomizing p on of first coat wet mist coat wet mist coat fied mil thickno r 1/2" (9.5 m surfaces. nded for small 0°C) Maxim Il not cure belo	Air Cap 765 or 704 ses require higher pot Atomizing Press 3000-4800 ps: (207-330 bar) pressure for equipmer on CMU should be fa and allow tiny bubble ess. n or 12.7 mm) synthe areas only. Use high num 135°F (57°C) ow minimum surface	Air Hose ID 5/16" or 3/8" (7.9 or 9.5 mm) t pressure. ure i nt, applicator teclollowed by backr es to form. When tic woven nap ro quality natural of The surface show temperature.	Mat'l Hose ID 3/8" or 1/2" (9.5 or 12.7 mm) Mat'l Hose ID 1/4" or 3/8" (6.4 or 9.5 mm) nnique and weather oller cover. Use longer or synthetic bristle Id be dry and at let	Atomizing Pressure 75-100 psi (5.2-6.9 bar) Man 6 (250 er conditions. cation over inorg r in 1 to 2 minute ager nap to obtain brushes. east 5°F (3°C) abo	Pot Pressu 10-20 ps (0.7-1.4 ba ifold Filter 0 mesh microns) anic zinc-rich rs, apply a full a penetration of ve the dew

proper coating application procedures. Test performance results were obtained in a controlled environment and Tnemec Company makes no claim that these tests or any other tests, accurately represent all environments. As application, environmental and design factors can vary significantly, due care should be exercised in the selection and use of the coating.

6800 Corporate Drive Kansas City, Missouri 64120-1372 1-800-TNEMEC1 Fax: 1-816-483-3969 www.tnemec.com Tnemec Company Incorporated



LIMITED WARRANTY 12 and 18 Month Material Warranty

We warrant each of our products to be free from defects in material and workmanship for a period of one (1) year from the date of shipment for parts OR eighteen (18) months from the date of shipment for all other goods, provided that such product was both: (1) under normal use and service and used for the purposes and under the conditions for which it is intended; and (2) installed and maintained according to the Pratt instructions and applicable local codes.

The Pratt obligations under this warranty are conditioned upon prompt written notice of the defect from the purchaser. If any Pratt product is proven to have failed to conform to the above stated warranty, then we, at our sole option, shall refund, repair, or replace the defective product (F.O.B, the point of manufacture). We shall have the right to inspect the product for which a claim is made under this warranty. If we request such an inspection, then the purchaser must return the product to us, transportation prepaid.

This warranty does not cover failure of any product caused by external forces such as, but not limited to, acts of God or the elements, civil insurrection, vandalism, vehicular or other impact, application of excessive torque to the operating mechanism, presence of foreign matter, or frost heave. The purchaser shall assume all responsibility and expense for removal, reinstallation, and shipping charges in connection with this warranty.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING SPECIFICALLY, THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND ANY WARRANTIES OF NON-INFRINGEMENT OF THIRD PARTY RIGHTS. IN NO EVENT SHALL WE BE RESPONSIBLE OR LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGE. FURTHER, WE HEREBY LIMIT OUR TOTAL LIABILITY TO THE VALUE OF PRODUCT SOLD.

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UPPER OCCOQUAN SEWAGE AUTHORITY VIRGINIA



DAM AND RESERVOIR PHASE B CONTRACT NO. 74 ° DR ° 1





VICINITY MAP

CORNELL, HOWLAND, HAYES & MERRYFIELD CLAIR A. HILL & ASSOCIATES ECONOMISTS



LYON-NOTTINGHAM & ASSOCIATES



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2. 6 2010.12

PIEZOMETER ŠCHEDULE								
PIEZOMETER NO.	DAM AXIS STATION	DISTANCE	TIP ELEVATION	MATER				
1.8	9+50	50	159.3	STR				
. (.B	9+50	50	169.8	EMB				
2.A	11+00	55	158.3	ST				
2.B.	11+00	55	170.3	EME				
3.A.	9+46	120	149.8	HAR				
З.В.	9+46	120	154.8	WEAT				
4.A.	10+50	120	137.2	HAR				
4.B.	10+50	120	147.0	HAR				
5. A	10+90	120	148.9	HARDSH				
5. B.	10+90	120	156.2	OVERE				
6.A.	11+36	120	145.1	HAP				
6.B	11+36	120	154.6	HAR				
T.A.	9+46	80	150.3	HAR				
7.B	9+46	80	159.2	WEATH				
8.A.	10+90	-80	(439	HARD				
8.B.	. 10+90	80	159.4	WEATHER				
			-					

