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HMP™ Range Of Hydraulic Pipe Couplings - Installation Procedure

Motivation:

The HMP™ Hydraulic coupling is designed as an easy method of joining plain ended pipes in a vertical shaft. The coupling allows for pipe expansion and contraction. It eliminates the expensive welding process, saves space and reduces installation time. If the pipe ends are well prepared and the coupling is installed as per installation procedure, the risk of leaks are very low.

Designed Gap:

There should be a gap between the pipes when they are installed in the shaft. This gap will allow for expansion, contraction of the pipe and not interfere with the centre bolts/ pins of the HMP™ Hydraulic coupling. In most cases the design gap will be 25mm / 0,98". The design gap must be calculated and specified by the engineer, who is in charge of the design of the entire piping system. Should the design gap be greater than 25mm / 0,98", the face to face of the coupling will exceed the values specified in the table at the end.

Risk Assessment:

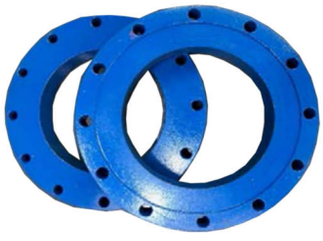
This procedure is just a guide line. The client must do their own risk assessment and can change or add to this procedure, however they see fit to do so.

Step 1:

Be sure you have all the parts and tools ready to install the pipes and HMP™ Hydraulic coupling in the shaft and everything is well prepared. Quantity and sizes of bolts sets will vary depending on the sizes and pressure rating of the pipe coupling.

Coupling Body

2 x Coupling Flanges



2 x Seals

Center Bolts / Pins

Note! The dowty washer that is installed on the centre bolt / pins. Exclusion of the Dowty washer will allow water to leak through the coupling body tapped holes.

Bolt set - make sure you got the correct size & quantity

Make sure you have all the tools ready to install the pipe and coupling. The tool sizes my vary with different pipe sizes, pipe support design, pressure ratings, imperial bolts or metric bolts. Typically you will require your stopper clamps, ring spanners, a ratchet, a torque wrench, alien keys and lifting equipment (Eye bolts, shackles, chainblock). In addition you will need some rubber friendly lubricant and a method to apply it to the seals and pipe ends.

2 x Stopper clamps

2 x Stopper clamps with seal protection

Ring flat spanners - make sure you have the correct sizes & quantity

Allen key - make sure you have the correct size

Eye bolts - make sure you have the correct size & quantity

Shackles - make sure you got the correct size & quantity

Torque Wrench

Pipe trestles. Lifting equipment and slings. Make sure all lifting equipment is correctly sized and in good working order.

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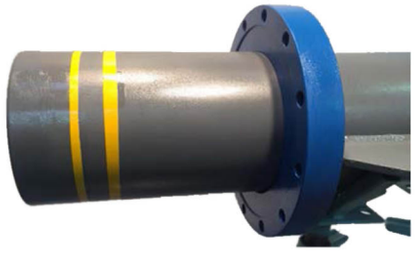
Step 2:

Installing pipes from the top down:
Lay the first / top pipe that will be installed on the pipe trestles. This work will be done on surface as preparation work prior to the pipe being slung down the shaft for installation. Work will now start on the pipe end that is facing down in the shaft. Make sure the pipe ends are free of any scratches (surfaces 1,6 to 3,2 μm is acceptable), dents (flat spots of +/10mm are acceptable, but not dents. Dents must be polished out), bad ovality (There must be at least 0.5mm clearance between coupling flange internal diameter and the pipe outside diameter at any point) or damage. There should be a small chamfer (3 to 5mm x 20°) on the pipe end that will help prevent the seal from being damaged when the seal is stretched over the pipe. Make sure the indication band has been marked out on the pipe end. The position of the band (10 to 25mm thick) is calculated as follows: we use the face to face of the coupling including the flanges, divide by 2 and add half of the designed gap. Once the coupling is installed correctly the painted band on the pipe will be visible on the top and bottom of the coupling.

