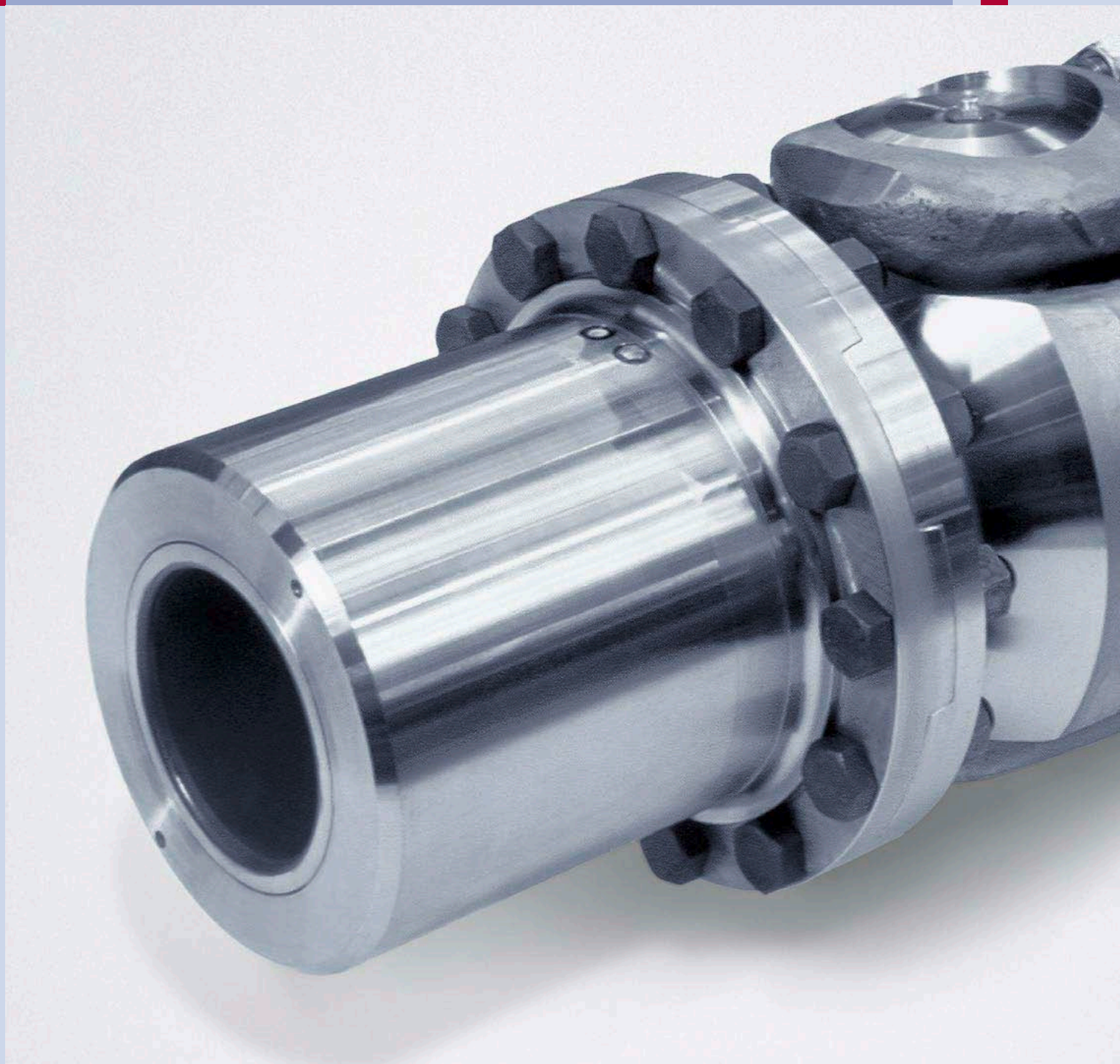
Voith Turbo

VOITH

Connection Couplings
HyCon, HyLoc and HyGrip



Voith Turbo Safeset

We are the experts in torque-limiting and connection couplings at Voith Turbo.

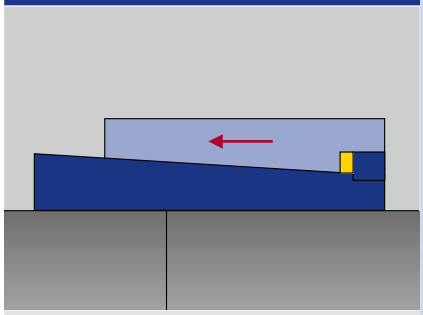
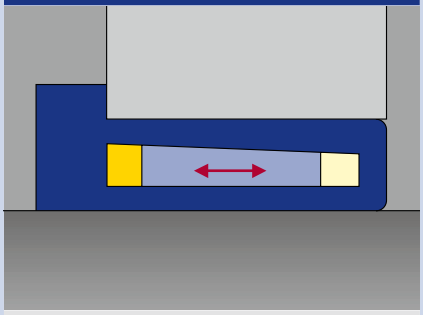
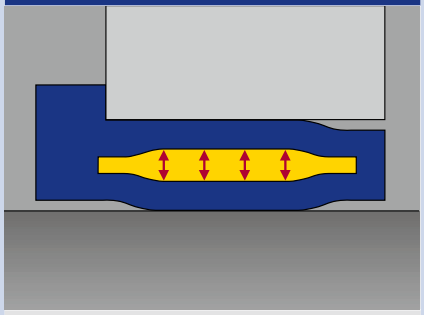
Voith Turbo, the specialist for hydrodynamic drive, coupling and braking systems for road, rail and industrial applications, as well as for ship propulsion systems, is a Group Division of Voith AG.

