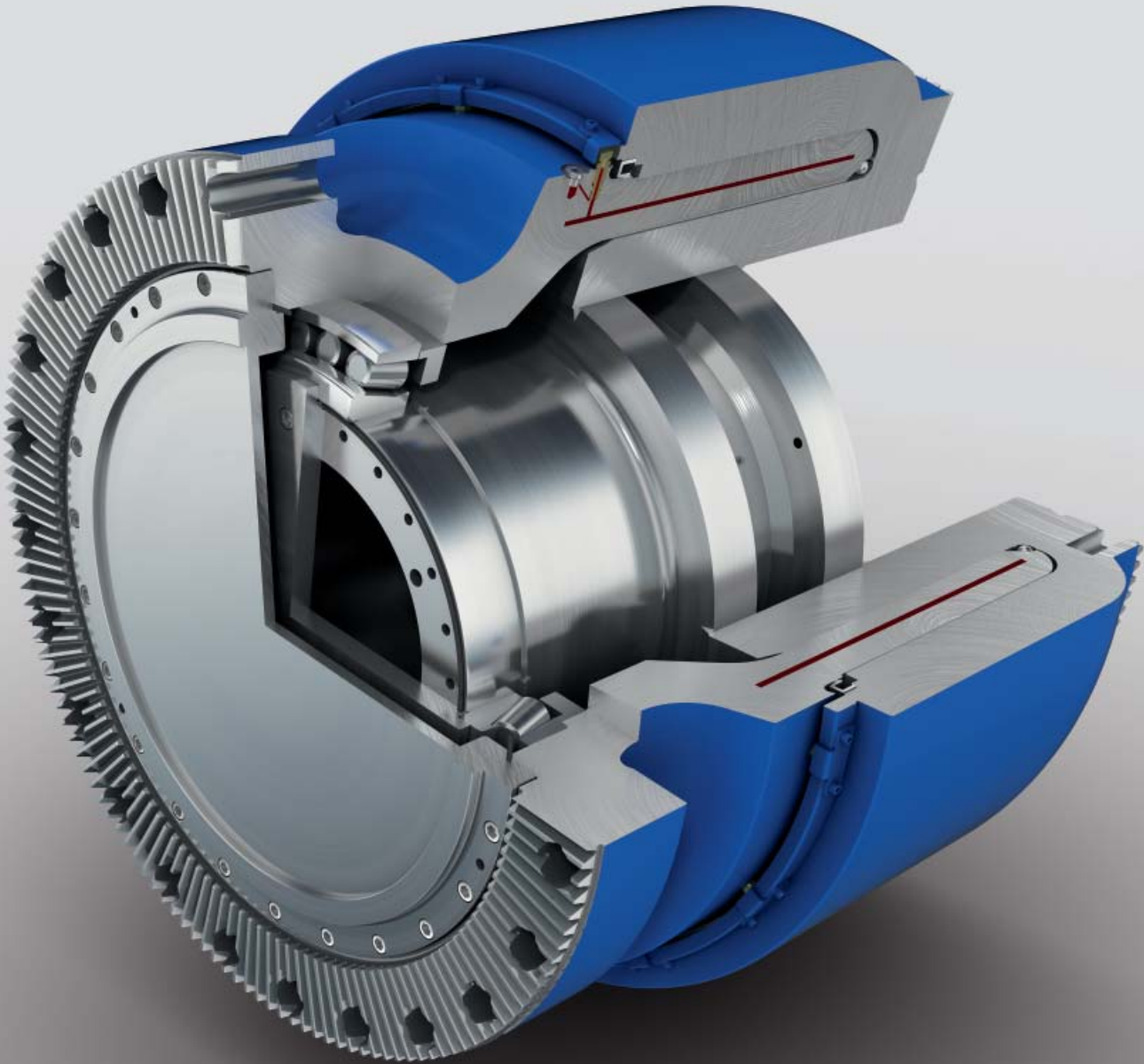


Voith Turbo

VOITH

SafeSet – Torque-limiting Safety Coupling



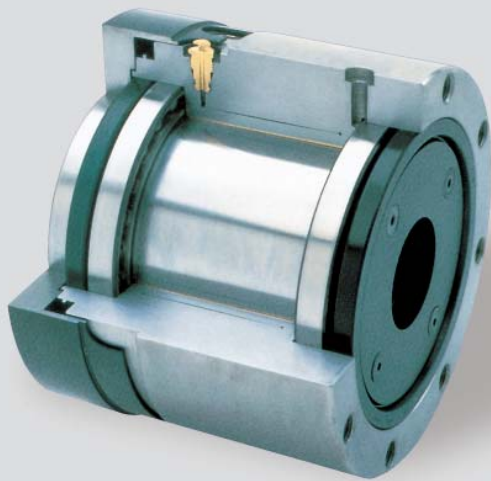
Voith Turbo Safeset

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.

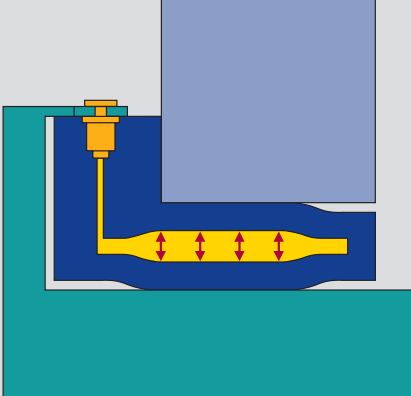
SafeSet – The torque limiting safety coupling



- **precise point of release**
- **minimum down-time**
- **suitable for every application**