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ZO'-71/4" 12-0" 20'-0" 24'-43/4" 3-5/4" 5'-15/8" 12-03/8" 10'-0" 10'-0" 1-6" -CONCRETE ENCASEMENT AÌ 4" PLAIN (NON-PERFORATED) TYP. 710 DRAIN PIPE. ัก EDGE OF FOOTING _____ ~----____ D B 710 77 710 F SIM 710 TRASH RACK -24" STEEL PIPE SEE SH. 10 45 CONC. ENCASED 17+0+ EDGE OF WALL FOOTING -----------_ ___ ___ ___ ___ ___ ___ ___ -----/INSIDE FACE OF WALL - 3" PERFORATED DRAIN PIPE, EXTEND PIPE CUT FLUSH WITH WALL. -END CAP THRU WINGWALLS. PLACE FIRST JOINT WITHIN 2 FT. OF WALL PLAN 1/8"=1'-0" STA. 14+15 EL. 162.79 E.V.C. STA. 14+25 EL. 162.07 STA. 14+60 EL. 159.50 STA. 14+39.40 EL. 161.40 STA. 14+80 EL. 159.50 TYP 10 -C.J. -C.J. - C.J. - C.J. EL.152.33 EL 148.00 6 EL.151.40 EL.150.00 -S=0.0971 LEVE PIPE INV. 14+31.68 EL. 148.00 CONT. SLAB REINF. ACROSS THIS JOINT SECTION 1/8" = 1'-0" APPROVED EALTH . E. MOYER E Moyers 13 No. 05920

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3"GALV. STEEL. VENT PIPE HYDRAULIC CONTROL PIPES

APPROVÉD

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B RECORD REVISIONS 10-1-76 TUB

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	EB-30	2	
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NG THESE LOGS REPRESENT O	NLY THE OPINION OF THE ENGINEER AS TO		
N OF NG ON 2 TEST PITS. NO WARRANTY REGARD TO ANY VARIATIO	, EXPRESSED OR IMPLIED, IS GIVEN IN ONS WHICH MAY OCCUR BETWEEN BORINGS. ED USING A BACKHOE MOUNTED ON A		
JOHN DEERE 450 DOZER. DECOMPOSED SHALE AND S	THE DISTINCTION BETWEEN CLAYEY SILT, SILTSTONE, AND SHALE AND SILTSTONE		
WAS BASED ON VISUAL CL EXCAVATION ONLY. TEST THE BACKHOE.	PITS WERE TERMINATED AT REFUSAL OF	ti ta Lan	
3. RESERVOIR BORINGS EXCE A POWER AUGER WITHOUT DISTINCTION BETWEEN CLA	PI FOR RB-1 AND RB-2 WERE MADE WITH MAKING STANDARD PENETRATION TESTS. AYEY SILT, DECOMPOSED SHALE AND		
SILTSTONE, AND SHALE AN CLASSIFICATION OF THE D	ND SILTSTONE WAS BASED ON VISUAL RILL CUTTINGS AND THE DIFFICULTY OF		
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Upper Occoquan Sewage Authority Intake Structure Inspection

December 6, 2018

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PROFESSIONAL CERTIFICATION – I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND, LICENSE NO. 45528, EXPIRATION DATE: JUNE 3, 2020.

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LOCATION MAP

EXECUTIVE SUMMARY

Specialty Underwater Services (SUS) performed an underwater intake structure inspection at the Upper Occoquan Sewage Authority (UOSA) facility for Gannett Fleming, Inc. (GF) on December 4, 2018. GPS coordinates of the structure are 38°48'9.36"N, The primary elements for inspection included concrete pedestals with 77°27'26.02"W. associated components, 8" gate valve with associated components, 36" gate valve with associated components and drop inlet grating frame structure. The inspection consisted of a Level I general visual inspection to detect obvious major damage or deterioration due to overstress, impacts, severe corrosion, or extensive biological growth and attack. Visual and tactile inspection methods were used to obtain general condition states as well as field measurements. It is important to note that underwater elements were not cleaned prior to inspection and that all measurements obtained are approximate. Field measurement verification, to include cleaning and removal of all surface corrosion/scale, is recommended prior to construction or structure replacement activities. The inspection was performed from an SUS provided dive trailer with diving operations performed in accordance with all OSHA and ADCI guidelines governing safe diving practices. Video recording was performed during inspection and dive videos were provided to GF separately. All structure documents provided to SUS can be found in Appendix A marked up with inspection findings.

