

Raflex[®]



Steel Disk Couplings

High-Speed Series

API 671



Raflex® Steel Disk Couplings

High-Speed Series

Quality and reliability are of essential importance, especially in the field of high-speed applications. With its Raflex® High-Speed Series, RENK offers a steel disk coupling which is ideal for high-speed drive systems.

Owing to its innovative technology the Raflex® High-Speed Series is specifically designed for highly demanding drive systems. It is particularly apt for use in drive trains for gas and steam turbines, compressors and high-speed test stands as well as for gas turbine driven ships.

The Raflex® High-Speed Series fulfils the requirements of API 671. It can also be designed to meet ISO 10441 and is optionally available with ATEX-certification.

Within the frame of the given technical data, the Raflex® High-Speed Series accomplishes the tasks of a flexible coupling at highest speeds:

- safe torque transmission
- compensation of an often inevitable shaft misalignment
- no need for lubrication and maintenance
- torque transmission at zero backlash
- favourable influence on the running characteristics due to high quality standard in terms of true running and balance grade
- very low axial forces
- safe interchangeability of high-quality components
- disks made of high-strength stainless steel
- uniform stress distribution ensuring optimum utilization of the material due to 'waisted' disks
- minimized coupling weights and mass moments of inertia
- maximized versatility of application areas

1 Raflex® Steel Disk Coupling Type MTR

2 Raflex® Steel Disk Coupling Type MTM

3 Back-to-back test of Raflex® disk pack



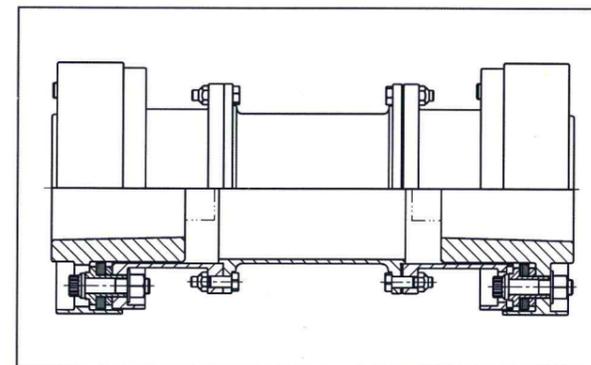
Quick and easy installation is ensured on account of the factory pre-assembled disk pack and connection of the individual components. This ensures that the balance quality of the coupling is not impaired, not even in the event of repeated removal and re-installation.

As a standard, the Raflex® couplings of the High-Speed Series MTR / MTM are designed and manufactured according to the requirements of API 671. Materials according to European Standard and bolts and nuts with metric threads are used.



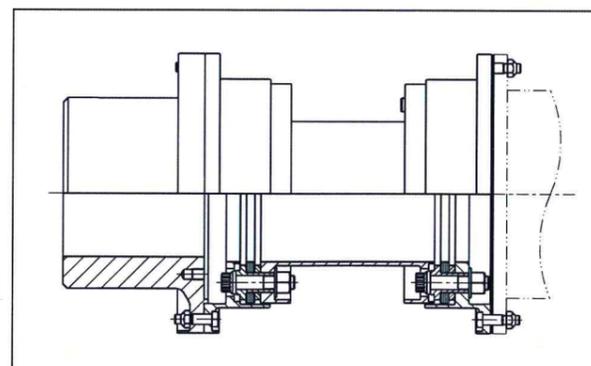
Raflex® High-Speed Steel Disk Coupling Type MTR

The MTR series features the 'reduced moment configuration' where the coupling inertia is moved toward the bearings. This considerably improves the vibration excitation of the connected rotors. The spacer length can be varied to provide for the required distance between shaft ends and to tune the torsional stiffness of the coupling to specific applications.



Raflex® High-Speed Steel Disk Coupling Type MTM

The MTM series is equipped with flange hubs which, compared to the MTR series, allow for considerably larger bore diameters. The MTM series is therefore ideal for drive applications with electric motors or generators generally equipped with larger shaft sizes. In this case, the coupling size is determined by the torque to be transmitted, and not by the bore to be realized. Over-dimensioning of the coupling is thus effectively prevented. Without flange hub, the MTM-coupling type can be bolted directly to a flange shaft, as often used for large gas and steam turbines.