Voith is one of the largest family-owned companies in Europe with a workforce of around 39,000, EUR 5.1 billion in sales in the 2008/2009 fiscal year and 280 sites worldwide. The company is active in the energy, oil and gas, paper and raw materials as well as transportation and automotive markets around the world.

Principle

HyCon, HyLoc and HyGrip

Voith connection couplings provide a backlash-free, frictional, quick setting/releasing shaft-hub connections. The setting or releasing occurs hydraulically. Depending on the application, various operating principles are available, all of which offer the advantage of a backlash-free pressure connection.

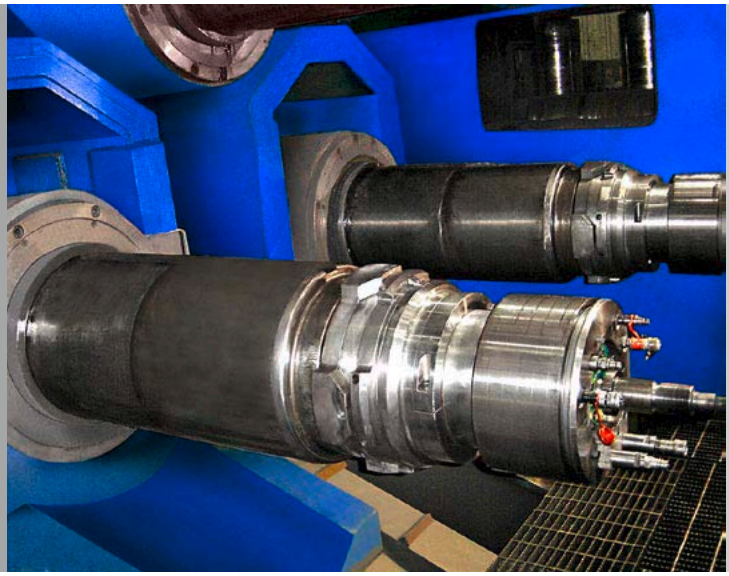
HyCon	HyLoc	HyGrip
		
■ Mechanical shaft-shaft/shaft-flange connection ■ Hydraulically set and released ■ Oil pressure is not required for transmitting torque	■ Mechanical shaft-hub connection ■ Hydraulically set and released ■ Oil pressure is not required for transmitting torque	■ Hydraulic hollow sleeve-shaft-hub connection ■ Pumped up hydraulically ■ Oil pressure is required for transmitting torque
By hydraulically pushing a tapered outer sleeve upon a tapered inner sleeve, a radial force is created. Subsequently a frictional connection is created between shaft, coupling and shaft/flange.	By hydraulically pushing a tapered sleeve inside a coupling unit, a radial force is created. Subsequently a frictional connection is created between shaft, coupling and hub.	By hydraulically expanding a coupling unit, a radial force is created. Subsequently a frictional connection is created between shaft, coupling and hub.
During setting and releasing, the shaft hub remains static, only the tapered outer sleeve is moved.	During setting and releasing, the shaft hub remains static, only the tapered conical sleeve inside the coupling moves.	During setting and releasing, the shaft hub remains static.

Connecting applications

HyCon, HyLoc and HyGrip

Marine: propulsion shafts and drive line components

Navy: propulsion shafts and drive line components



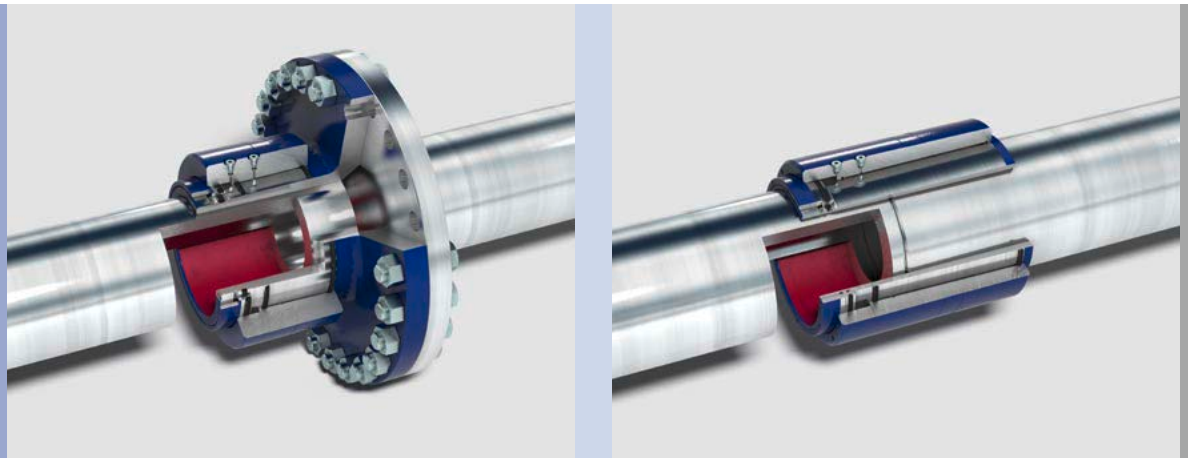
Metal processing: roll connections, slitting equipment, grinding shafts and drive train components