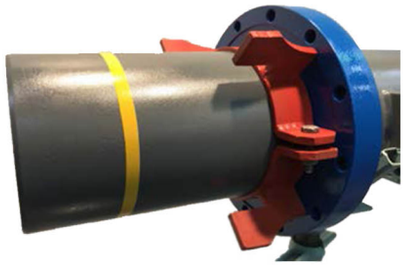
Step 3:

Then slide the coupling flange over the pipe +/- 400mm / +/- 16". Make sure the step is facing towards the pipe end.



Step 4:

Slide the stopper clamp with seal protection over the pipe, up against the flange. The seal protection stoppers should face the end of the pipe. Tighten the stopper clamp onto the pipe, so that when the pipe is slung down the shaft, the flange cannot fall off.

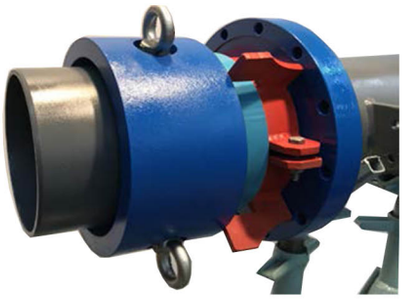


Step 5:

Lubricate the seal inside diameter & outside diameter of the pipe end. Slide the Seal over the pipe, so that it is against the stopper clamp with seal protection. The seal protection stoppers should be over the seal. Make sure the taper of the seal faces the end of the pipe.

Step 6:

Screw the eye bolts into the coupling body. Now slide the coupling onto the pipe, against the stopper with seal protection.



Step 7:

Slide the stopper clamp onto the pipe end, against the coupling body and tighten it. This will ensure the coupling cannot slide off while the pipe is slung down the shaft.

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Step 8:

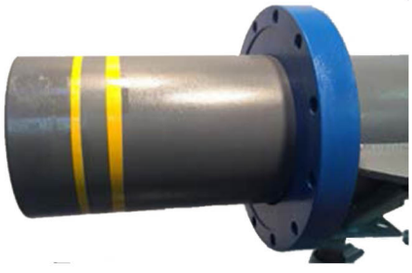
Lay the second pipe that will be installed below the pipe on the pipe trestles. Work will now start on the pipe end that is facing up in the shaft. Make sure the position band is in place on the pipe end as previously explained in step 2. Calculate the position where the coupling body must stop when it is installed. To calculate this position, measure the coupling body. Take this measurement, subtract the design gap and divide into two. For example, the standard DN200 / 8" body face to face is 140mm / 5, 51" and the most common design gap is 25mm / 0,98" (140 - 25 = 115 / 2 = 57,5mm / 2,26", round up to 60mm / 2, 36"). Then mark out 60mm / 2,36" from the pipe end, paint or mark a line using a permanent marker or boilermakers chalk. The stopper clamp will be tightened exactly on this line.

Step 9:

Slide the stopper clamp over the pipe end to about +/- 400mm / +/- 16" from the end and tighten it. If the pipe support structure is close to the end of the pipe, this step is not required. The photo from step 10 down will not show this step as it was not necessary for our demo.

Step 10:

Slide the coupling flange over the pipe end until it rests up against the stopper clamp. Make sure the step is facing towards the pipe end.

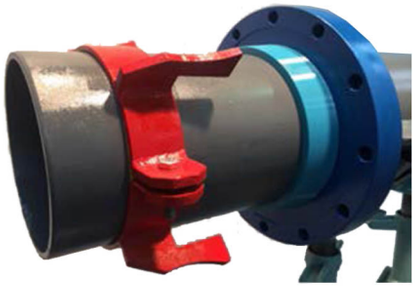


Step 11:

Lubricate the seal inside diameter and outside diameter of the pipe. Slide the Seal over the pipe end, up against coupling flange. Make sure the taper of the seal faces the end of the pipe.