Both coupling types enable the separation of the drive line without having to axially move the connected machines. By using the shipping screws, the disk packs can be axially pre-stretched, so that radial installation and removal of the unit is possible without any problem.

If requested by the customer, the couplings can be supplied in accordance with API 610, or as torque measurement couplings with built-in electronics.



4) CNC internal and external grinding machine

5) CNC planer type boring mill

Raflex® Steel Disk Couplings

High-Speed Series

The Raflex® Steel Disk Couplings are available as 3-, 4- or 5-bolt design to select the optimum coupling based on the torque to be transmitted and the anticipated misalignments.

3-Bolt Design

This design allows for the most axial and angular misalignment at high torques. It is particularly suited for use in applications where high shaft misalignment due to thermal expansion is to be expected.

4-Bolt Design

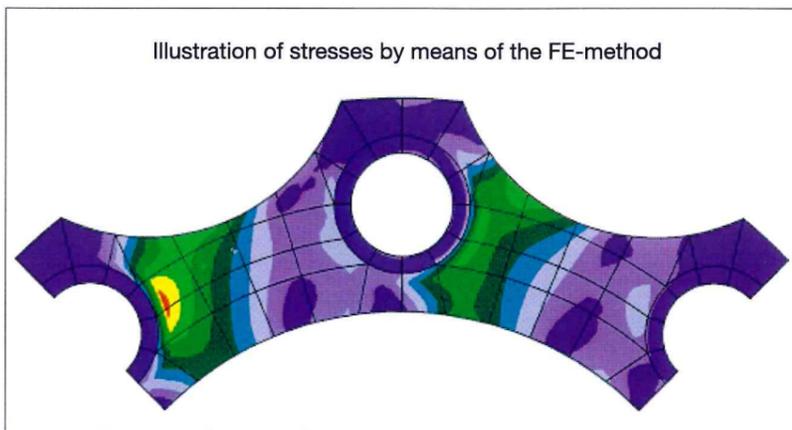
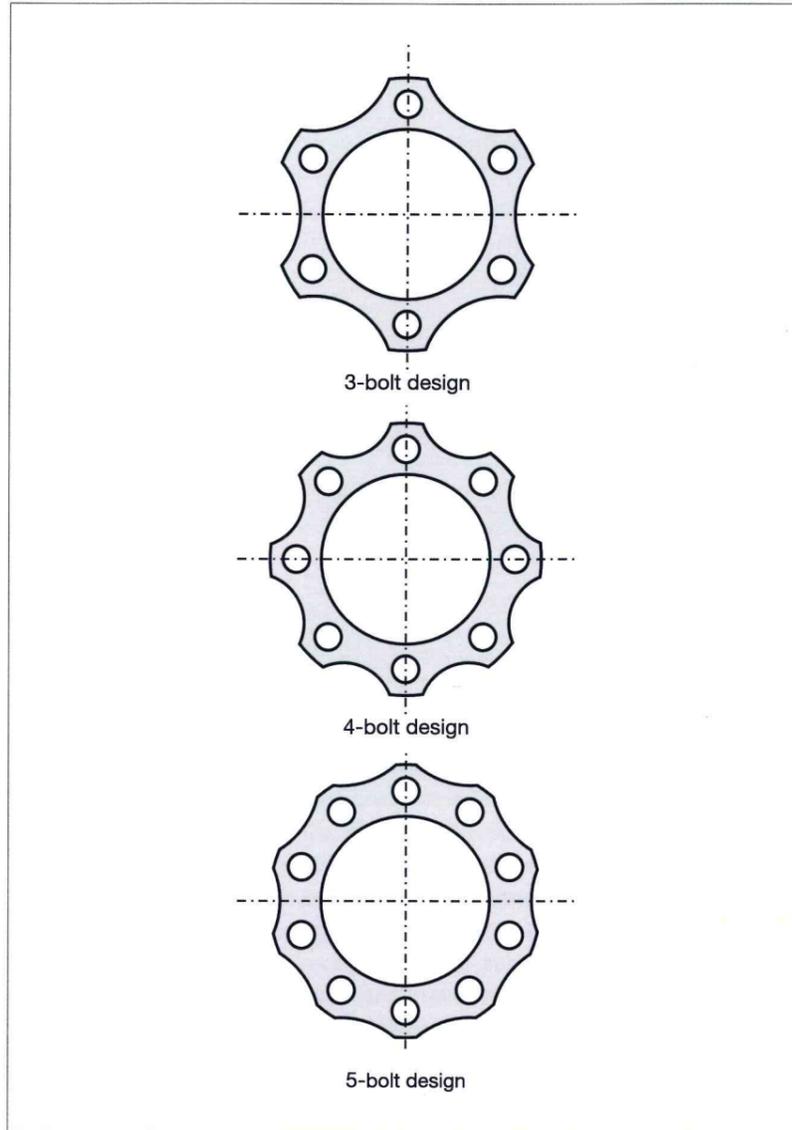
The 4-bolt type is to be preferred. It allows very high torques with average misalignment capability.