SafeSet

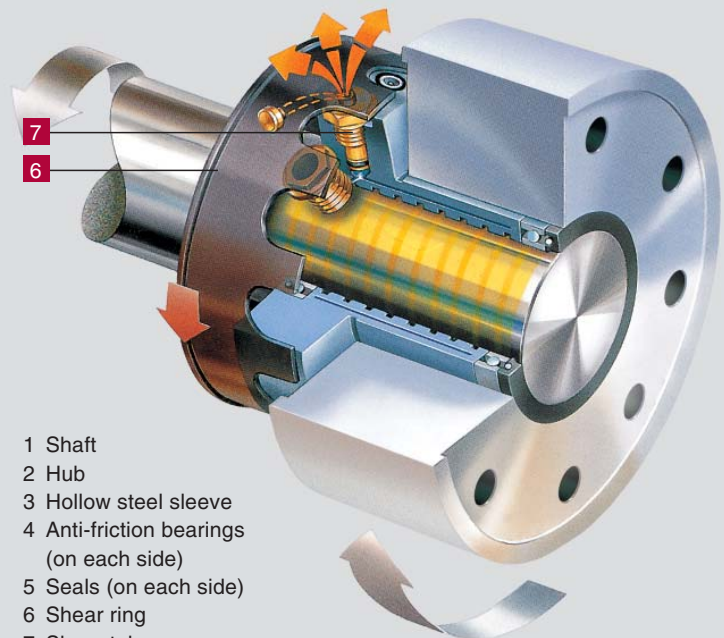
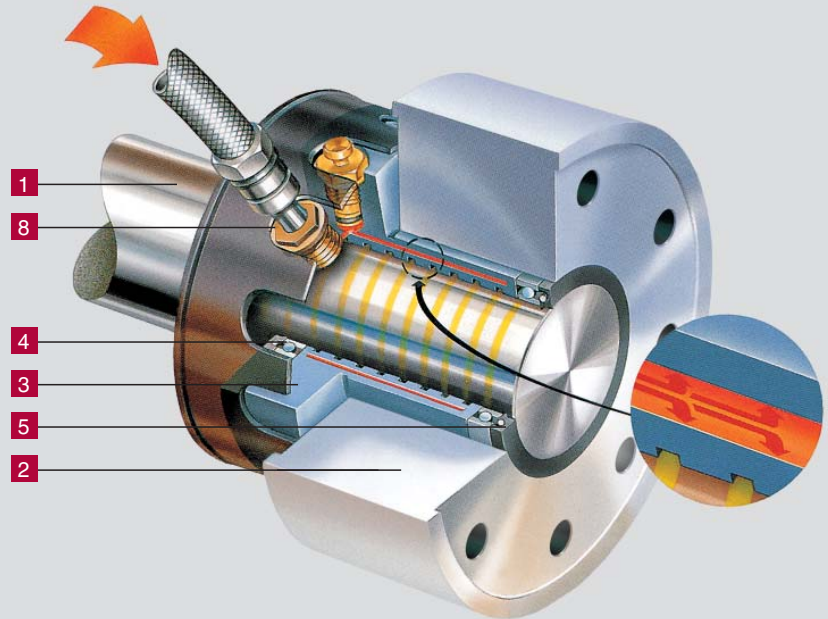
The torque limiting safety coupling



Features:

- adjustable release torque
- selected release torque remains constant
- precise point of release
- back-lash free power transmission
- compact, low weight design
- low moment of inertia
- minimal maintenance requirements

A hollow steel sleeve is expanded by oil under pressure; this produces a friction connection between a shaft and a hub. At overload the coupling instantaneously releases the oil pressure and interrupts the drive.

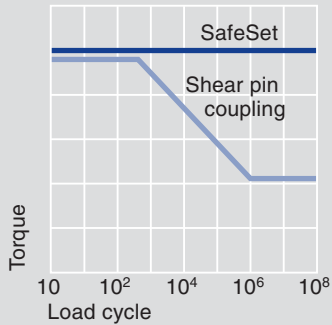


- 1 Shaft
- 2 Hub
- 3 Hollow steel sleeve
- 4 Anti-friction bearings (on each side)
- 5 Seals (on each side)
- 6 Shear ring
- 7 Shear tube
- 8 Oil charge port

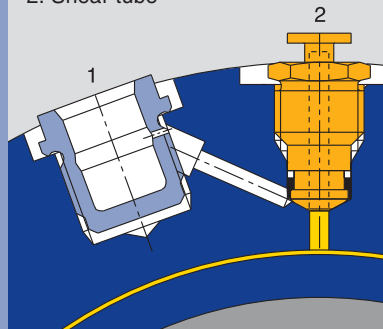
SafeSet

Operation and Design

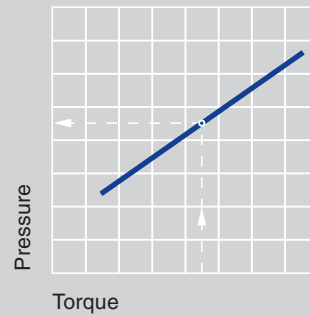
S-N Curve



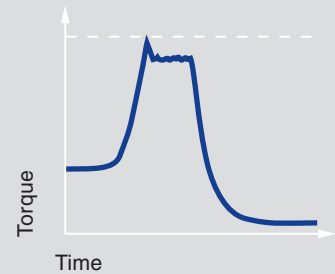
1. Charge port
2. Shear tube



Calibration diagram



Release diagram



Operation

To start operation of the coupling, connect a SafeSet pump to the oil charge port and release the shear valve slightly to allow oil to be pumped into the pressurised sleeve. The operator can select the required oil pressure using a calibration diagram which is provided for each coupling.

The selected hydraulic pressure generates a defined friction load between the pressure sleeve and shaft. This pressure determines the maximum torque which can be transmitted (slip torque).

If the operating torque exceeds the selected slip torque, the shaft rotates within the pressure sleeve. The shear ring is fixed to the shaft, so it also rotates and breaks off the top of the shear tube. This causes an instantaneous drop in oil pressure and releases the friction connection.

The SafeSet coupling can be returned to operation after a minimum of delay by replacing the tube and re-applying the pressure.

Since the release process does not cause any wear, no maintenance is required apart from a regular oil change.

Permitted temperature range -20 to +60°C. Temperatures exceeding this range are possible with special measurements.

Design

The SafeSet coupling consists of a twin-walled pressure sleeve. This can be pressurised up to 1000 bar using oil under high pressure, while a shear valve (shear tube) ensures that the system is completely sealed. Larger couplings have more than one shear tube.

A shear ring is fixed to the shaft. If any overload occurs, this shear ring breaks off the top of the shear valve.

The friction load surfaces are specially treated to prevent any wear when the coupling releases. To ensure that friction surfaces do not come into contact with each other after release, anti-friction bearings are fitted between the components which rotate relatively to one another. A plain bearing is sufficient for couplings operated at low speeds.

The area around the pressure surfaces and bearing is filled with a special oil. This oil supports a constant friction coefficient and, in turn, a precise release torque.