Step 12:

Slide the stopper clamp with seal protection over the pipe end. Make sure the seal protection risers face the flange. Tighten the stopper clamp on the marked line at the calculated position from step 8.



Step 13:

Prepare the other end of the pipe exactly as per steps 2 to 7. The pipe is now ready to be slung down the shaft.

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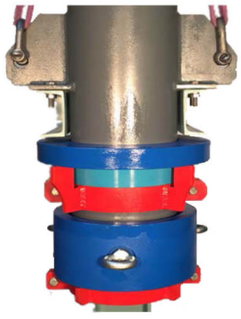
HMP™ Range Of Hydraulic Pipe Couplings - Installation Procedure

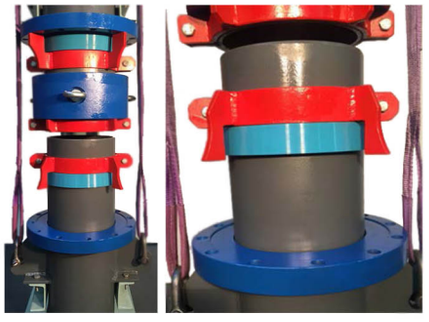
Step 14:

Sling top pipe down and move it into position onto the pipe support structure. Bolt the pipe down onto support structure. Extra safety devises, like slings can be used to prevent coupling parts from falling.



Step 15:

Sling second pipe into position and bolt down onto the support structure. Make sure the pipes are aligned in a straight line with each other and the design gap between the pipes is correct.

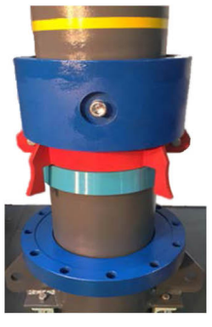


Step 16:

Secure the coupling body with lifting equipment onto the eye bolts. Remove the clamp below the coupling body.

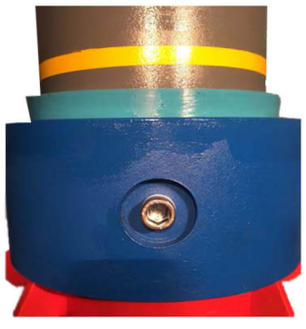
Step 17:

Lower the coupling onto the stopper clamp that is below the coupling body and is secured onto the 60mm mark. Remove the lifting equipment holding the coupling body. Remove the eye bolts. Make sure the dowty washers are on the centre bolts/ pins. If the dowty washer is not in place, the coupling will leak. Screw the centre bolts/ pins into the tapped holes in the coupling body and tighten it with the Allen key.



Step 18:

Make sure the coupling body is lined up on the pipe so that there is an equal gap all around. Lubricate both seals outside diameters. Slide the seal from the top pipe down onto the coupling body and make sure it goes into the coupling body equally all around.



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Step 19:

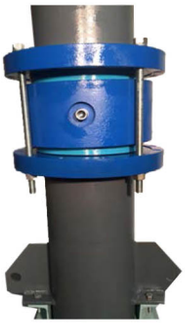
Secure the top flange and remove the stopper clamp below it. Slide the top flange down onto the coupling body and seal.

Step 20:

Remove stopper clamp below the coupling body. Slide the seal on the bottom pipe up into the coup ling. Try and ensure the seal enters the body as straight as possible by hand.

Step 21:

Insert 4 x bolts into the top flange. Slide the bottom flange up into the 4 bol ts. Screw the 4 nuts onto the bolts. Make sure the washers are in place.



Step 22:

Insert the rest of the bolts and screw the nuts on. Using the ring flat spanners, start to tighten the bolts using a cross over method. Once all the nuts are tightened to finger tightness, then use the spanners to turn opposite nuts two or three rotations then move onto the next nuts in the sequence. The Flanges will now start to compress the seals into the body. Continue tightening the bolts until they become tight and constantly check for uniformity so that flanges are not pulled skew. The torque wrench should be used to ensure correct level of tightness is achieved (See the bolt torque table for guidance). The yellow band at the top and bottom of the coupling must now be visible.