5-Bolt Design

The 5-bolt type is used for applications where highest torque capacities (e.g. High peak torques) with low misalignment values are required.

The last digit of the size designation indicates the number of bolts, e.g. Size 224 is a 4-bolt design.

The disks are designed for infinite life while considering a service factor. Under load, they are subjected to constant stresses due to torque, axial misalignment and centrifugal force, and in addition, to alternating stresses resulting from radial and angular misalignment.



Size Determination and Selection



In many cases, the size is not determined by the continuous load, but by starting, peak or short-circuit loads. It is, therefore, imperative to consider these loads when selecting the coupling size.

Permissible starting and peak load for max. 10^5 load cycles: $1.3 T_{KN}$

Permissible short-circuit load for max. 10^3 load cycles: $1.75 T_{KN}$

Condition for continuous load: $\frac{P_N}{n} \cdot K_A \leq \frac{P_{KN}}{n}$

Condition for starting or peak load: $\frac{P_N}{n} \cdot \frac{f_{Peak}}{1.3} \leq \frac{P_{KN}}{n}$

Condition for short-circuit load: $\frac{P_N}{n} \cdot \frac{f_{short}}{1.75} \leq \frac{P_{KN}}{n}$

P_N = max. continuous power (kW)
 n = operating speed (rpm)

K_A = application factor: see table

f_{Peak} = starting or peak factor, load increase in relation to the continuous load, e.g. for 2-fold it is $f_{Peak} = 2$

f_{short} = short-circuit factor, load increase in relation to the continuous load, e.g. for 6-fold it is $f_{short} = 6$

$\frac{P_{KN}}{n}$ = coupling rating acc. to technical data table

Selection Example

Steam turbine/ gearbox/ generator

Required: coupling between steam turbine and gearbox

Known: $P_N = 13,000$ kW $n = 10,700$ rpm

Short circuit torque = 8 times P_N

Shaft diameter: 130 mm

1. Selection based on continuous rating

$$\frac{P_N}{n} \cdot K_A = \frac{13,000}{10,700} \cdot 1.5 = 1.82$$

Size 224 with $\frac{P_{KN}}{n} = 2.2$ is required.

2. Selection based on short-circuit

$$\frac{P_N}{n} \cdot \frac{f_{short}}{1.75} = \frac{13,000}{10,700} \cdot \frac{8}{1.75} = 5.55$$

According to the technical data sheet, size 324 with $\frac{P_{KN}}{n} = 6.81$ is to be used.

3. Verification of the max. permissible bore diameter, d_1 and d_2 for size 324 according to the dimension table of the MTR construction series. The permissible value is 137 mm, the existing value is 130 mm: coupling size MTR 324 meets this requirement.