Power generation: driveline components

Mining: driveline components

HyCon

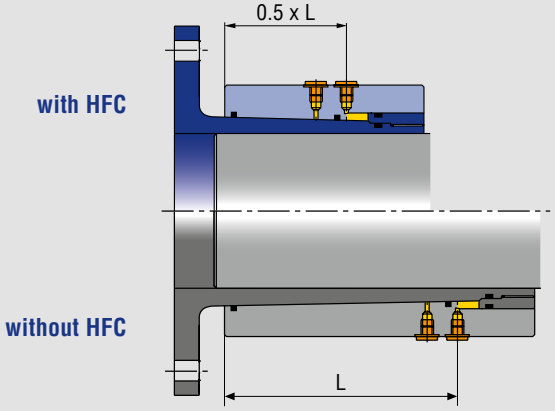
A breakthrough in connection technology

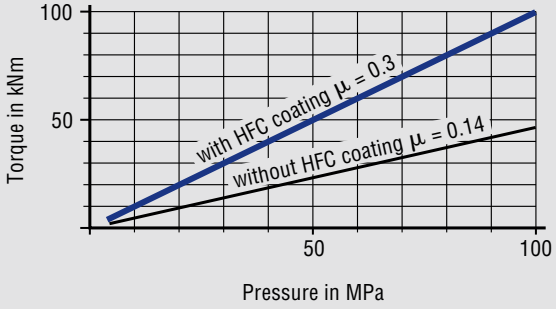


HyCon-F and HyCon-S with high friction coating (HFC), approved by DNV and ABS

The coupling friction surfaces are treated with a unique process, which more than doubles the friction factor. This gives the corresponding increase of the transmittable torque.

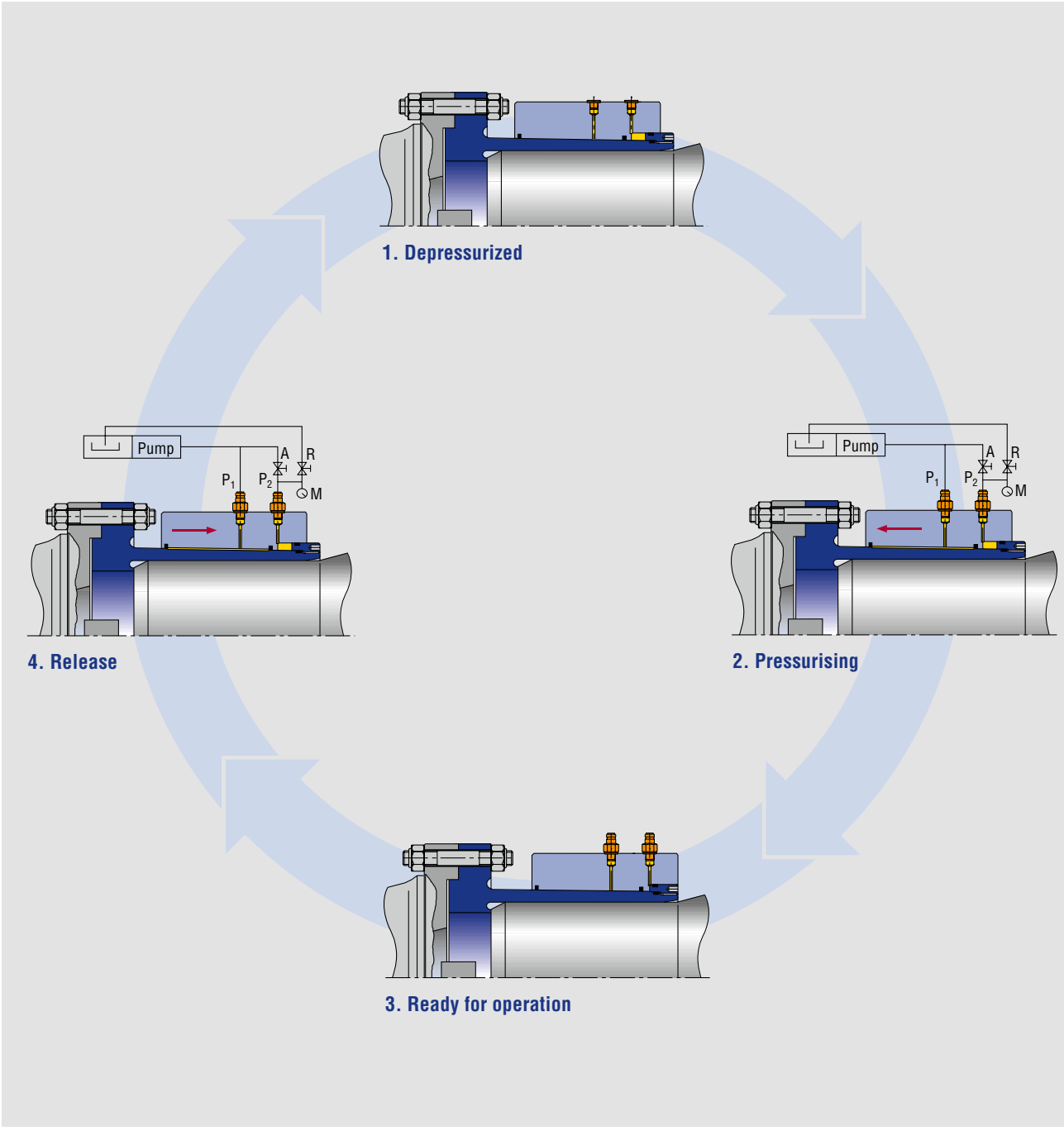
After a careful investigation DNV and ABS has type approved the HyCon coupling for marine applications using a calculation value of μ = 0.3 on the friction coefficient. The corresponding value for conventional friction joints is μ = 0.14.