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Materials Of Construction:

Part Name	Specification	
Body - #1	Pipe - ASTM A106 Grade B	Available sizes: DN50 / 2" to DN500 / 16"
Body - #2	Hollow bar - ST-52	Pressure rating: up to 25MPa / 3 626 Psi
Body - #3	Casting - BS3100 Grade A2	
Flanges - #1	ASTM A105	
Flanges - #2	Carbon steel	
Centre bolts / pins	316 S/Steel	
Dowty washer	304 S/Steel / Nitrile	
Seals	Polyurethane	
Bolts	Hex Grade 8.8, Hot dipped galvanizing	

Note! Materials can be changed to client specification, but this will result in longer lead times.

Bolt Dimensions:

	Inner Bolt Dimensions				Outer Bolt Dimensions			
Pipe Sizes	Face To Face		Outside Diameter		Face To Face		Outside Diameter	
Unit	(mm)	(inch)	(mm)	(inch)	(mm)	(inch)	(mm)	(inch)
DN50 / 2"	180	7.09	145	5.71	180	7.09	180	7.09
DN80 / 3"	190	7.48	175	6.89	190	7.48	190	7.48
DN100 / 4"	200	7.87	200	7.87	200	7.87	230	9.06
DN150 / 6"	200	7.87	260	10.24	200	7.87	274	10.79
DN200 / 8"	220	8.66	305	12.01	220	8.66	355	13.98
DN250 / 10"	220	8.66	360	14.17	220	8.66	410	16.14
DN300 / 12"	250	9.84	420	16.54	250	9.84	465	18.31
DN350 / 14"	250	9.84	450	17.72	250	9.84	480	18.90
DN400 / 16"	250	9.84	500	19.69	250	9.84	575	22.64
DN450 / 18"	250	9.84	565	22.24	250	9.84	645	25.39
DN500 / 20"	300	11.81	630	24.80	300	11.81	740	29.13

Maximum Bolt Torque Settings:

Pipe Sizes	Bolts Sizes		Bolt Torque		Centre Bolt Sizes	
Unit	(metric)	(imperial)	(Nm)	ft lb		
DN50 / 2"	M12	1/2"	85	62.69	3 x M12	3 x 1/2"
DN80 / 3"	M12	1/2"	85	62.69	3 x M12	3 x 1/2"
DN100 / 4"	M16	5/8"	210	154.89	3 x M12	3 x 1/2"
DN150 / 6"	M16	5/8"	210	154.89	3 x M16	3 x 5/8"
DN200 / 8"	M16	5/8"	210	154.89	3 x M16	3 x 5/8"
DN250 / 10"	M16	5/8"	210	154.89	3 x M16	3 x 5/8"
DN300 / 12"	M20	3/4"	425	313.46	3 x M16	3 x 5/8"
DN350 / 14"	M20	3/4"	425	313.46	4 x M16	4 x 5/8"
DN400 / 16"	M20	3/4"	425	313.46	4 x M20	4 x 3/4"
DN450 / 18"	M24	1"	730	538.42	4 x M20	4 x 3/4"
DN500 / 20"	M24	1"	730	538.42	6 x M20	6 x 3/4"

The minimum bolts torque settings of the HMP coupling bolts are 40% of the maximum torque settings. Should it be found that a coupling leaks during commissioning, the bolt torque can be increased by 10% increments, until the coupling seals 100%.

