Patented

Features and Benefits

- Eliminates keys, splines, and tapered shaft ends
- Allows for use of smaller diameter shafts
- Reduces overhung moment
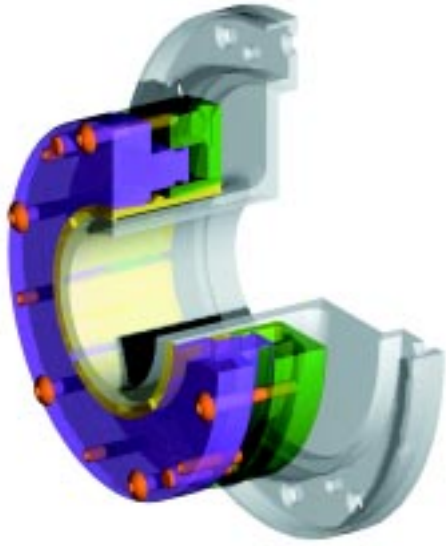- Custom designs to fit your envelope and shaft ends

Riverhawk
Company
®

Figure 1 -
Cutaway View of HTC Hub Assembly

Figure 2 -
Hydraulic torque coupler mounted on high speed gear.

Eliminates keys, splines and tapered shaft ends.

Keys and splines produce stress concentration in machine shafts. Tapered shaft ends and bores are expensive to produce and require special tooling. The Hydraulic Torque Coupler shown in Figures 1 and 2 allows designs using straight, cylindrical, slip fit surfaces eliminating stress concentrations and reducing costs.

Allows for the use of smaller diameter shafts.

High squeeze capacity of Riverhawk Hydraulic Torque Couplers translates into smaller shafting requirements. Smaller shafts translate into smaller bearing requirements reducing overall cost and increased design flexibility.

Reduces overhung moment.

In high power density applications it is the *total* overhung moment that impacts rotordynamics. The Hydraulic Torque Coupler allows for designs with smaller shafts and shorter interfaces. These factors translate into reduced overall overhung moment.

Custom designs fit your envelope and shaft

In addition to a standard line, Riverhawk will modify a standard product or engineer a custom solution for your particular application.

Slip-Fit Components For Keyless Connections

The Hydraulic Torque Coupler provides high integrity keyless fit joints using convenient, low cost slip-fit designs. Our design eliminates heat at assembly as well as keys, splines, tapered shafts, plug/ring gages, and hydraulic maintenance equipment. Shaft ends are simplified therefore reducing design, manufacturing, and maintenance costs. In addition, maximum axial and phase adjustment simplifies timing issues.

Hydraulically Applied Clamp Pressure For High Torque Capacity

Select the Riverhawk Hydraulic Torque Coupler to meet the high power density requirements of today's high performance equipment. Hydraulic coupling provides ultra-secure clamping of shaft elements with reduced shaft diameter.

Design, Existing Shaft Ends

Select the Riverhawk Hydraulic Torque Coupler to meet the high power density requirements of today's high performance equipment. Hydraulic coupling provides ultra-secure clamping of shaft elements with reduced shaft diameter.
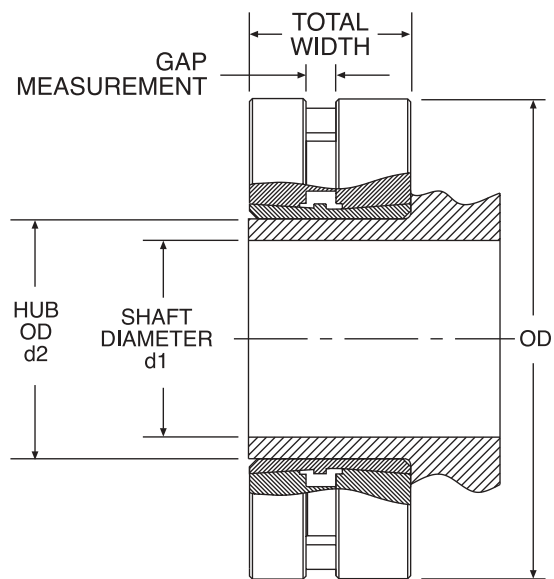
Dimensional Drawing