Comparison of HyCon with and without HFC coating: 50% reduction of friction length or pressure

Setting and releasing



1. *Shaft is removed or pushed into correct axial position.*

2. *Connect both hydraulic hoses to hydraulic fittings “P1” and “P2”. Activate the pump. With increasing pressure, the hub moves in the direction of the arrow. Once the set pressure is reached (approximately 1000 bar) open the valve “R” and the relief valve at the pump. It is now safe to remove the hydraulic hoses.*

3. *HyCon is now set without any internal oil pressure.*

4. *Connect both hydraulic hoses again to “P1” and “P2”. Open valve “A” and close valve “R”. Activate the pump until a pressure of approximately 400 bar is achieved, then close valve “A”. Carry on pumping until the hub releases which results in a slight pressure increase at the gauge “M”. Slowly open valve “R”. The hub returns back to its original position. It is now safe to remove the hydraulic hoses.*

HyCon

F/FX and S/SX series

HyCon type F/FX

Design and function

The HyCon connection coupling consists mainly of a tapered sleeve and a tapered hub. By means of a sealed piston sleeve, a piston space is created which exerts hydraulic axial forces on the hub when pressure is applied. Consequently, the hub is pushed up the taper of the sleeve, which results in a radial compression. In order to carry out this process at minimum pressure and without wear, the surface of the taper is lubricated with pressurised oil. The surface of the taper is sealed on both sides, thus no leakage can occur.

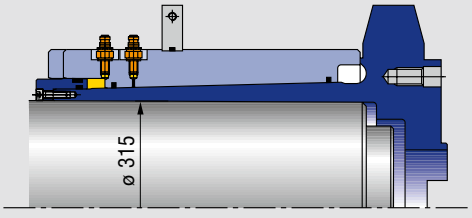
In order to release the connection, oil is pumped in between the tapered surfaces until they are separated and the sleeve is moved down by the axial forces generated.

Typical applications

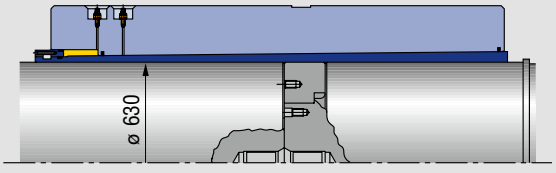
- Marine: Connect shaft sections in conventional propulsion drive lines
- Marine: Connect drive lines to waterjets, thrusters etc.
- Industrial: Connect drive shafts in heavy industry

Feature	Benefits
High torque capacity due to high friction coating (HFC)	■ Ideally suited for thin hollowed shafts ■ No internal reinforcement sleeves necessary
Low weight	■ Reduced system weight ■ Increased effective load especially in ships and boats ■ Excellent resistance against shock loads in the driveline
Low mass moment of inertia	■ Reduced system vibrations
F/FX: Flange connection on inner sleeve	■ Simple positioning of the coupling ■ Connection bolts can be tightened before pressurizing of the coupling
S/SX: Shaft to shaft connection	■ Low hydrodynamic resistance when located outboard in ships and boats

Industrial application designs

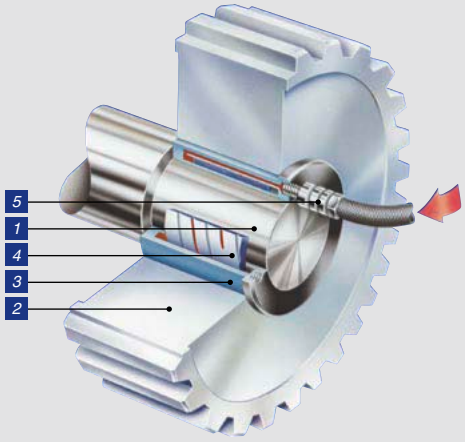


Cold rolling mill, HyCon F315 installed between roll and universal joint



Hot plate mill, HyCon SX630 installed between motor and intermediate shaft on a twin drive arrangement (design torque 4200 kNm)

HyLoc



1 *Shaft*
2 *Hub*
3 *Hollow sleeve*
4 *Conical ring piston*
5 *Sealing valve/pump hose connection*

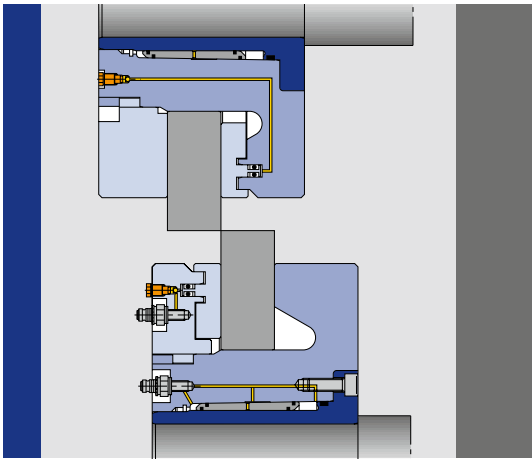
HyLoc type HC-B

Design and function

The HyLoc connection coupling consists of a hollow sleeve, where the internal chamber is a conical ring piston that is moved hydraulically. The ensuing radial expansion produces a backlash-free connection between a shaft and a hub.
The pressure required for assembly is normally 1000 bar. A maximum of 1200 bar is usually required for disassembly. After assembly, the oil is drained, so that there is no residual oil pressure in the coupling during operation. The same applies for disassembly. The ring piston is provided with specially arranged lubrication grooves, hence a lubricating film is created when the ring piston moves between the working surfaces.