4. Verification of the max. permissible speed according to the technical data table. The speed of 11,600 rpm is permissible for size MTR 324; the existing speed amounts to 10,700 rpm: MTR 324 meets this requirement, too.

Result: Coupling MTR 324.

Application factor K_A

Constant torque: 1.50
(turbine, boiler feed pump, centrifugal compressor)

Design according to API 671 1.50

Moderate torque fluctuations 2.00
(large fans, screw compressors etc.)

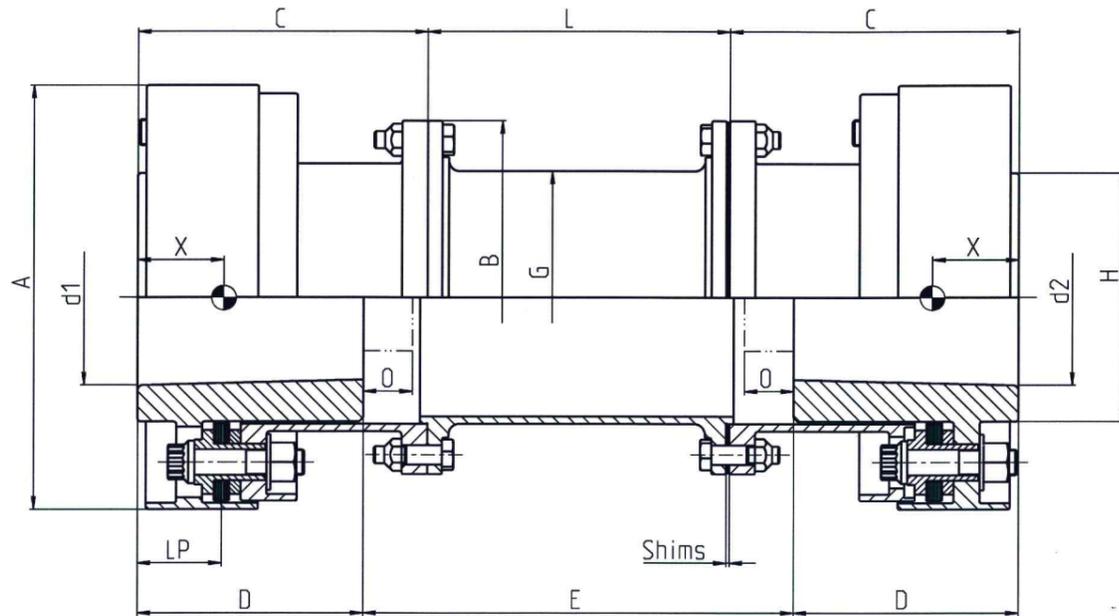
The stated application factors K_A are valid for drives by smooth start electric motors, steam and gas turbines.

For synchronous motor drives where high alternating torques occur at start up, we recommend using couplings with overload protection. Please consult RENK in such cases.

Raflex® Steel Disk Couplings

MTR Series

Dimension table No. B008683
Sheet 1



Type MTR Size	Dimensions												
	d ₁ ; d ₂ max. mm	A mm	B mm	C mm	D mm	E ¹⁾ API min. mm mm		G mm	H _{max.} mm	L mm	O mm	Shims mm	LP mm
103	40	106	88	75	50	482	126	57	56	E-51	11	1.00	23.5
133	55	142	112	90	70	490	131	80	78	E-41	15	1.25	26.5
163 / 164	68	167	130	115	90	498	166	98	96	E-51	19	1.25	33.5
193 / 194	82	198	165	135	105	506	197	118	116	E-62	23	1.50	39.0
223 / 224	96	231	188	155	120	514	227	137	135	E-72	27	1.50	43.5
253 / 254	110	263	215	175	135	520	257	156	154	E-82	30	1.50	48.5
293 / 294	122	298	240	200	155	528	292	175	172	E-92	34	1.75	54.0
323 / 324	137	328	267	225	175	536	327	195	192	E-102	38	1.75	62.0
354 / 355	152	360	293	245	190	544	357	217	214	E-112	42	1.75	64.0
384 / 385	165	391	326	270	210	552	392	235	231	E-122	46	2.00	72.5
424 / 425	178	427	349	285	220	560	417	254	250	E-132	50	2.00	74.5
464 / 465	190	476	373	310	235	566	447	280	266	E-142	53	2.25	86.5
514 / 515	216	525	429	350	270	580	512	307	303	E-162	60	2.25	96.5
584 / 585	237	592	469	390	300	592	572	338	333	E-182	66	2.25	107.0
665	282	675	534	455	350	668	668	400	395	E-213	79	2.50	127.2