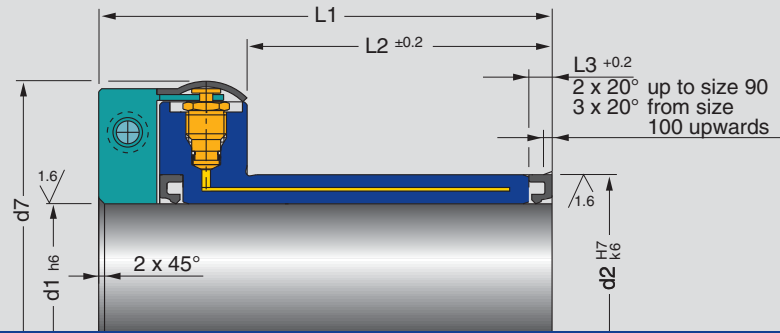
In contrast to shear element couplings the release torque of the SafeSet coupling is not influenced by material fatigue, i.e. SN datas. The release torque always remains constant.



SafeSet

ST series with sleeve bearing

For installation between a plain shaft and hub, with low operating speeds. This type is not axially located and cannot absorb axial thrust following release of the coupling. The sleeve bearing only allows limited radial and bending forces following release.



Size ST	M_A [kNm]	n_{max} [rpm]	d1 [mm]	d2 [mm]	d7 [mm]	L1 [mm]	L2 [mm]	L3 [mm]	G [kg]	J [kgm ²]
30	0.3- 0.6	900	30	40	98	82	40	4	1.9	0.002
35	0.4- 0.9	800	35	45	104	87	45	4	2.1	0.003
40	0.6- 1.3	700	40	52	109	94	52	5	2.5	0.003
45	0.8- 1.7	620	45	58	116	102	60	7	2.8	0.004
50	1.1- 2.2	560	50	65	122	109	65	8	3.4	0.006
60	1.8- 3.6	450	60	75	133	117	73	8	4.0	0.009
70	3.0- 6.0	400	70	90	148	130	82	8	5.7	0.015
80	3.9- 7.8	350	80	100	157	146	98	8	6.6	0.020
90	5.0- 10.0	325	90	110	168	158	110	8	7.6	0.028
100	7.5- 15.0	275	100	125	183	180	120	12	12	0.052
110	10.0- 20.0	250	110	140	201	176	121	12	13	0.073
120	13.0- 25.0	225	120	150	209	205	145	12	16	0.095
130	17.0- 33.0	215	130	160	218	214	156	12	17	0.110
140	20.0- 40.0	200	140	170	228	225	165	13	20	0.150
150	23.0- 46.0	185	150	180	238	235	175	13	22	0.180
160	36.0- 71.0	175	160	200	246	260	195	15	27	0.260
170	39.0- 78.0	165	170	210	256	256	191	15	28	0.290
180	49.0- 98.0	155	180	225	274	256	191	15	32	0.370
190	63.0-126.0	150	190	240	286	302	236	15	43	0.540
200	70.0-140.0	140	200	250	296	302	236	15	45	0.610
220	85.0-170.0	125	220	270	314	302	236	15	49	0.760

M_A : release torque – adjustment range

n_{max} : maximum permissible speed

G: mass (weight)

J: inertia moment

Selection of size (Valid for all types)

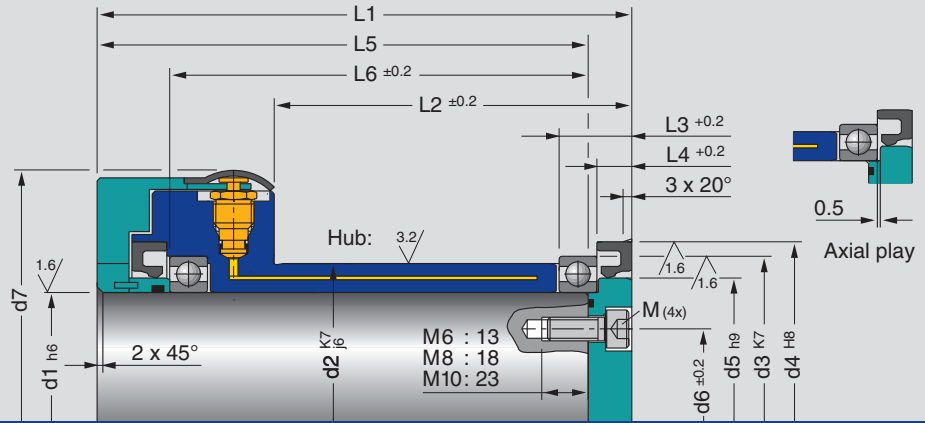
The coupling size is determined by the required release torque. This torque must be within the stated adjustment range. Practice has shown that in many cases, it is useful to have a torque safety margin of at least 20%.

The torque can be set below the lower limit. Thereby however the release torque accuracy is reduced. Less than 1/3 of the max. value should never be used.

SafeSet

ST-B series with ball bearings

For installation between a plain shaft and hub, with higher operating speeds.



Size	M_A	d1	d2	d3	d4	d5	d6	d7	L1	L2	L3	L4	L5	L6	M	G	J
ST-B	[kNm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[kg]	[kgm ²]
60	1.8- 3.6	60	75	78	90	70	40	136	137	83	18	8	128	106	M6	4.9	0.012
70	3.0- 6.0	70	90	90	100	80	50	148	150	92	18	8	140.5	115.5	M6	6.6	0.020
80	3.9- 7.8	80	100	100	110	90	50	157	166	108	18	8	156.5	131.5	M6	7.6	0.025
90	5.0- 10.0	90	110	115	125	100	65	168	184	123	25	12	170	145	M8	9.2	0.037
100	7.5- 15.0	100	125	125	140	110	70	183	206	133	25	12	191	156	M8	14	0.065
110	10.0- 20.0	110	140	140	150	120	80	201	208	137	28	12	193	167	M8	16	0.095
120	13.0- 25.0	120	150	150	160	130	90	209	237	161	29	13	221	189	M8	19	0.120
130	17.0- 33.0	130	160	165	170	140	100	218	250	174	31	13	234	203	M8	21	0.140
140	20.0- 40.0	140	170	175	180	150	105	228	261	183	31	13	245	212	M10	24	0.190
150	23.0- 46.0	150	180	190	190	160	115	238	275	195	33	13	259	226	M10	27	0.230
160	36.0- 71.0	160	200	200	200	170	120	253	300	215	33	13	284	249	M10	32	0.320
170	39.0- 78.0	170	210	215	215	180	130	258	300	213	37	15	282	247	M10	34	0.370
180	49.0- 98.0	180	225	225	225	190	135	273	300	213	38	16	281	248	M10	38	0.460
190	63.0-126.0	190	240	240	250	200	145	286	350	260	39	15	332	300	M10	50	0.660
200	70.0-140.0	200	250	250	250	220	150	296	350	260	39	15	332	300	M10	53	0.750
220	85.0-170.0	220	270	270	270	240	175	320	350	260	39	15	332	300	M10	57	0.930