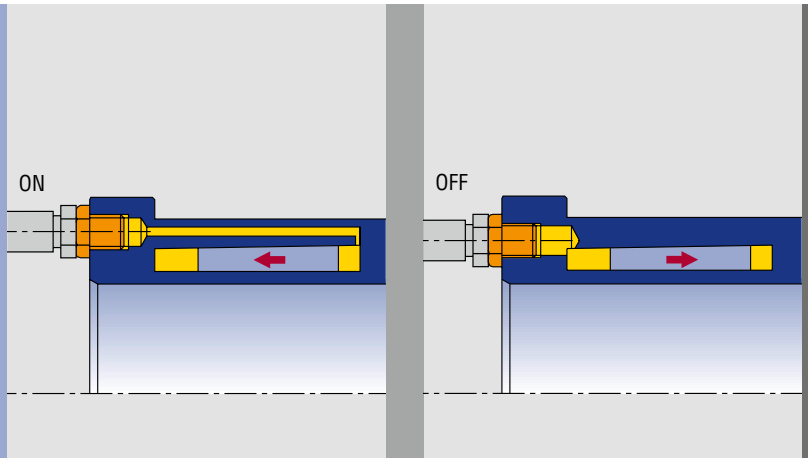
Typical applications

- Industrial: Fixing of straightening and cutting rolls in the steel industry
- Industrial: Fixing of different hubs and runners as flywheels, turbines etc.
- Industrial: Knife/blade holders for rotating sitters to cut sheet metal or paper
- Industrial: Blade holders for cutting thick sheet metals, e.g. in wide strip hot rolling mills



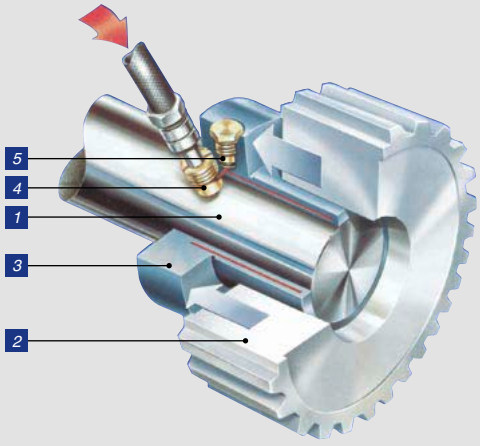
HyLoc disc knife holder type HC-B

Feature	Benefits
Backlash-free connection	■ Improved control of processes ■ Increased service life of all driveline components ■ No notch effects as the keyways are eliminated
Design optimized for simple assembly and disassembly	■ Rapid and accurate installation
Minimized radial and axial run out	■ Improved control of actual process
Design optimized for withstanding high radial forces	■ Ideally suited for roll connections
Robust design	■ Able to withstand dirty and difficult environments
High friction coating (HFC) optional	■ Extremely high torque capacity



Connection of the hydraulic pump
ON: setting/pressurizing
OFF: releasing/depresurizing

HyGrip



1 Shaft
2 Hub
3 Hollow sleeve
4 Pump hose connection
5 Sealing valve

HyGrip type HG-B

Design and function

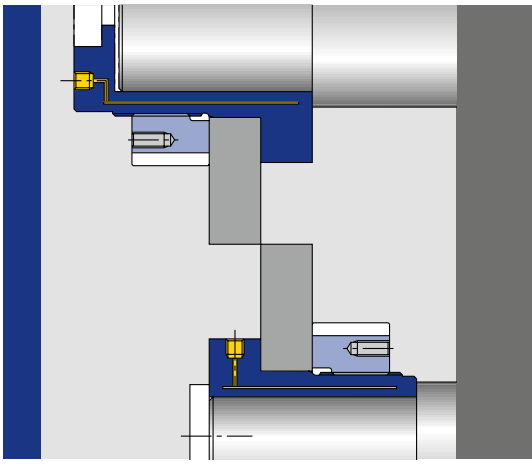
The HyGrip connection coupling consists of a twin-walled pressure sleeve. It is pressurized with oil to 1200 bar and sealed with a brass valve. This results in a completely backlash-free frictional connection.

HyGrip connection couplings can be specifically designed to meet the exact requirements of the application.

The torque transmission capacity and the axial forces are proportional to the oil pressure. The connection can be set and released very quickly if a suitable hydraulic pump is used.

Typical applications

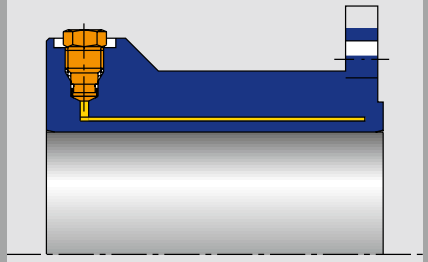
- Industrial: Fixing of straightening rolls and cutting rolls where the radial forces are low
- Industrial: Fixing of flexible drive shafts and couplings for easy assembly and disassembly
- Industrial: Knife/blade holders for rotating slitters to cut sheet metal or paper



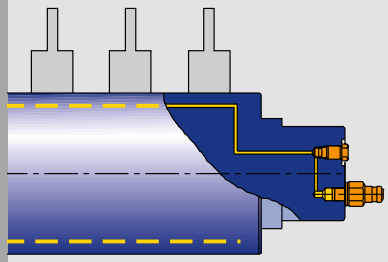
HyGrip disc knife holder type HG-B

Feature	Benefits
Backlash-free connection	■ Improved control of processes ■ Increased service life of all driveline components ■ No notch effects as the keyways are eliminated
Design optimized for simple assembly and disassembly	■ Rapid and accurate installation
Minimized radial and axial run out	■ Improved control of actual process
Robust design	■ Able to withstand dirty and difficult environments
High friction coating (HFC) optional	■ Extremely high torque capacity