Design Standards:

The HMP™ Hydraulic coupling are designed in accordance with various international standards as set out below:
ASME Boilers and pressure vessels design code
ANSI B16.3 ANSI B16.37
ANSI B16.34 ANSI N278.1

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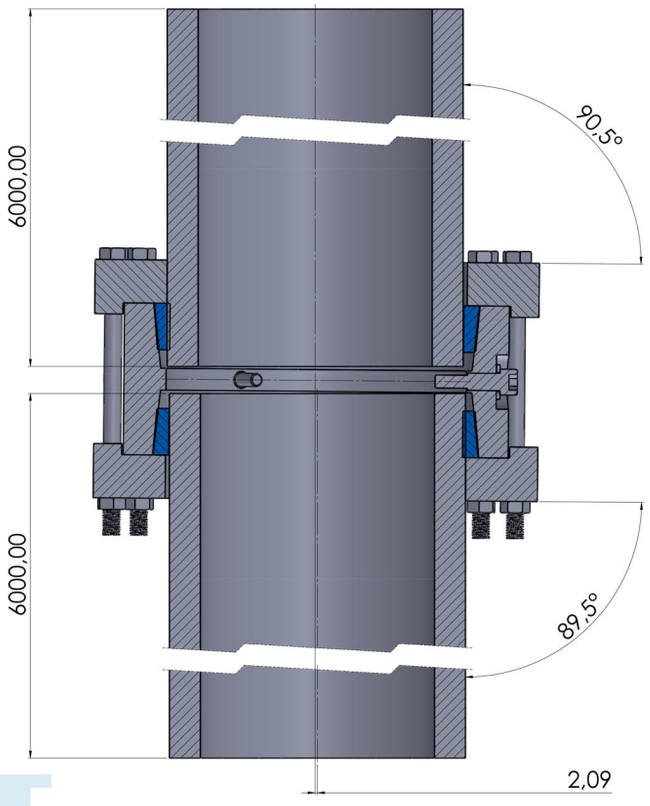
Pipe Outside Diameter Tolerances (In accordance with ASTM A106 Pipe specification)

Pipe Sizes		Over Size		Under Size	
(metric)	(imperial)	(mm)	(inch)	(mm)	(inch)
DN50 to DN100	2" to 4"	0.8	1/32"	0.8	1/32"
DN150 to DN200	6" to 8"	1.6	1/16"	0.8	1/32"
DN250 to DN450	10" to 18"	2.4	3/32"	0.8	1/32"
DN500	20"	3.2	1/8"	0.8	1/32"

Lateral Pipe Displacement Tolerance:

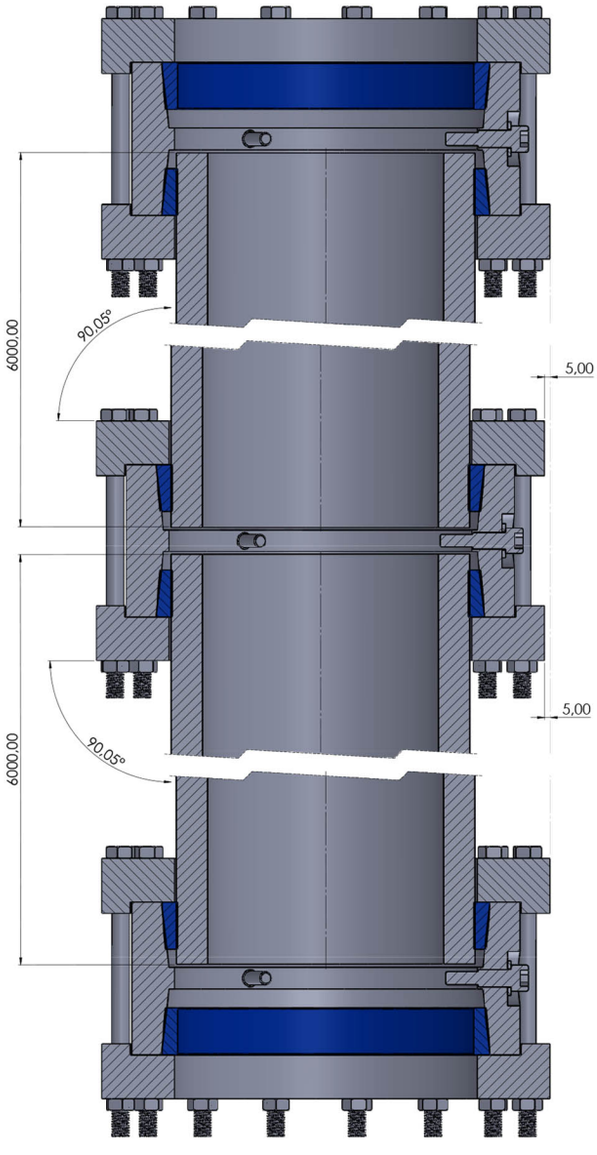
Lateral pipe displacement will cause the coupling to rotate.
Maximum rotational tolerance: 0.5° on coupling (Not pipe) which would correspond to a pipe lateral displacement tolerance of 2.09mm.
The HMP Hydraulic coupling can take as much misalignment as the pipe will allow and still seal, but misalignment is very bad for the system and can be the cause of failures.