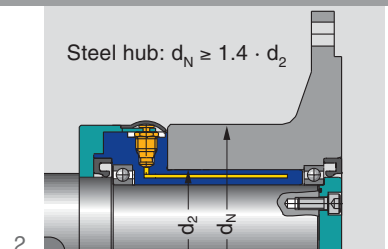
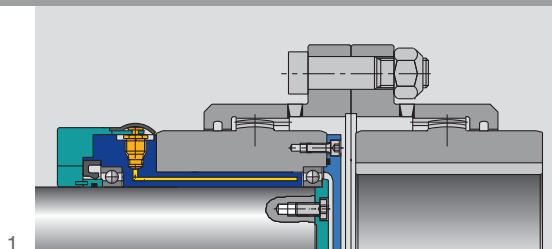
M_A : release torque – adjustment range

G: mass (weight)

J: inertia moment

Sample applications

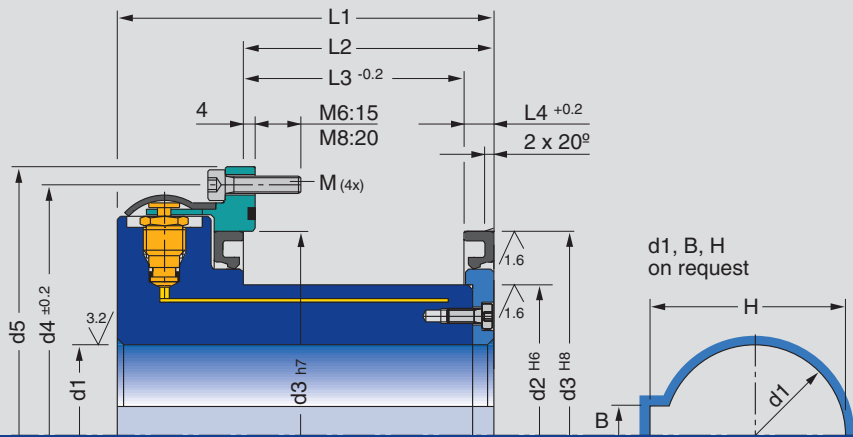
- 1 ST-B coupling with gear coupling.
- 2 ST-B coupling with flanged hub.



SafeSet

ST-K series with plain bearing

For installation between a shaft with parallel key and a hub, with low operating speeds. Friction surface between coupling and hub.



Size ST-K	M_A [kNm]	n_{max} [rpm]	d1 [mm]	d2 [mm]	d3 [mm]	d4 [mm]	d5 [mm]	L1 [mm]	L2 [mm]	L3 [mm]	L4 [mm]	M	G [kg]	J [kgm ²]
52	0.6- 1.2	575	26- 35	52	72	121	135	80	40	31	9	M6	6	0.008
60	1.0- 2.0	500	30- 40	60	90	131	145	95	55	46	9	M6	7	0.010
70	1.5- 3.0	425	38- 48	70	100	140	154	100	60	51	9	M6	8	0.013
80	2.1- 4.2	375	45- 55	80	110	147	161	105	65	56	9	M6	9	0.017
90	3.0- 6.0	330	50- 60	90	125	157	171	115	71	58	13	M6	11	0.024
100	3.9- 7.8	300	60- 70	100	140	166	180	125	81	68	13	M6	14	0.034
110	5.0- 10.0	275	65- 80	110	150	177	191	130	86	73	13	M6	16	0.046
120	7.0- 14.0	250	70- 85	120	160	183	197	140	96	83	13	M6	18	0.059
130	9.0- 17.0	230	80- 95	130	170	196	211	150	106	93	13	M8	20	0.080
140	10.0- 20.0	215	85-105	140	180	204	219	160	116	103	13	M8	23	0.100
150	13.0- 25.0	200	95-115	150	185	213	228	170	128	117	11	M8	25	0.130
160	17.0- 33.0	190	100-120	160	190	223	238	180	133	117	16	M8	29	0.160
180	23.0- 46.0	170	115-135	180	220	246	262	190	146	133	13	M8	35	0.220
200	35.0- 70.0	150	130-155	200	240	266	282	200	153	137	16	M8	44	0.360
220	48.0- 96.0	135	140-170	220	260	286	302	230	183	167	16	M8	58	0.550
250	70.0-140.0	120	160-190	250	290	316	332	250	202	185	17	M8	74	0.880
280	90.0-180.0	110	180-210	280	320	345	360	270	222	205	17	M8	101	1.530

M_A : release torque – adjustment range

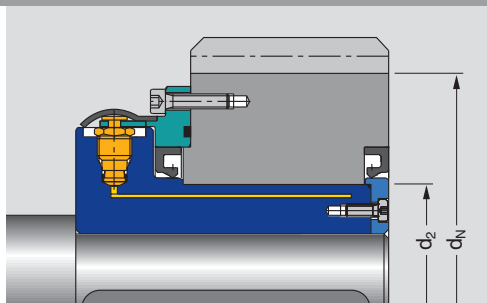
n_{max} : maximum permissible speed

G: mass (weight)

J: inertia moment

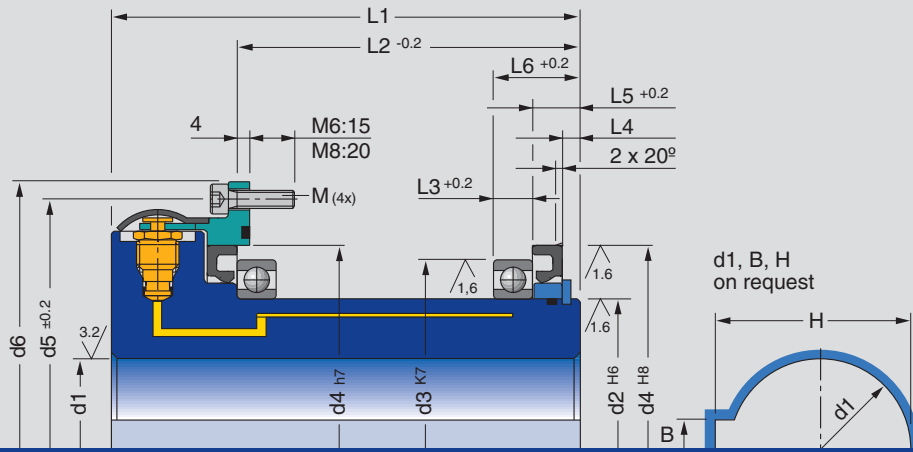
Sample application

ST-K coupling with gear.
Steel hub: $d_N \geq 1.4 \cdot d_2$



SafeSet

ST-KB series with anti-friction bearings



For installation between a shaft with parallel key and a hub, with higher operating speeds. Friction surface between coupling and hub.