Figure 3

APPLICATION DATA

Model	Shaft Size d1 (inches)	Total Width (inches)	OD (inches)	Weight (pounds)	Static [1] Hub Slip Torque, Ts (in.-lb.) [2]	Motor Speed (RPM)	Motor Speed Hub Slip Torque, Tss (in.-lb.)	Torque/ Speed Reduction Factor [3], Fs (in.-lb./krpm²)	Limit Speed (RPM)
HTC020	1.500	1.640	4.250	3.5	15,100	3,600	15,000	9.2	23,900
	1.750				23,000	3,600	22,800	11.8	
	1.875				27,700	3,600	27,500	13.2	
	2.000				32,900	3,600	32,700	14.5	
HTC025	2.125	2.070	5.313	7.1	41,900	3,600	41,400	35.5	20,700
	2.250				48,900	3,600	48,400	38.9	
	2.375				56,600	3,600	56,100	42.2	
	2.500				64,900	3,600	64,300	45.5	
HTC030	2.625	2.430	6.375	12.1	78,000	3,600	76,800	91.3	19,500
	2.750				88,500	3,600	87,200	98.2	
	2.875				99,700	3,600	98,300	105	
	3.000				111,700	3,600	110,000	110	
HTC040	3.250	3.200	8.500	28.9	151,400	3,600	147,000	340	15,500
	3.500				185,400	3,600	180,000	380	
	3.750				223,400	3,600	218,000	430	
	4.000				265,500	3,600	259,000	470	
HTC050	4.250	4.000	10.625	56.7	334,900	1,800	331,200	1,135	13,800
	4.500				391,300	1,800	387,300	1,243	
	4.750				452,700	1,800	448,300	1,350	
	5.000				519,300	1,800	514,600	1,456	
HTC060	5.250	4.800	12.750	96.8	624,100	1,800	614,600	2,922	10,800
	5.500				707,900	1,800	697,700	3,143	
	5.750				797,600	1,800	786,700	3,360	
	6.000				893,500	1,800	881,900	3,580	
HTC075	6.500	6.000	15.938	189.1	1,187,800	1,800	1,159,000	8,780	8,800
	7.000				1,451,200	1,800	1,419,000	9,860	
	7.500				1,745,100	1,800	1,710,000	10,920	
HTC095	8.000	7.500	20.188	383.2	2,230,100	1,800	2,142,000	27,250	7,200
	8.500				2,629,400	1,800	2,532,000	30,030	
	9.000				3,066,800	1,800	2,961,000	32,800	
	9.500				3,542,700	1,800	3,428,000	35,500	
HTC120	10.000	9.500	25.500	774.7	4,371,600	1,200	4,247,000	86,400	5,500
	10.500				4,993,200	1,200	4,859,000	93,500	
	11.000				5,662,800	1,200	5,518,000	100,600	
	12.000				7,148,000	1,200	6,982,000	114,500	
HTC150	13.000	11.800	31.875	1513.2	9,502,000	1,200	9,097,000	281,100	4,700
	14.000				11,609,900	1,200	11,160,000	315,600	
	15.000				13,960,900	1,200	13,460,000	349,400	

NOTES:

Contact Riverhawk Engineering for assistance in evaluating special conditions and requirements.

1. Static slip torque values reflect hub and shaft machined with a slip fit per AGMA 9002 class I fit for sizes up to 6.5 in. See dimensional chart and Figures 6 and 7 for design clearances.

2. The application torque must always be less than the slip torque at speed. Slip torque calculations are based on "steel on steel" fits with a coefficient of friction of 0.15. The actual slip torque may vary depending on hub & shaft materials and surface condition.