Subject to change due to technical progress.

Technical Data



Dimension table No. B008683
Sheet 2

Type MTR Size	Ratings ²⁾			X ³⁾ mm	Complete Coupling ⁴⁾			Spacer ⁵⁾		
	P _{KN/n} kW min	T _{KN} Nm	N _{max.} rpm		G ₁ kg	J ₁ kg m ²	C _{T1} MNm/rad	G _R 1E-03 kg/mm	J _R 1E-06 kgm ² /mm	C _{TR} 1E+03 MNm mm/rad
103	0.136	1 300	36 000	23	5.63	0.007	0.023	3.36	2.50	0.0253
133	0.31	3 000	26 800	28	11.0	0.024	0.054	5.70	8.46	0.0856
163	0.59	5 650	22 800	36	17.2	0.053	0.101	7.03	15.9	0.161
193	0.91	8 700	19 200	42	29.2	0.132	0.181	9.88	32.4	0.328
223	1.47	14 000	16 500	47	43.1	0.263	0.288	13.1	58.0	0.588
253	2.30	22 000	14 500	53	62.1	0.494	0.455	16.8	96.5	0.978
293	3.35	32 000	12 800	59	89.2	0.898	0.683	23.0	165	1.67
323	4.40	42 000	11 600	68	123	1.520	0.978	30.2	269	2.72
164	0.89	8 500	22 800	36	17.5	0.054	0.149	7.03	15.9	0.161
194	1.41	13 500	19 200	42	29.6	0.134	0.275	9.88	32.4	0.328
224	2.20	21 000	16 500	47	43.6	0.267	0.440	13.1	58.0	0.588
254	3.46	33 000	14 500	53	62.8	0.502	0.701	16.8	96.5	0.978
294	5.03	48 000	12 800	59	90.1	0.911	1.06	23.0	165	1.67
324	6.81	65 000	11 600	68	124	1.540	1.55	30.2	269	2.72
354	8.59	82 000	10 600	72	163	2.410	2.17	43.7	476	4.82
384	11.52	110 000	9 700	81	217	3.840	2.97	52.8	672	6.81
424	14.66	140 000	8 900	83	268	5.610	3.90	63.1	937	9.48
464	19.48	186 000	8 000	92	359	9.270	5.74	82.5	1479	15.0
514	27.75	265 000	7 200	105	502	16.0	7.73	108	2308	23.4
584	40.84	390 000	6 400	115	692	27.5	11.2	149	3804	38.6
355	10.79	103 000	10 600	72	167	2.51	2.94	43.7	476	4.82
385	14.45	138 000	9 700	81	221	3.95	4.01	52.8	672	6.81
425	18.32	175 000	8 900	83	273	5.78	5.28	63.1	937	9.48
465	24.29	232 000	8 000	92	366	9.55	7.82	82.5	1479	15.0
515	34.55	330 000	7 200	105	512	16.5	10.5	108	2308	23.4
585	50.78	485 000	6 400	116	707	28.4	15.2	149	3804	38.6
665	75.39	720 000	5 600	138	1057	56.6	24.3	179	6512	65.8

1) E_{API} considers the API-requirement:
BSE = 18" ≈ 460 mm
E_{API} = 460 + 2·O

For size 665, E_{API} equals E_{min}, and is thus larger than 18" (460 mm).

2) An application factor K_A acc. to page 5 is always required.

3) Center of gravity refers to half coupling.