Size ST-KB	M _A [kNm]	d1 [mm]	d2 [mm]	d3 [mm]	d4 [mm]	d5 [mm]	d6 [mm]	L1 [mm]	L2 [mm]	L3 [mm]	L4 [mm]	L5 [mm]	L6 [mm]	M	G [kg]	J [kgm ²]
50	0.5- 1.0	25- 35	50	65	75	113	124	95	56	7	4	13	20	M6	3.2	0.004
60	1.0- 2.0	30- 45	60	78	90	123	134	112	73	10	4	13	23	M6	4.2	0.006
70	1.5- 3.0	38- 55	70	90	100	133	144	119	80	10	5	14	24	M6	5.1	0.009
80	2.1- 4.2	45- 63	80	100	110	141	152	124	85	10	5	14	24	M6	6.1	0.012
90	3.0- 6.0	50- 70	90	115	125	148	159	136	93	13	5	18	31	M6	7.5	0.016
100	3.9- 7.8	60- 80	100	125	140	158	169	140	97	13	5	18	31	M6	8.4	0.021
108	5.0- 10.0	65- 88	107.95	133.35	140	166	177	146	103	13	7	20	33	M6	9.9	0.029
120	7.0- 14.0	70- 96	120.65	146.05	150	174	185	160	117	13	7	20	33	M6	12.0	0.040
127	9.0- 17.0	80-103	127	152.4	160	181	192	172	128	13	7	21	34	M6	14.0	0.048
140	10.0- 20.0	85-115	139.7	165.1	170	193	204	176	132	13	7	21	34	M6	17.0	0.070
152	13.0- 26.0	95-125	152.4	177.8	185	206	221	175	134	13	7	18	31	M8	18.0	0.087
165	17.0- 34.0	100-137	165.1	190.5	200	218	233	194	150	13	7	21	34	M8	23.0	0.128
178	23.0- 46.0	115-147	177.8	203.2	210	228	243	219	175	13	7	21	34	M8	29.0	0.178
203	35.0- 70.0	130-166	203.2	228.6	262	247	262	253	210	13	9	22	35	M8	42.0	0.324
228	50.0-100.0	140-187	228.6	254	270	295	310	281	235	13	9	25	38	M8	63.0	0.617
254	70.0-140.0	160-210	254	279.4	290	318	333	303	256	13	9	26	39	M8	80.0	0.979
280	90.0-180.0	180-230	279.4	304.8	320	342	357	311	265	13	9	25	38	M8	96.0	1.411

M_A: release torque – adjustment range

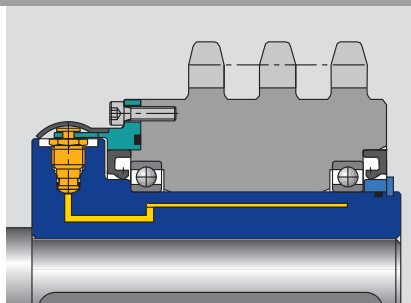
G: mass (weight)

J: inertia moment

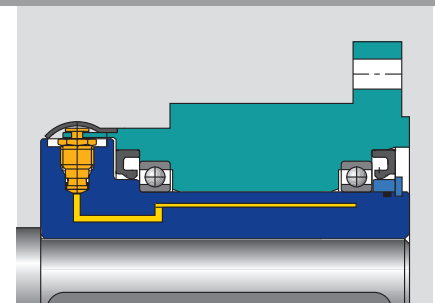
Sample applications

- 1 ST-KB coupling with sprocket.
- 2 ST-KB coupling with flanged hub.

1

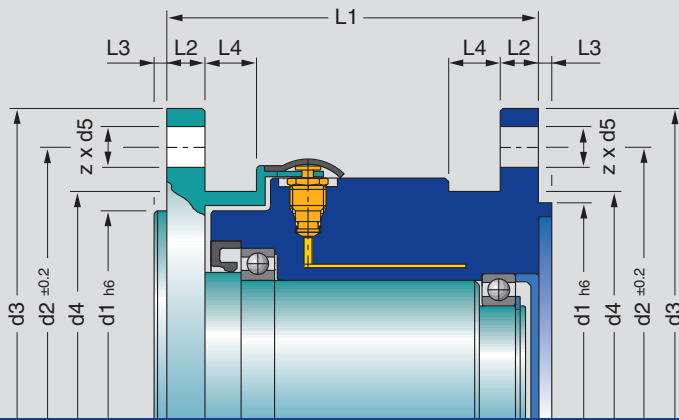


2



SafeSet

SR-P series with anti-friction bearings



Compact design with connection flange at each end, suitable for gear couplings.

Size SR-P	M_A [kNm]	d1 [mm]	d2 [mm]	d3 [mm]	d4 [mm]	d5 [mm]	z	L1 [mm]	L2 [mm]	L3 [mm]	L4 [mm]	G [kg]	J [kgm ²]	suitable to gear coupl.
45	0.7- 1.5	73	96	117	76	9	6	105	14	2	12	7	0.009	VSA 40
60	1.6- 3.2	94	122	152	96	11	8	115	19	2	15	11	0.025	VSA 55
80	2.9- 5.8	115	150	178	122	13	6	113	19	2	18	15	0.047	VSA 70
100	5.4- 10.8	140	184	213	150	17	6	135	22	2	22	25	0.110	VSA 85
110	8.2- 16.4	163	208	240	174	17	8	161	22	2	-	36	0.190	VSA 100
130	12.6- 25.2	188	242	280	200	21	8	173	28	2	-	54	0.393	VSA 120
160	20.5- 41.0	222	280	318	234	21	8	193	28	2	-	78	0.727	VSA 140
190	28.0- 56.0	245	305	347	262	21	10	199	28	3	-	98	1.095	VSA 160
203	39.0- 78.0	273	345	390	294	21	10	206	38	3	-	139	2.084	VSA 180
228	58.0-116.0	310	368	425	324	21	14	240	38	3	-	187	3.242	VSA 200
254	111.0-222.0	331	406	457	355	25	14	330	26	4	-	279	5.073	VSA 220
300	142.0-284.0	371	460	527	404	25	16	309	28	6	-	340	8.187	VSA 250
356	244.0-488.0	451	530	591	472	32	14	385	33	6	-	565	17.746	VSA 280
406	290.0-580.0	483	580	640	518	32	18	387	38	6	-	684	25.971	VSA 320