3. There are three ways to calculate slip torque at speed (Tss):

A. For motor speeds you can read Tss directly off the above table.

B. To estimate slip torque at any speed read Ts & Fs from the Application Data table and "Speedfactor" from the graph Figures 4 and 5. Calculate using the formula:

$$Tss = Ts - (Fs \cdot Speedfactor)$$

C. For precise slip torque calculation apply the formula:

$$Tss = Ts - Fs \cdot \left(\frac{RPM}{1000}\right)^2$$

At Riverhawk we always strive to improve the products we produce. For that reason the dimensions and specifications contained in this catalog are subject to change without notice. Certified dimensions of ordered material can be furnished upon request.
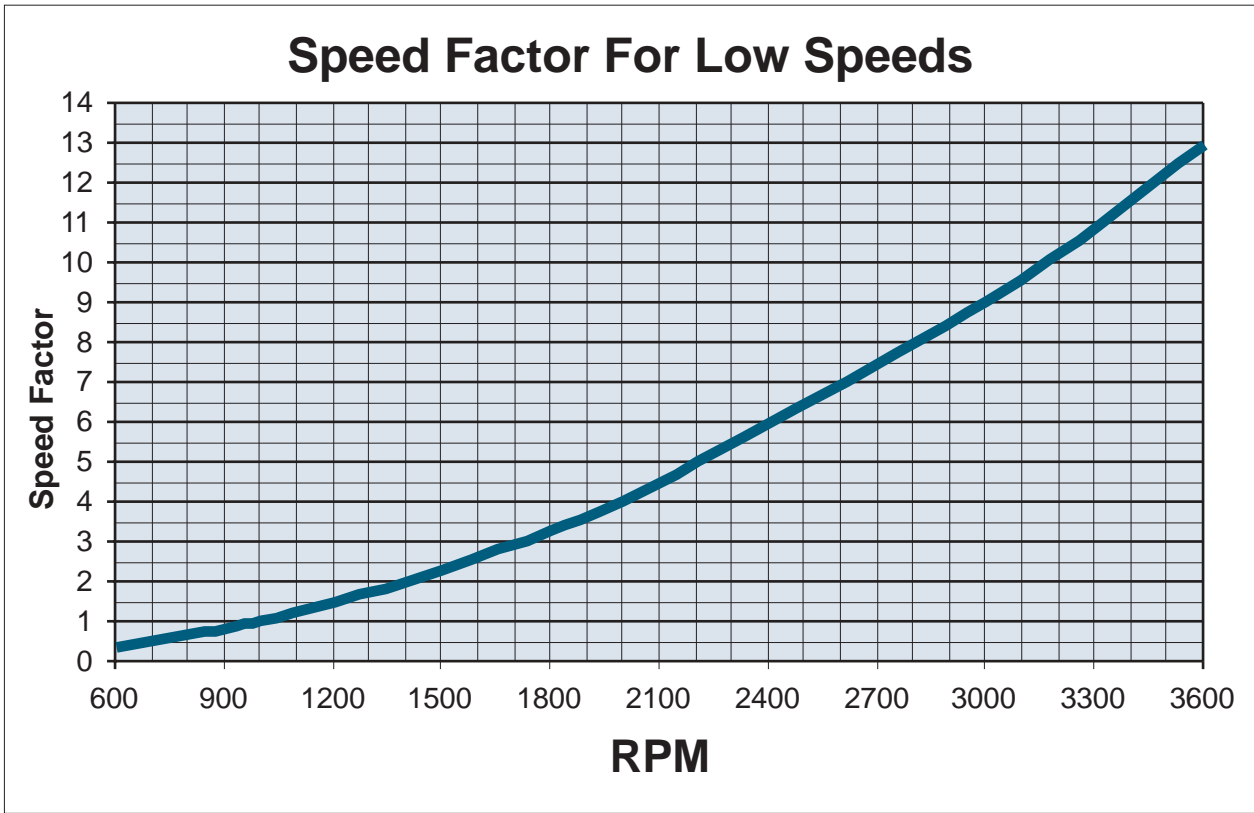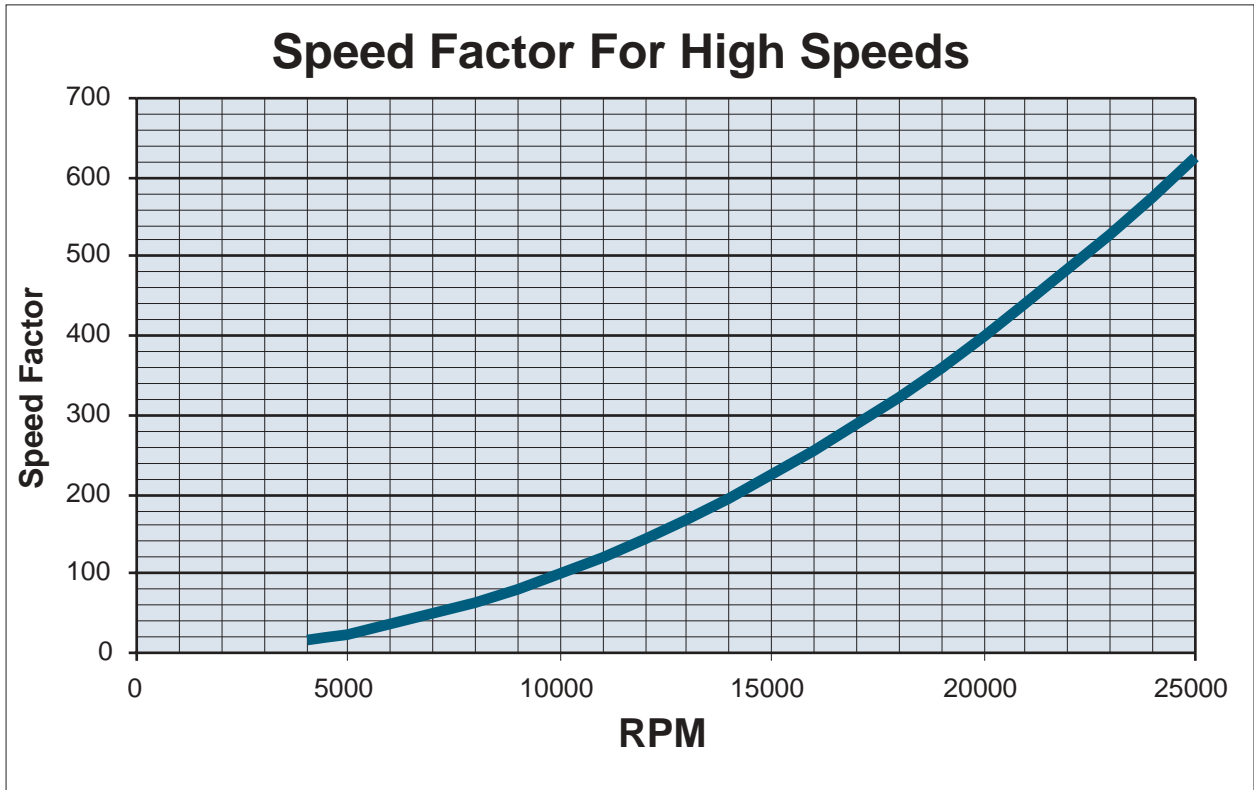
Figure 4