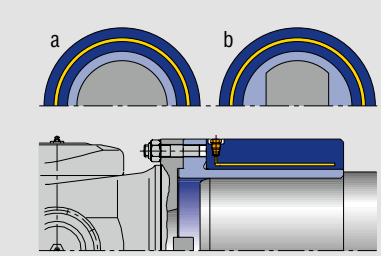
Various Applications



HyGrip type HG-N



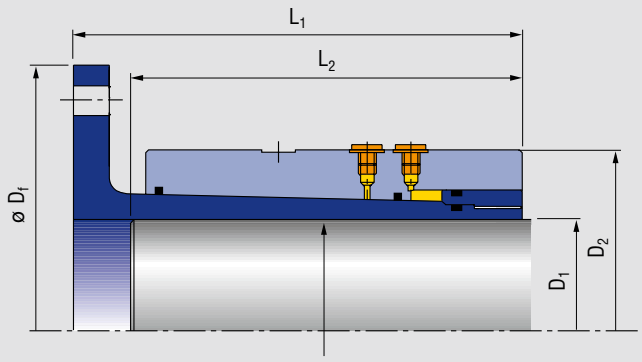
HyGrip type HG-W



HyGrip type HG-F
a) shaft with round journal
b) shaft with flat journal

Technical Data

HyCon F and FX series

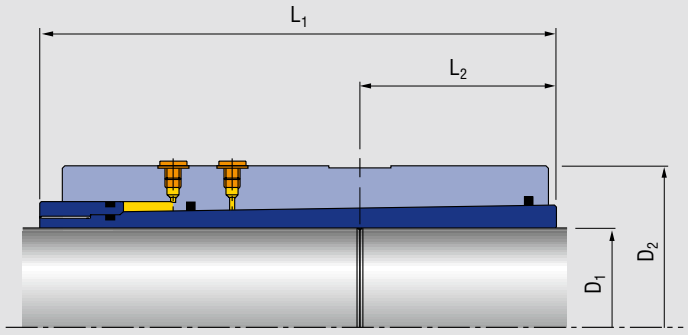


HyCon F									
Size	T [kNm]	D_1 [mm]	D_2 [mm]	D_f [mm]	DD1 [mm]	L_1 [mm]	L_2 [mm]	m [kg]	J [kgm²]
80	14.7	80	130	185	0.06	113	87	8	0.027
90	21.4	90	147	210	0.06	125	95	11	0.050
100	29.1	100	158	235	0.06	135	103	14	0.077
110	38.4	110	174	260	0.08	149	114	19	0.126
120	50.5	120	191	285	0.08	166	125	25	0.205
130	65.3	130	207	305	0.08	176	132	31	0.294
140	82.6	140	223	325	0.08	194	147	40	0.425
150	102	150	240	345	0.08	205	154	49	0.597
160	126	160	256	365	0.08	216	161	58	0.801
170	151	170	272	390	0.085	226	168	69	1.084
180	179	180	288	415	0.09	236	175	81	1.441
190	211	190	303	435	0.095	247	183	93	1.836
200	246	200	320	455	0.1	257	190	108	2.342
220	327	220	351	495	0.11	278	204	139	3.612
240	424	240	383	525	0.12	302	220	176	5.306
260	540	260	416	575	0.13	322	234	224	8.028
280	674	280	448	605	0.14	344	249	272	11.056
300	830	300	480	635	0.15	365	264	327	14.942
320	1000	320	511	695	0.16	385	277	398	21.247
340	1200	340	544	730	0.17	407	291	473	28.282
360	1430	360	576	760	0.18	427	305	550	36.259
380	1680	380	607	820	0.19	447	319	651	48.860
400	1960	400	639	855	0.2	469	332	751	61.957

HyCon FX									
Size	T [kNm]	D_1 [mm]	D_2 [mm]	D_f [mm]	DD1 [mm]	L_1 [mm]	L_2 [mm]	m [kg]	J [kgm²]
80	26.6	80	145	235	0.06	182	139	19	0.092
90	39.1	90	164	285	0.06	202	153	29	0.201
100	53	100	177	305	0.06	222	168	37	0.293
110	69.7	110	194	325	0.08	243	185	47	0.432
120	92.3	120	214	345	0.08	269	202	62	0.657
130	120	130	233	390	0.08	289	216	82	1.093
140	153	140	252	415	0.08	317	237	104	1.573
150	191	150	270	455	0.08	336	250	130	2.344
160	235	160	289	475	0.08	358	265	156	3.101
170	282	170	307	495	0.085	377	278	183	4.008
180	335	180	324	525	0.09	395	291	214	5.269
190	393	190	343	555	0.095	416	305	253	6.973
200	458	200	362	575	0.1	435	318	291	8.723
220	610	220	400	620	0.11	473	344	380	13.439
240	793	240	436	675	0.12	512	372	489	20.531
260	1000	260	470	730	0.13	549	398	610	30.024
280	1260	280	506	810	0.14	588	426	777	46.345
300	1540	300	542	840	0.15	626	452	924	60.444
320	1880	320	578	890	0.16	663	478	1108	81.825
340	2250	340	614	955	0.17	701	504	1333	112.763
360	2680	360	650	1000	0.18	738	530	1560	145.829
380	3150	380	685	1040	0.19	775	556	1799	183.807
400	3670	400	721	1115	0.2	812	581	2121	246.385

T: torque *m: mass* *J: mass moment of inertia* *DD1: Assembly clearance shaft-bore*