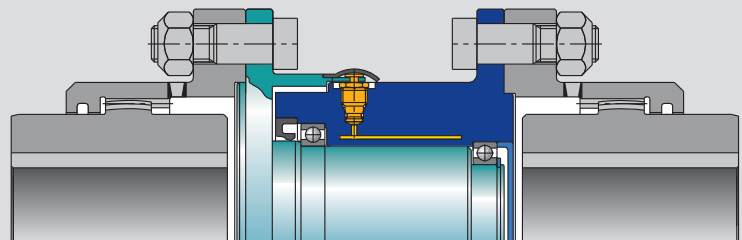
M_A : release torque – adjustment range

G: mass (weight)

J: inertia moment

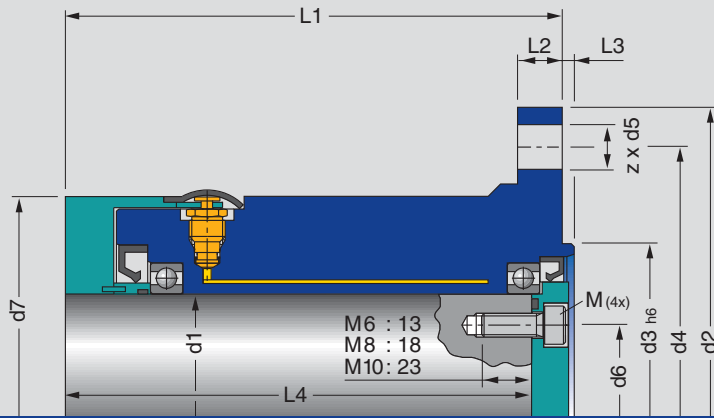
Sample application

SR-P coupling integrated in a cardan shaft and between the two halves of gear coupling.



SafeSet

SR-N series with integrated flange



For installation between a plain shaft and a universal joint or other flange connection. On request the flange connection dimensions can be modified.

Size SR-N	M_A [kNm]	d1 [mm]	d2 [mm]	d3 [mm]	d4 [mm]	d5 [mm]	d6 [mm]	d7 [mm]	z	L1 [mm]	L2 [mm]	L3 [mm]	L4 [mm]	M	G [kg]	J [kgm ²]	universal joint
60	1.8- 3.6	60	150	90	130	12	40	132	8	136	12	2.3	128	M6	12	0.032	S 150
		60	180	110	155.5	14	40	132	8	136	12	2.3	128	M6	13	0.037	S 180
70	3.0- 6.0	70	150	90	130	12	50	144	8	150	12	2.3	140	M6	13	0.036	S 150
		70	180	110	155.5	14	50	144	8	150	12	2.3	140	M6	14	0.041	S 180
80	3.9- 7.8	80	180	110	155.5	14	50	153	8	166	12	2.3	156	M6	18	0.069	S 180
		80	225	140	196	16	50	153	8	166	15	4	156	M6	20	0.088	S 225
90	5.0-10.0	90	180	110	155.5	14	65	164	8	184	12	2.5	171	M8	21	0.097	S 180
		90	225	140	196	16	65	164	8	184	15	4	171	M8	23	0.115	S 225
100	7.5-15.0	100	225	140	196	16	75	179	8	203	15	5	191	M10	26	0.146	S 225
		100	250	140	218	18	75	179	8	203	18	5	191	M10	28	0.168	S 250
		100	285	175	245	20	75	179	8	203	20	6	191	M10	30	0.214	S 285

M_A : release torque – adjustment range

G: mass (weight)

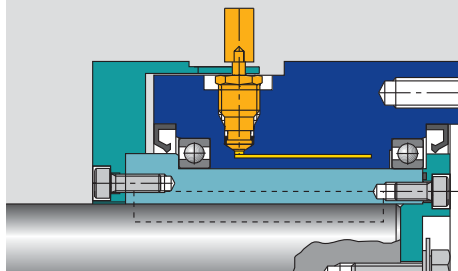
J: inertia moment

Other sizes and features are available on request. Above size 120 the type SR-F is recommended.

Sample of a special application

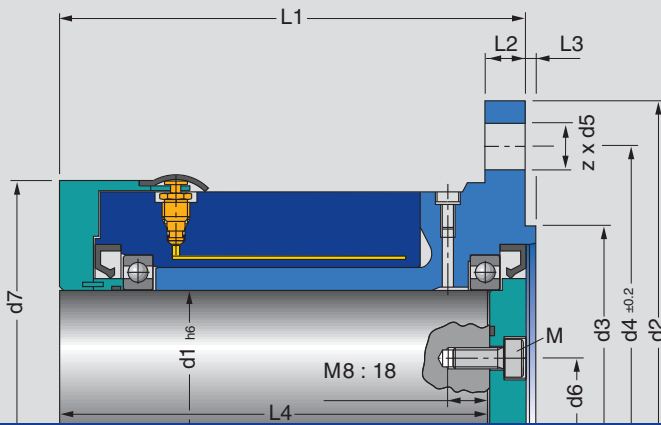
SafeSet SR-N 70 spec with shaft sleeve for a shaft with key and flange connection with pin screws and prolonged shear tube for additional remote release.

9 SafeSets SR-N 85 in a leveler.



SafeSet

SR-F series for higher torques with connecting flange



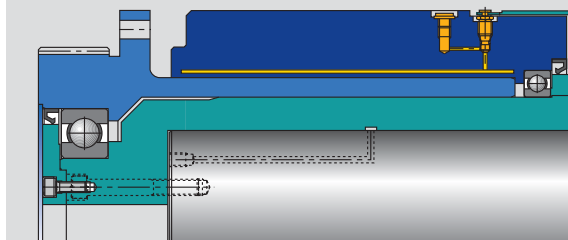
With this design the SafeSet pressure ring plays no active role in the torque transmission. The ring merely exerts a static radial force onto a torque transmitting connection sleeve, pressing this against the shaft or shaft sleeve. Thereby higher dynamic bending moments and radial forces can be transmitted by the SafeSet.