Figure 5

SELECTION PROCEDURE

1. Establish the loading requirements for your application. Loading includes the application torque (Ta) and axial force (Fa).
2. Establish service factors to account for uncertainties of the application.
3. Calculate the total equivalent application torque (Te) using the loading requirements and service factors you have established.
4. Compare the calculated Te with Ts from the application data chart to obtain the candidate selection.
5. For final size selection you will need to adjust the Ts value of the candidate selection using the rotational speed of your application. To do this, calculate the at speed slip torque (Tss) using the formula below.

Application Torque

$$Ta = 63025 \frac{HP}{RPM}$$

HP is the application horse power.
RPM is the application speed.

Equivalent Torque

$$Te = \sqrt{(K_t \cdot Ta)^2 + \left(K_f \cdot Fa \cdot \frac{d1}{2}\right)^2}$$

Ta is the application torque. (in-lb)
Kt is the service factor on torque
Fa is the application axial force. (lbf)
Kf is the service factor on axial force.
d1 is the shaft diameter.

At Speed Slip Torque

$$Tss = Ts - Fs \cdot \left(\frac{RPM}{1000}\right)^2$$

Tss is the joint slip torque at speed (in-lb)
Ts is the static slip torque from the application data chart (in-lb)
Fs is the torque/speed reduction factor from the application data chart (in-lb)

Important Note: Service Factor

The application torque Ta and application axial force Fa should be the greatest values which the system is expected to transmit. Establishing these may require evaluating several loading combinations as dictated by the application.

The slip torque values supplied in the application chart are limiting values. Exceeding these values will result in slip. The application loading must always be below the slip capacity of the joint. The selecting engineer is advised to apply a service factor to the application loads to account for factors such as, start-up conditions, peak loading conditions and service uncertainty.

Example Application

A fan is to be mounted on 5" shaft. It is to be powered by an 9,000 HP, 3,560 RPM induction motor. The motor can produce a peak torque of 2.5 times its rated torque during start up. The fan can produce an axial force of 15,000 lbf. A factor of 1.25 will be added to both the start up torque and the axial force to account for possible surges and vibration caused by wind gusts at the intake.

Applying this data to the formulas above:
- The normal torque for the application is:
  159,333 (in-lb)
- The start up torque is:
  398,332 (in-lb)
- From these, Te becomes:
  500,117 (in-lb)
- Comparing Te to the rating chart yields HTC050 as a preliminary selection.
- Applying the operating speed to the static rating in the table. The "at speed" slip torque Tss of HTC050 becomes:
  500,847 (in-lb)
- Tss>Te, the HTC050 shrink disc meets the application requirements as defined.

Design, Dimensions, and Fits

The Hydraulic Torque Coupler (HTC) design allows hub/shaft fits to be designed with cylindrical slip fits. The Suggested Fit Dimensions table provides suggested hub bore and shaft outside dimensions (OD.) These fits were derived from AGMA 9002 class 1. Larger sizes were extrapolated. The HTC can accommodate hub/shaft fits other than those supplied here such as cylindrical interference fits and taper fits. In general, tighter fits are preferable. Contact Riverhawk engineering for assistance in evaluation of fits that are not listed here.

Surface finishes on hub and shaft diameters of 64 microinches or better are recommended. In general, smoother surfaces are preferable. Rough surface finishes tend to mask profile variations and other detrimental defects.

A fillet as shown in Figures 6 and 7 between the hub OD and the flange is recommended. The HTC can accommodate a fillet up to the values listed in the dimensional chart.

When the HTC is activated, the material directly under it is squeezed into a heavy interference with the shaft.

Other areas, such as that below the flange, will still have a clearance. Machinery misalignment can cause a microscopic rocking motion between the flange and the shaft. A slight clearance under the flange such as shown in Figures 6 and 7 will prevent the possibility of fretting in this area.

A redundant mechanical stop, such as a shaft step or shaft nut, should be considered in cases where the equipment must accommodate large thrust loads, especially where axial slip would affect safe or reliable operation.

Figures 6 and 7 show options where the HTC is mounted with hardware and hydraulic access areas located away from the flange. Access holes can be drilled in the flange in cases that require the HTC to be mounted with the hardware against the flange. Contact Riverhawk engineering for recommendations for access solutions.