Maximum Pipe Misalignment Tolerance:

Recommended maximum tolerance: Anything more than 0.05° pipe rotation on a 6m length of pipe is unacceptable.

Note! The coupling can handle up to 0.5 misalignment, but the design of the pipe / shaft brackets must be capable of handling the lateral loads caused by misalignment.



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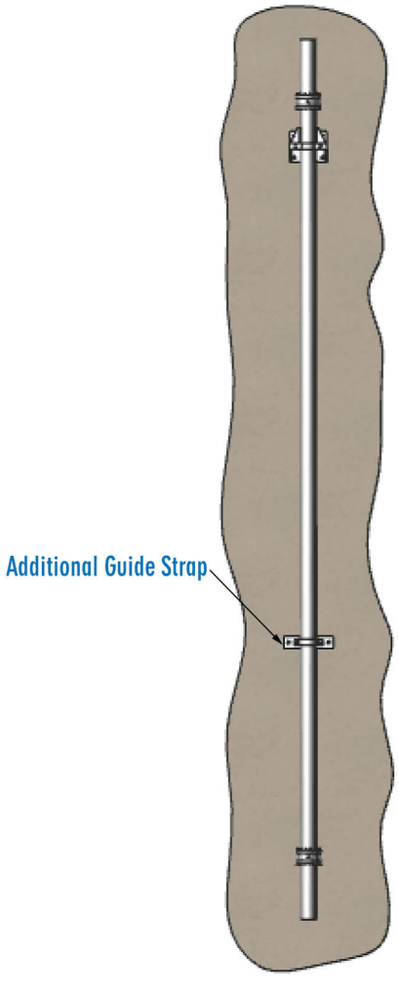
Line Assembly



Some Important Information For Consideration And Installation Tips:

- Pipe misalignment will generate lateral (hydraulic) loads.
- Errors in installation must not be cumulative.
- Cumulative misalignment will generate lateral loads that shall far exceed the design capacity of the pipe brackets.
- A coupled pipe system is sensitive to misalignment.
- The pipe column must be aligned in two (vertical) planes.
- The required pipe end to end gap is critical and must be ensured - Incorrect spacing could cause the pipes to buckle.
- Pipe thermal growth (expansion), must not cause pipe end engagement with the central pin - there must be sufficient clearance.
- Pipe thermal contraction must not cause disengagement from the coupling - there must be adequate engagement across the full temperature range.
- The use of packers / shims / spacers must be limited.
- (Additional) guide straps to be considered at the client's own discretion, at one or two locations for each pipe and coupling assembly, depending on the pipe lengths.
- Bracket bolts, through slotted plates, must be secured post installation and alignment.
- Quality control systems must be in place to control pipe lengths, pipe end clearances, as well as bracket locations in both radial and vertical planes.
- A formal risk analysis on the support design is mandatory.
- A formal risk analysis on the installation procedure is mandatory.
- A tolerance (risk) analysis is recommended.
- Installation errors and the associated risks are higher for a shaft barrel installation.
- Pipe ends must not be oval and the sealing surface must not be damaged.
- Pipe lengths must be controlled.
- Bracket location in the radial, circumferential and vertical planes must be controlled.