Size SR-F	M_A [kNm]	d1 [mm]	d2 [mm]	d3 [mm]	d4 [mm]	d5 [mm]	d6 [mm]	d7 [mm]	z	L1 [mm]	L2 [mm]	L3 [mm]	L4 [mm]	M	G [kg]	J [kgm ²]	universal joint
100	7.5-15	100	250	140	218	18	70	187	8	209	18	5	200	M8	35	0.22	S 250
		100	285	175	245	29	70	187	8	209	20	6	200	M8	38	0.26	S 285
110	10-20	110	250	140	218	18	80	200	8	208	18	5	198	M8	38	0.27	S 250
		110	285	175	245	20	80	200	8	208	20	6	198	M8	41	0.31	S 285
120	13-26	120	250	140	218	18	60	215	8	237	18	5	220	M10	48	0.38	S 250
		120	285	175	245	20	60	215	8	237	20	6	220	M10	50	0.41	S 285
		120	315	175	280	22	60	215	8	237	22	6	220	M10	53	0.48	S 315
130	17-33	130	285	175	245	20	100	230	8	250	20	6	234	M8	59	0.54	S 285
		130	315	175	280	22	100	230	8	250	22	6	234	M8	62	0.60	S 315
		130	350	220	310	25	100	230	10	250	25	7	234	M8	66	0.72	S 350
140	20-40	140	350	220	310	25	110	235	10	261	25	7	243	M10	68	0.77	S 350
		140	285	190	245	21	110	235	8	270	20	6	243	M10	63	0.61	SW 285
		140	315	190	280	23	105	235	10	305	32	7	243	M10	76	0.79	SW 315
150	25-50	150	315	210*	280	23	115	250	8	305	22	7	270	M10	78	0.86	S 315
		150	350	220	310	22	115	250	10	305	25	7	270	M10	82	0.97	S 350
160	35-71	160	350	220	310	22	120	275	10	355	25	7	320	M10	117	1.56	S 350
		160	390	250	345	24	120	275	10	355	28	7	320	M10	104	1.53	S 390
		160	350	190	310	23	120	275	10	355	35	7	320	M10	120	1.64	SW 350

Other sizes and features are also available. * not to universal joint standard

Sample of a special design

SafeSet SR-F 300 spec with gears to connect a gear spindle and a shrunk shaft sleeve. Max. release torque 450 kNm. Assembly from SafeSet SR-F 120 for cement mills.

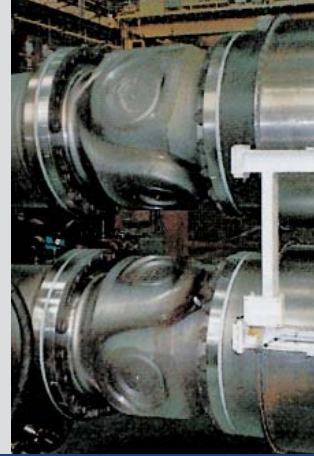
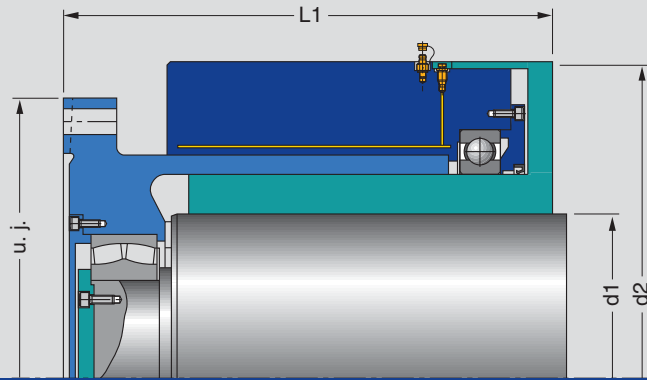


SafeSet

SR-F series for rolling mill drives

The couplings are designed and manufactured according to the customer's specification. The couplings are often used together with universal joints.

The table below does not show a standard-series but is a guide for a preliminary coupling selection.



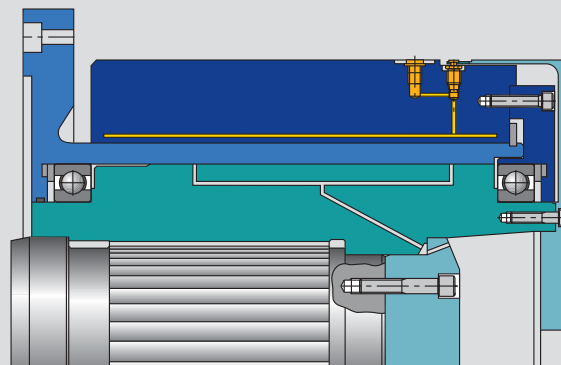
Size SR-F	M_A [kNm]	d1 [mm]	d2 [mm]	L1 [mm]	G [kg]	suitable to universal joint (u.j.)
200	75- 150	160	300	350	250	SW 285- 315
300	200- 400	240	520	450	400	SW 350- 390
400	350- 750	320	600	600	800	SW 440- 550
500	700- 1500	400	750	750	1.500	CW 600- 700
600	1000- 2200	480	900	950	2.200	CW 760- 800
710	1700- 3500	570	1070	1150	3.500	CW 840- 880
800	2500- 5000	640	1200	1200	5.000	CW 900-1020
900	3500- 7000	720	1350	1350	7.000	CW 1080-1120
1000	5000-10000	800	1500	1500	10.000	CW 1180-1220

M_A : release torque – adjustment range G: mass (weight)