Design, Hub & Shaft Stress

Keyways, splines, and pins produce stress concentrations in shafts. Stress concentrations greatly reduce a shaft's ability to endure varying loads such as bending and varying torques. This fact forces the machinery designer to design larger, heavier shafts than would otherwise be needed. The Riverhawk Hydraulic Torque Coupler virtually eliminates these stress concentrations allowing for more efficient machinery designs.
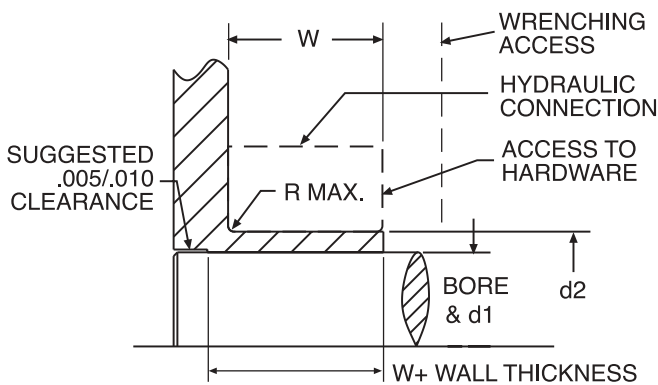
The hub and shaft material must be capable of accommodating the clamping, torque, and bending loads produced by the application. For the joint to be capable of transmitting the full rated slip torque, the hub and shaft material should have a yield strength of at least 45,000 psi, which represents 1040 steel as commonly used in shafting. The Hydraulic Torque Coupler can be used for applications with weaker materials by reducing the clamping load. Contact Riverhawk engineering for assistance with evaluating shaft and hub stresses.

Design, Balance

Balance level is an issue for high speed applications utilizing machinery that is sensitive to vibration. Riverhawk Hydraulic Torque Couplers are designed and manufactured to tight tolerances in order to produce "as built" balance level better than required by AGMA 9000 class 8. Tighter balance requirements can be met with addition of an assembly balance. Balanced and match-marked assemblies can achieve balance repeatability levels per AGMA 9000 class 10 and API 671.

SUGGESTED FIT DIMENSIONS

Shaft Size d1	Suggested Shaft Tolerance	Suggested Bore Size Tolerance	Net Maximum Clearance	Model	Hub OD d2	Hub OD Tolerance	Machined Hub OD Width W	Maximum Fillet R
1.5000			0.002	HTC020	2.440			
1.750		+.001	0.002		2.440		1.650	0.062
1.875		+.000	0.002		2.440			
2.000			0.002		2.440			
2.125			0.0025	HTC025	3.050			
2.250			0.0025		3.050		2.070	0.094
2.375			0.0025		3.050			
2.500			0.0025		3.050			
2.625			0.0025	HTC030	3.660	+.000		
2.750			0.0025		3.660	-0.001	2.430	0.094
2.875			0.0025		3.660			
3.000			0.0025		3.660			
3.250			0.0025	HTC040	4.880			
3.500			0.0025		4.880		3.200	0.156
3.750	+.000		0.0025		4.880			
4.000	-.0010		0.0025		4.880			
4.250			0.0025	HTC050	6.100			
4.500		+.0015	0.0025		6.100		4.000	0.156
4.750		+.000	0.0025		6.100			
5.000			0.0025		6.100			
5.250			0.0025	HTC060	7.320			
5.500			0.0025		7.320		4.800	0.188
5.750			0.0025		7.320	+.000		
6.000			0.0025		7.320	-0.0015		
6.500			0.0025	HTC075	9.150			
7.000			0.003		9.150		6.000	0.250
7.500			0.003		9.150			
8.000			0.003	HTC095	11.590	+.000		
8.500			0.003		11.590	-0.002	7.500	0.313
9.000			0.003		11.590			
9.500			0.003		11.590			
10.000	+.000		0.003	HTC120	14.640			
10.500	-.0015		0.004		14.640	+.000	9.500	0.375
11.000		+.0025	0.004		14.640	-0.0025		
12.000		+.000	0.004		14.640			
13.000			0.004	HTC150	18.300	+.000		
14.000			0.004		18.300	-0.003	11.800	0.500
15.000			0.004		18.300			