4) Data refer to bore d₁, d₂ max. and E_{API}. Calculation of torsional stiffness acc. to API/AGMA.

5) Data given per 1 mm of spacer length.

Calculation of torsional stiffness

$$C_{T3} = \frac{1}{\frac{1}{C_{T1}} + \frac{E - E_{API}}{C_{TR}}} \quad [\text{MNm/rad}]$$

Calculation of mass moment of inertia
J₃ = J₁ + J_R · (E - E_{API}) [kgm²]

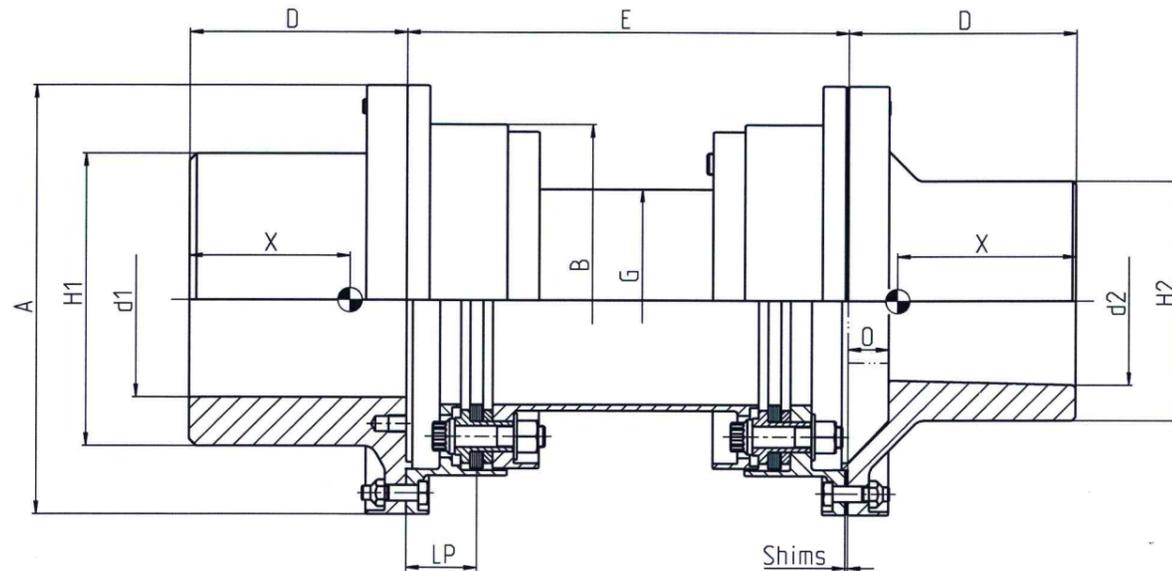
Calculation of total weight
G₃ = G₁ + G_R · (E - E_{API}) [kg]

Raflex® Steel Disk Couplings

MTM Series

Dimension table No. B008684

Sheet 1



Type MTM Size	Dimensions											
	d ₁ ; d ₂ max. mm	d ₁ ; d ₂ nenn. mm	A mm	B mm	D mm	E ¹⁾ API mm	E ¹⁾ min. mm	G mm	H _{max.} mm	O mm	Shims mm	LP mm
103	72	55	137	106	61	460	120	62	101	11	1.00	24.5
133	97	65	173	142	85	460	140	86	136	15	1.25	27.5
163 / 164	115	80	199	167	109	460	175	104	161	19	1.25	33.5
193 / 194	136	95	242	198	128	460	210	125	191	23	1.50	40.0
223 / 224	159	110	275	231	147	460	235	145	223	27	1.50	44.5
253 / 254	181	120	318	263	165	460	265	165	254	30	1.50	49.5
293 / 294	205	130	353	298	189	460	305	186	287	34	1.75	56.0
323 / 324	225	150	389	328	213	460	340	207	316	38	1.75	63.0
354 / 355	246	165	421	360	232	460	365	232	345	42	1.75	65.0
384 / 385	267	175	466	391	256	460	410	252	374	46	2.00	75.5
424 / 425	292	210	503	427	270	460	430	272	409	50	2.00	78.5
464 / 465	322	220	552	476	288	480	480	296	451	53	2.25	89.5
514 / 515	358	230	621	525	330	535	535	330	502	60	2.25	100.5
584 / 585	402	260	688	592	366	595	595	366	564	66	2.25	110.0
665	462	300	781	675	429	620	620	428	647	79	2.50	131.2

Subject to change due to technical progress.