SR-F series for gas turbines

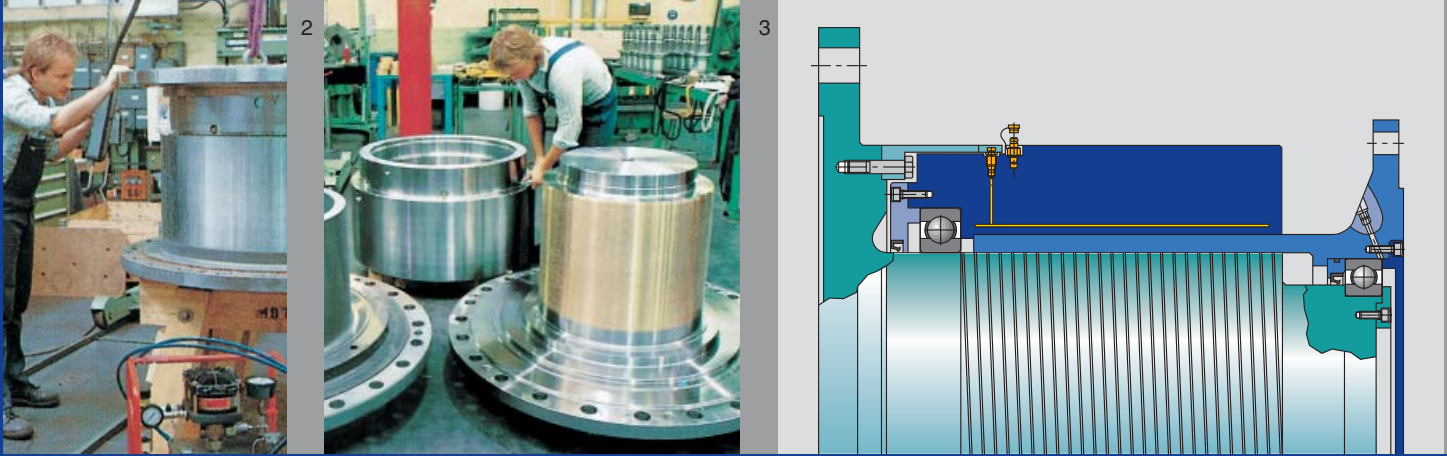
Sample

SafeSet SR-F 350 for gas turbine generator set. Max. $M_A = 500$ kNm at 3000 rpm.



SafeSet

SR-PF series for heavy duties



This design is developed for heavy duties and preferably in conjunction with gear couplings, metal membrane couplings or universal joints. For this purpose connecting flanges on both sides are provided.

The couplings are designed and manufactured according to the customer's specifications.

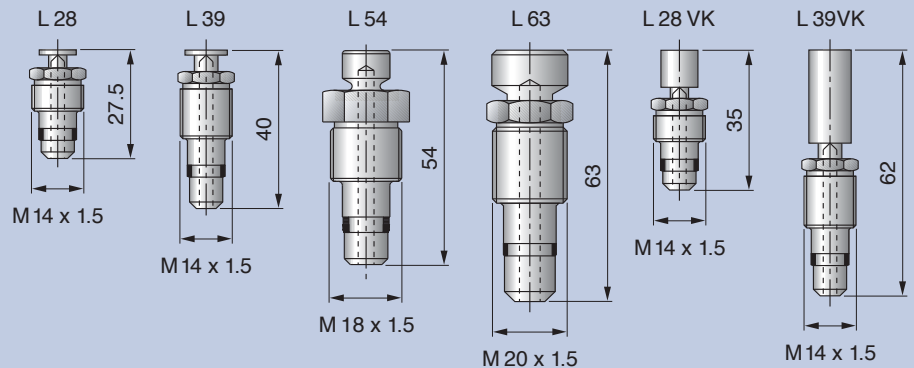
In this design the torque is not transmitted over the welded SafeSet ring but directly from a flange shaft to a flange sleeve.

- 1 Assembling SafeSet SR-P couplings in the workshop.
- 2 SafeSet SR-PF 710 with 4000 kNm release torque, during assembly for a rolling mill.
- 3 SafeSet SR-PF 800 for a wind tunnel drive with a release torque of 7000 kNm.

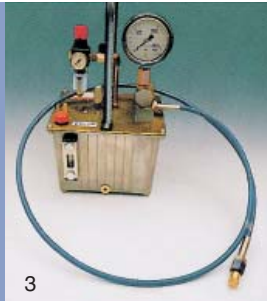
Shear tubes

The couplings are equipped with 1-12 shear tubes of a suitable size depending in the application and the size of the coupling.

For external remote releases, i.e. on test benches there are shear tubes with an extended head.



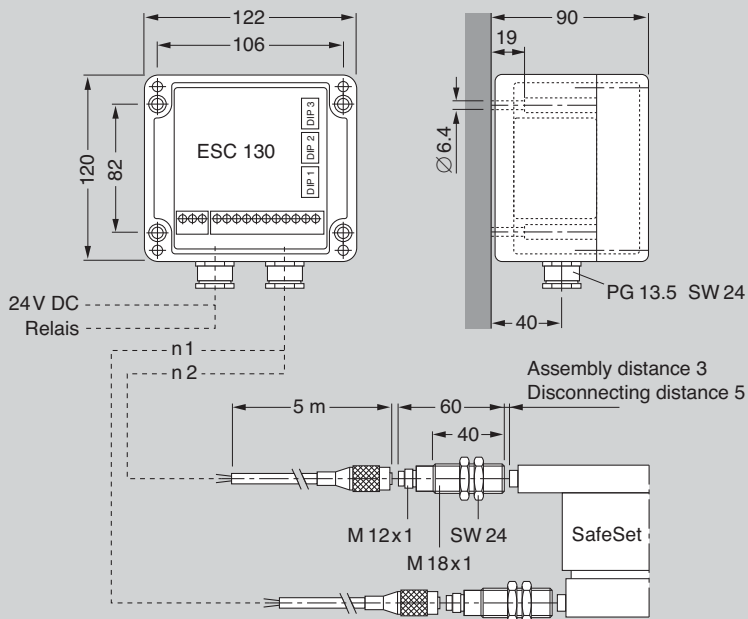
Accessories



Pumps

Various pumps and appropriate tools are available for the operation of the different sizes of SafeSet. They are delivered in a service box with oil and other tools.

- 1 Pump P 115 for SafeSet up to size 200.
- 2 Pump P 240 for SafeSet up to size 300.
- 3 Pump P 500, air driven pump for SafeSet up to size 400.
- 4 Pump P 1000, air driven pump for SafeSet above size 400.



Electronic release indicator ESC 130

The input and output speeds of a SafeSet are monitored by 2 proximity sensors. For this purpose the SafeSet is equipped with cams on both sides. When the SafeSet has released the speeds are no longer synchronous. The device recognises this and a relay on the output side will switch on an alarm.

In cases where the speed difference can not be measured the SafeSet can be equipped with a mechanical release indicator.

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