HyCon S and SX series



HyCon S

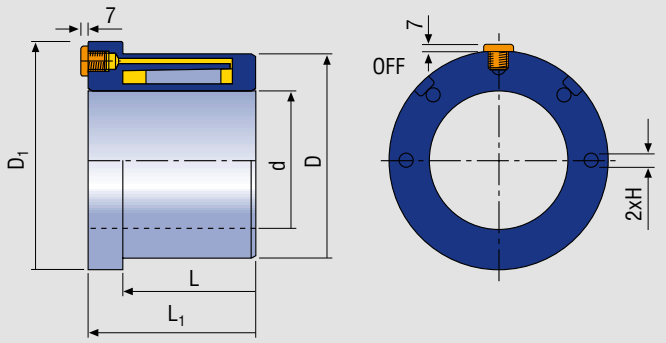
Size	T [kNm]	D_1 [mm]	D_2 [mm]	DD1 [mm]	L_1 [mm]	L_2 [mm]	m [kg]	J [kgm²]
80	15.6	80	125	0.06	142	51	8	0.022
90	22.6	90	140	0.06	157	58	11	0.039
100	31.3	100	152	0.06	173	64	14	0.058
110	40.6	110	166	0.08	189	70	18	0.089
120	53.5	120	181	0.08	206	76	23	0.138
130	68.9	130	196	0.08	222	83	29	0.204
140	86.5	140	212	0.08	244	89	38	0.308
150	107	150	227	0.08	257	95	46	0.426
160	131	160	240	0.08	272	101	54	0.558
170	157	170	256	0.085	285	107	64	0.760
180	187	180	272	0.09	298	113	76	1.016
190	220	190	286	0.095	314	119	89	1.304
200	256	200	300	0.1	327	125	101	1.638
220	341	220	331	0.11	354	137	134	2.636
240	443	240	360	0.12	382	149	170	3.968
260	563	260	391	0.13	409	162	215	5.927
280	704	280	420	0.14	437	174	264	8.410
300	865	300	450	0.15	465	186	323	11.792
320	1050	320	479	0.16	491	198	385	15.952
340	1260	340	510	0.17	519	211	462	21.714
360	1490	360	540	0.18	545	223	544	28.660
380	1760	380	570	0.19	571	235	635	37.276
400	2050	400	600	0.2	597	247	736	47.850

HyCon SX

Size	T [kNm]	D_1 [mm]	D_2 [mm]	DD1 [mm]	L_1 [mm]	L_2 [mm]	m [kg]	J [kgm²]
80	28.7	80	136	0.06	253	102	19	0.059
90	41.8	90	154	0.06	282	116	27	0.108
100	58.7	100	165	0.06	311	128	33	0.154
110	75.5	110	180	0.08	342	140	43	0.238
120	99.5	120	197	0.08	371	152	56	0.371
130	129	130	214	0.08	400	165	71	0.559
140	163	140	231	0.08	435	177	91	0.826
150	203	150	247	0.08	461	189	110	1.143
160	248	160	264	0.08	489	201	133	1.584
170	298	170	280	0.085	515	213	157	2.108
180	354	180	296	0.09	541	225	184	2.763
190	415	190	314	0.095	570	238	220	3.698
200	485	200	330	0.1	596	250	253	4.712
220	645	220	363	0.11	649	274	334	7.513
240	838	240	394	0.12	703	298	423	11.259
260	1060	260	427	0.13	757	323	536	16.728
280	1330	280	460	0.14	811	348	666	24.143
300	1630	300	492	0.15	864	372	810	33.623
320	1980	320	525	0.16	916	396	978	46.227
340	2380	340	558	0.17	971	421	1172	62.548
360	2830	360	590	0.18	1022	445	1377	82.211
380	3320	380	625	0.19	1074	469	1630	109.039
400	3870	400	655	0.2	1126	493	1868	137.510

T: torque m: mass J: mass moment of inertia DD1: Assembly clearance shaft-bore

HyLoc HC-B series



HyLoc											
Size	**T [Nm]**	**F [kN]**	**d [mm]**	**D [mm]**	**D_1 [mm]**	**L [mm]**	**L_1 [mm]**	**DH [mm]**	**H**	**J [$kgm^2 \cdot 10^{-3}$]**	**m [kg]**
50	2600	104	50	77	101	57	82	105	M8	3.3	2.4
60	4600	153	60	89	113	65	90	125	M8	5.4	3.1
70	7900	226	70	102	122	75	100	145	M8	8.7	4.1
80	12100	303	80	115	135	85	110	160	M8	14	5.4
90	17100	380	90	128	148	95	120	180	M12	23	7.0
100	24200	484	100	140	160	105	130	200	M12	34	8.6
110	32900	598	110	154	173	115	140	220	M12	51	11
120	43200	720	120	168	186	125	150	240	M12	76	14
130	53800	828	130	182	200	135	160	260	M16	110	17
140	68900	984	140	196	213	145	170	280	M16	150	21
150	85400	1139	150	210	227	155	180	300	M16	210	25
160	104000	1300	160	224	240	165	190	320	M16	290	30
180	150000	1667	180	252	267	185	210	360	M16	500	42
200	206000	2060	200	280	293	205	230	400	M16	830	56
220	273000	2482	220	308	320	225	250	435	M16	1300	73

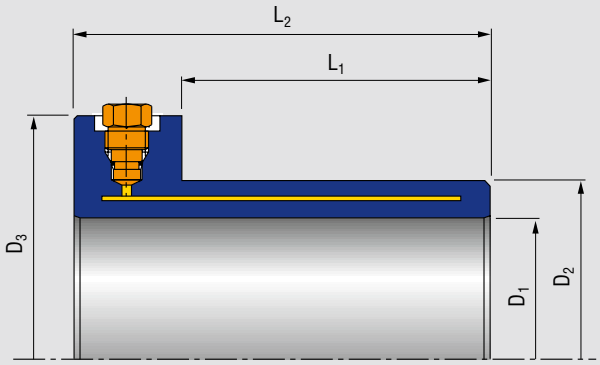
T: torque (without axial force)
m: mass
Assembly pressure: 100 MPa

F: axial force (without torque)
Hub/shaft tolerances: H7/h7
Disassembly pressure: ~ 120 MPa

J: mass moment of inertia
Oil: Gear oil type 80 W

Different designs are possible on request. Larger model sizes only available as special designs.