Technical Data



Dimension table No. B008684

Sheet 2

Type MTM Size	Ratings ²⁾			Complete Coupling ⁴⁾				Spacer ⁵⁾		
	P _{KN/n} kW min	T _{KN} Nm	n _{max.} rpm	X ³⁾ mm	G ₁ kg	J ₁ kg m ²	C _{T1} MNm/rad	G _R 1E-03 kg/mm	J _R 1E-06 kgm ² /mm	C _{TR} 1E+03 MNm mm/rad
103	0.136	1 300	27 800	60	7.95	0.015	0.029	3.67	3.25	0.0329
133	0.31	3 000	22 000	80	14.4	0.044	0.063	6.14	10.6	0.107
163	0.59	5 650	19 100	98	21.9	0.090	0.120	7.47	19.1	0.193
193	0.91	8 700	15 700	115	36.6	0.226	0.215	10.5	38.8	0.392
223	1.47	14 000	13 800	131	52.3	0.421	0.340	13.9	69.1	0.701
253	2.30	22 000	12 000	149	74.3	0.794	0.536	17.8	115	1.16
293	3.35	32 000	10 800	167	106	1.370	0.804	24.5	200	2.02
323	4.40	42 000	9 800	189	143	2.330	1.14	29.7	300	3.04
164	0.89	8 500	19 100	98	22.2	0.091	0.195	7.47	19.1	0.193
194	1.41	13 500	15 700	115	36.9	0.228	0.361	10.5	38.8	0.392
224	2.20	21 000	13 800	131	52.7	0.424	0.577	13.9	69.1	0.701
254	3.46	33 000	12 000	150	75.1	0.803	0.914	17.8	115	1.16
294	5.03	48 000	10 800	168	107	1.380	1.39	24.5	200	2.02
324	6.81	65 000	9 800	190	145	2.360	2.01	29.7	300	3.04
354	8.59	82 000	9 000	201	184	3.500	2.72	41.5	523	5.30
384	11.52	110 000	8 100	229	243	5.720	3.70	51.0	757	7.67
424	14.66	140 000	7 500	232	321	8.940	5.10	58.4	1011	10.2
464	19.48	186 000	6 900	257	417	14.000	7.24	73.9	1508	15.3
514	27.75	265 000	6 100	298	559	23.280	9.42	90.3	2293	23.2
584	40.84	390 000	5 500	332	762	39.050	13.62	122	3785	38.2
355	10.79	103 000	9 000	203	187	3.58	4.02	41.5	523	5.30
385	14.45	138 000	8 100	231	248	5.85	5.46	51	757	7.67
425	18.32	175 000	7 500	234	326	9.11	7.74	58.4	1011	10.2
465	24.29	232 000	6 900	260	424	14.24	10.89	73.9	1508	15.3
515	34.55	330 000	6 100	301	569	23.73	13.91	90.3	2293	23.2
585	50.78	485 000	5 500	335	777	39.97	20.12	122	3785	38.2
665	75.39	720 000	4 800	391	1172	78.67	32.68	143	6134	62.1

1) E_{API} considers the API-requirement:
BSE = 18" ≈ 460 mm

As of size 464 / 465, E_{API} equals E_{min},
and is thus larger than 18" (460 mm).

2) An application factor K_A acc. to page 5
is always required.

3) Center of gravity refers to half
coupling.

4) Data refer to
bore d₁, d₂ nom. and E_{API}.
H_{nom} = d₁, d₂ nom · 1.4
Calculation of torsional
stiffness acc. to API/AGMA.