Overall, heavy surface corrosion and pitting was observed on all submerged steel elements. All gate valves, piping and flanged connections appeared to be intact and secure. Bolt patterns and hardware measurements can be found on the drawings in Appendix A. All water depth measurements were taken using the diver's open-ended pneumofathometer hose. Drawing details verified to match field conditions are marked on the drawings in Appendix A.

Concrete Pedestals:

Concrete pedestals, as shown on Outlet Works Detail drawing sheet 13, consist of a square concrete column, grout pad, steel plate with anchor hardware, steel W4x13, 3" galvanized steel vent pipe, and hydraulic control pipes with associated fasteners. Typically, heavy surface corrosion and pitting was observed on all submerged steel elements. Grout leveling pads show signs of deterioration around the exposed edges but are otherwise functioning and intact. Hardware was observed with surface corrosion but otherwise appeared tight and intact. No concrete column defects were noted. Concrete pedestals appear to be in satisfactory to fair condition overall based on observations at time of inspection.

8" Gate Valve:

The 8" gate valve, as shown on Outlet Works Intake Structure drawing sheet 12, is located on top of a vertical concrete tower. The 8" steel pipe exits the top of the concrete tower and is flange connected to a 90-degree pipe bend. This 90-degree pipe bend is flange connected to the 8" gate valve. The intake screen is flange connected to the opposite side of the 8" gate valve and is serving its intended purpose. Flanged connections at this location were observed to be eight (8) bolt pattern connections. Typically, heavy surface corrosion and pitting was observed on all submerged steel elements. Hardware was observed with surface corrosion but otherwise appeared tight and intact. Based on external inspection observations only, the 8" gate valve and hydraulic actuator appear to be in satisfactory to fair condition overall. Internal condition or operability of the gate valve and actuator is not part of this condition assessment.

10" Gate Valve:

The 10" gate valve, as shown on Outlet Works Intake Structure drawing sheet 12, is no longer installed. The 10" steel pipe exits the side of the concrete tower and is flange connected to a twelve (12) bolt pattern blind flange. Heavy surface corrosion and pitting was observed on the 10" steel pipe. Minor surface corrosion was observed on the blind flange. Hardware was observed with surface corrosion but otherwise appeared tight and intact. No condition assessment necessary for this location.

36" Gate Valve:

The 36" gate valve, as shown on Outlet Works Intake Structure drawing sheet 12, is located on top of a concrete encased 36" pipe. The 36" steel pipe exits the concrete encasement vertically and is flange connected to the 36" gate valve. The top flange of the 36" gate valve is open. Flanged connections at this location were observed to be thirty-two (32) bolt pattern connections. Typically, heavy surface corrosion and pitting was observed on all submerged steel elements. Hardware was observed with surface corrosion but otherwise appeared tight and intact. Based on external inspection observations only, the 36" gate valve and hydraulic actuator appear to be in satisfactory to fair condition overall. Internal condition or operability of the gate valve and actuator is not part of this condition assessment.

Drop Inlet Grating Frame:

The drop inlet grating frame structure, as shown on Outlet Works Detail drawing sheet 13, is located above the open 36" gate valve flange. The welded steel rack structure helps prevent large debris from entering the 36" gate valve. The frame has evenly spaced bars on five (5) of six (6) sides with only the bottom open to allow overlap with the 36" gate valve flange. Four (4) legs that straddle the 36" gate valve support the grating frame. Each leg assembly is mechanically fastened to concrete. Typically, minor surface corrosion and marine growth was observed on all submerged steel elements. Small bolted on elements were observed and are assumed to be cathodic protection anodes. Hardware was observed with surface corrosion but otherwise appeared tight and intact. Based on observations at time of inspection, the drop inlet grating frame appears to be in satisfactory condition overall and is serving its intended purpose.

INSPECTION LEVELS & CONDITION ASSESSMENT RATINGS

The three (3) levels of inspection as defined by Unified Facilities Criteria UFC 4-150-07 Maintenance of Waterfront Facilities are as follows:

LEVEL I: General Visual Inspection. This inspection involves no cleaning of any structural elements and, therefore, is the most rapid of the three types of inspection. The purpose of the Level I is to detect obvious major damage or deterioration due to overstress, impacts, severe corrosion, or extensive biological growth and attack.