INBOARD MOUNTED CLAMP

Figure 6
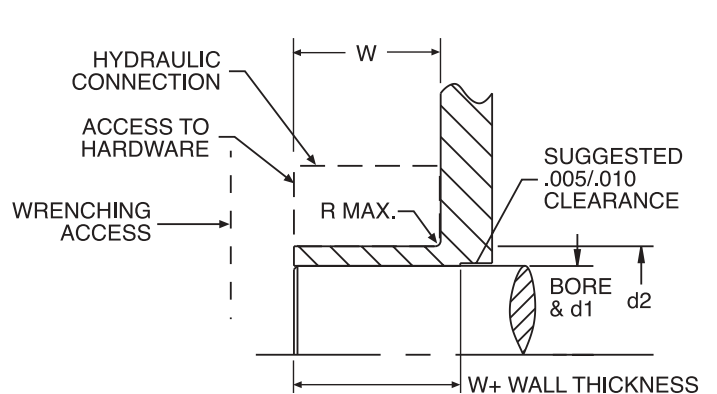
OUTBOARD MOUNTED CLAMP

Figure 7

Installation Overview

1. Inspect hub and shaft to insure that they have been machined to proper tolerances.

2. Clean the hub bore, hub OD and shaft OD. Make sure that they are free of any debris or coatings. Clean surfaces are essential for torque transmission.

3. Slide the HTC on to the hub. Take care to insure that the screws and hydraulic ports are accessible.

4. Slide hub/HTC assembly on to the shaft and set axial position. Rotate the HTC so that the ports are at the 12:00 and 6:00 positions.

5. Remove retraction screws but leave the retention screws (socket set screws).

6. Attach hydraulic pressure source to the fitting located at 6:00 and remove the plug at 12:00.

7. Bleed air out of hydraulics.

8. Apply 200 psi hydraulic pressure to HTC. This step takes up assembly clearances. At this point the HTC and hub should be lightly gripping the shaft.

9. Measure and record the gap at clamp outside diameter. This becomes the initial gap. See Figure 3.

10. Refer to installation instructions for recommended expansion.

11. Add the initial measured gap from step nine to the recommended expansion gap from step ten to arrive at a total gap necessary for proper installation.

12. In steps, apply hydraulic pressure and measure gap. Stop pumping when the actual gap meets the number calculated in step eleven. Stop pumping if either the pins become flush with the torque coupler face OR you exceed 7,500 psi hydraulic pressure.

13. While holding hydraulic pressure, turn retaining screws in until lightly seated and then release pressure.

14. Allow oil to drain and plug both hydraulic ports.

NOTE: Please refer to the formal installation and removal manual for additional instructions.

Removal

1. Attach hydraulic pressure source to fitting.

2. Bleed air out of hydraulics. Plug upper port after bleeding.

3. Slowly add hydraulic pressure, simultaneously apply removal torque to the retaining screws.

4. Increase hydraulic pressure until retaining screws can be turned. Screws should be free to rotate at a pressure between 4,500 psi and 7,500 psi. Once the retaining screws are free, stop increasing pressure and back off all screws.

5. Release hydraulic pressure and clamp should retract by itself. If it does not, retracting screws can be inserted and turned to retract unit.

NOTE: Care should be taken to tighten jacking screws in several stages by using approximate one-half turns following either a clockwise or counterclockwise sequence.

6. Once closed, the parts will be free to be disassembled.

NOTE: Please refer to the formal installation and removal manual for additional instructions.

Installation Accessories

Riverhawk provides pressure kits complete with flexible hoses as shown in Figure 8.

Figure 8 -Hydraulic Hand Pump

We invite you to visit our web site at www.riverhawk.com

Disclaimer

The information contained within this document is based upon certain assumptions about equipment design and operation as foreseen at the time of publication. The equipment designer is assumed to be familiar with the equipment and its operation. For this reason the equipment designer must assume responsibility for the proper application of the Riverhawk HTC to the subject equipment.

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