HyGrip HG-B series



Hydraulic setting sleeve for the connection of a hub with a shaft

HyGrip-B

Size	T [kNm]	F_{ax} [kN]	D_1 [mm]	D_2 [mm]	D_3 [mm]	L_1 [mm]	L_2 [mm]	m [kg]	J [kgm²]
30	0.6	40	30	40	85	36	66	1.33	0.001
35	0.9	51	35	45	91	41	71	1.5	0.002
40	1.3	65	40	52	96	47	77	1.7	0.002
45	1.7	75	45	58	103	53	83	2.0	0.003
50	2.2	88	50	65	109	57	87	2.4	0.004
60	3.6	120	60	75	120	65	95	2.8	0.005
70	6.0	171	70	90	135	74	104	3.9	0.010
80	7.8	195	80	100	144	90	120	4.7	0.013
90	10.0	222	90	110	155	102	132	5.5	0.018
100	15.0	300	100	125	170	108	146	8.2	0.034
110	20.0	363	110	140	188	109	144	10.0	0.050
120	25.0	416	120	150	196	133	171	12.2	0.068
130	33.0	507	130	160	205	144	182	13.6	0.084
140	40.0	571	140	170	215	152	190	15.0	0.104
150	46.0	613	150	180	225	162	200	16.5	0.128
160	71.0	887	160	200	233	180	225	24.0	0.211
170	78.0	917	170	210	243	176	221	24.9	0.243
180	85.0	944	180	225	261	176	221	29.7	0.330
190	120.0	1263	190	240	273	222	270	40.0	0.491
200	130.0	1300	200	250	283	222	270	42.0	0.560
220	160.0	1454	220	270	301	222	270	45.0	0.710

T: torque *m: Mass* *J: Mass moment of inertia* *F_{ax}: Axial force*

If torque T and axial force F_{ax} are transmitted simultaneously, a resulting force F_{res} is to be calculated.
The latter must not exceed the indicated axial force F_{ax}:

$$F_{res} = \sqrt{F_{ax}^2 + \left(\frac{T \cdot 2000}{D_1}\right)^2}$$

The maximum operating loads must not exceed the indicated values. An adequate safety factor should be adhered to.

Accessories

HyCon, HyLoc and HyGrip

Service Boxes for HyCon

Service Box for HyLoc

Pumps

Pumps for pressurizing the couplings are available for all couplings. The size of the pump is dependent on the size of the connection coupling.

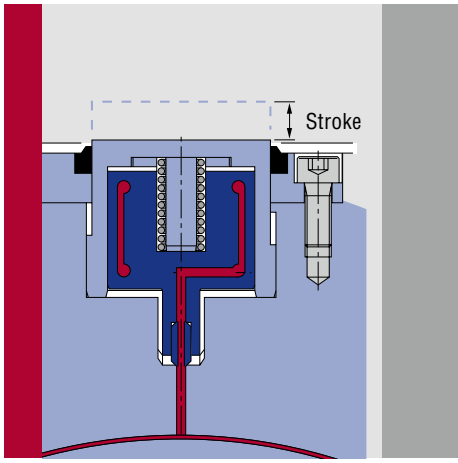
Available pumps:

- P115 series for coupling size 30 to 220
- P240 series for coupling size 200 to 360
- P700 series for coupling sizes above 360

The P115 and 240 are manually operated pumps, and the P700 is pneumatically operated. For special demands electrically driven pumps and custom solutions are available.

Service Boxes

All operations of the couplings require some additional tools and equipment. The service boxes include all necessary tools to operate any coupling in the connection coupling range. They are also adapted for HyLoc, HyCon or HyGrip connection couplings.



HyGrip pressure indicator “type 1”

Service Boxes for HyGrip

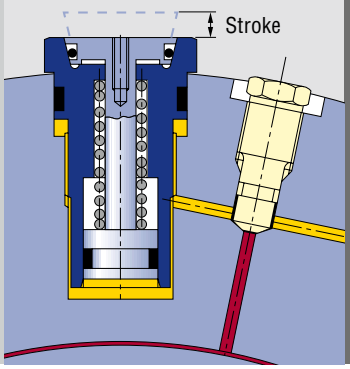
Pressure indicator and leakage detector

Additionally, in order to monitor its function, a HyGrip coupling can be fitted with a pressure indicator, or a leakage detector.

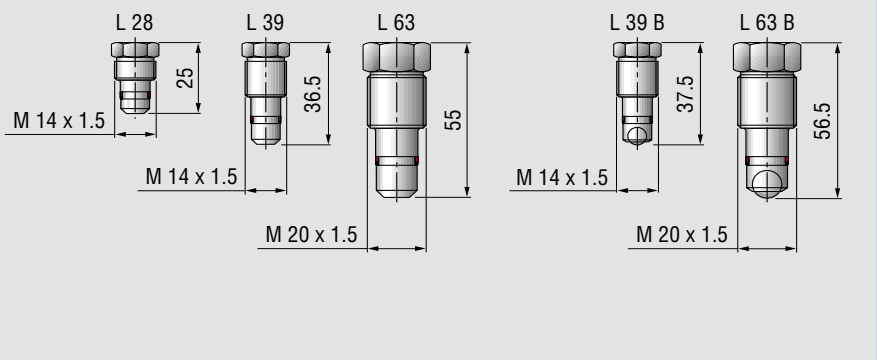
The pressure indicator reacts to internal pressure, whilst the leakage detector reacts when an oil leak appears at the pressure valve. In the event of oil loss, in both components a plate moves radially which can be sensed externally.

Sealing valves for Hygrip

The number of sealing valves is dependent on the coupling size.



HyGrip pressure indicator “type 2”



HyGrip sealing valves

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