LEVEL II: Close-Up Visual Inspection. This inspection is directed toward detecting and identifying damaged or deteriorated areas that may be hidden by surface biofouling or deterioration and obtaining a limited amount of deterioration measurements. Level II inspections often require cleaning the critical areas of structural elements to get a representative sample to determine overall general condition.

LEVEL III: Highly Detailed Inspection. The purpose of this type of inspection is to detect hidden or interior damage, loss in cross-sectional area, and material homogeneity through the use of nondestructive testing (NDT) techniques or partially destructive techniques in key structural areas or areas that may be suspect. Level III inspections normally require cleaning.

Level chosen for this inspection: Level I

The general condition assessment ratings for the inspected structure and component groups are based on a six (6) point assessment scale developed by the ASCE and are as follows:

GOOD: No visible damage or only minor damage is noted. Structural elements may show very minor deterioration, but no overstressing is observed. No repairs are required.

SATISFACTORY: Limited minor to moderate defects or deterioration is observed, but no overstressing is observed. No repairs are required.

FAIR: All primary structural elements are sound, but minor to moderate defects or deteriorations are observed. Localized areas of moderate to advanced deterioration may be present but do not significantly reduce the overall structural capacity. Repairs are recommended, but the priority of the recommended repairs is low.

POOR: Advanced deterioration or overstressing is observed on widespread portions of the structure but does not significantly reduce the load-bearing capacity of the structure. Repairs may be carried out with moderate urgency.

SERIOUS: Advanced deterioration, overstressing or breakage may have significantly affected the structure or load-bearing capacity of primary components. Local failures are possible and loading restrictions may be necessary. Repairs may need to be carried out on a high-priority basis with urgency.

CRITICAL: Very advanced deterioration, overstressing or breakage has resulted in localized failure(s) of primary structural components. More widespread failures are possible or likely to occur, and load restrictions should be implemented as necessary. Repairs may need to be carried out on a very high-priority basis with strong urgency.

INSPECTION TERMINOLOGY

(SOME OR ALL MAY BE USED IN THIS REPORT)

<u>Abrasion</u>

Reduction of the timber surface due to continual rubbing by debris, ice, vessels or suspended particulates in the water.

<u>Broken</u>

Piles which have buckled, sheared or have lost the ability to transfer the loads through its respective section.

<u>Checking</u>

Vertical cracking of the timber surface due to drying and shrinking. Minor checking is generally acceptable in standard timber design. However, excessive checking may be problematic and should be closed.

Crushing

Usually associated with the timber pile cap where it interfaces with the timber plumb pile below. Crushing is evidence of compression in the element beyond the ultimate capacity of the cap.

<u>Efflorescence</u>

The loss of water (or solvent) of crystallization from a hydrated or solvated salt to the atmosphere on exposure to air.

<u>Incipient</u>

In an initial stage; beginning to happen or develop.

<u>Knife Edging</u>

Corrosion of steel edges to where original thickness is lost and the element appears sharp or serrated.

<u>Missing</u>

Location where a pile was previously and is no longer. Hardware, pier history and site evidence is used to determine when a pile was but is no longer associated with the structure.

Non-Bearing/Partial Bearing

Less than 100% of the pile interfaces with the respective portion of the pile cap to which it is connected. Non-bearing piles may have good structural integrity, but lack the intended load transfer mechanisms.

<u>Overloading</u>

Overstressing of the timber element by continuous or impact loads in excess of their ultimate capacity. This is typically evidenced by severe vertical cracks in the timber that cross the grain, breakage of the timber, and/or bulging of the timber with splitting of the wood fibers.

<u>Pitting</u>

A localized form of corrosion by which cavities or "holes" are produced in the material.

Section Loss

When a structural member loses area from its design section. Section loss negatively affects structural capacity.

<u>Spall</u>

A small fragment or chip especially of stone or concrete.

<u>Split</u>

Elements exhibiting a complete separation through the section. Members may still be load bearing and functioning as intended.

<u>Tidal Zone</u>

The zone exposed to wet and dry conditions. Mean low water (MLW) to high water mark.

<u>Void</u>

A large hole or empty space where such condition is not expected or wanted.

APPENDIX A: STRUCTURE DOCUMENTS

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8" GATE VALVE

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