5) Data given per 1 mm of
spacer length.

Calculation of torsional stiffness

$$C_{T3} = \frac{1}{\frac{1}{C_{T1}} + \frac{E - E_{API}}{C_{TR}}} \quad [\text{MNm/rad}]$$

Calculation of mass moment of inertia

$$J_3 = J_1 + J_R \cdot (E - E_{API}) \quad [\text{kgm}^2]$$

Calculation of total weight

$$G_3 = G_1 + G_R \cdot (E - E_{API}) \quad [\text{kg}]$$



Reaction Forces/ Stiffness

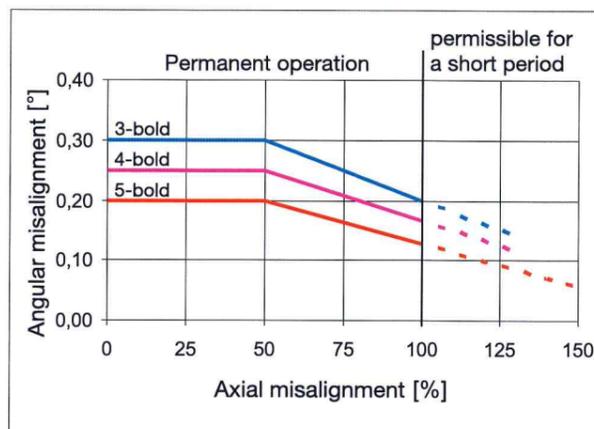
The restoring forces and stiffness values given in table B009154 may influence each other, so that different values may result. The curve of the axial force has a progressive course. Exact values for specific misalignment conditions are shown on the dimension drawing or can be requested from RENK.

$$n_e = 427 \sqrt{\frac{C_a}{m_{Sch}}}$$

n_e critical speed
 C_a local axial stiffness
 m_{Sch} vibrating mass

Axial and angular misalignment

The stated permissible axial and angular misalignments cannot be utilized simultaneously. The diagram below shows the permissible combinations. If the axial misalignment to be expected is known, the coupling should be pre-stretched accordingly. This allows permanent operation at low misalignment and reduces the stresses in the disks.



Determination of the Axial Natural Frequency

The axial natural frequency of the Raflex® Steel Disk Coupling can be calculated by using the formula given on the right side. The critical speeds at minimum and maximum misalignment can be determined by the values $C_{a,0\%}$ and $C_{a,100\%}$. The axial natural frequency does not constitute a problem for normal applications, because the stiffness is progressive. However, in the event of significant excitations, a minimum distance of 10 % from the 1-fold and 2-fold operating speed should be observed.

Shipping Screws

The shipping screws lock and stabilize the flexible disk packs. The screws are adjusted by RENK and must only be removed after installation of the last component of the coupling. The shipping screws make the coupling rigid so that it can be balanced as a unit. In addition, the screws protect the disk pack during transportation and act as a mounting aid during assembly on site.

Solo plate/ moment simulator

A solo plate is required in those cases where the flexible half of the MTR coupling has to run at speeds above 1800 rpm while uncoupled. In addition, the coupling half is safeguarded against unintentional deflections should the shipping screws loosen. The shipping screws are sufficient for speeds below 1800 rpm.

If required, the solo plate can be designed as a moment simulator. This will simulate the weight of the half coupling on the machine shaft.

Certification of our QA-System

Documented quality commences with the purchase of the raw material, covers all phases of the multifarious production process and is finally demonstrated by the finished product. Our quality assurance system has been certified according to DIN ISO 9001, EN 29001 since June 1989, and is applied as quality assuring measure prior to and throughout the production as well as by our after-sales service.

Our Quality System has been certified by:

- Det Norske Veritas
- Lloyds Register of Shipping
- Germanischer Lloyd
- RWE Power

Table No. B009154

MTR MTM Size	Axial Misalignment Values				m_{Sch}		Angular Misalignment Values	
	$K_{A,max.}$ mm	$F_{A,100\%}$ N	$C_{A,0\%}$ N/mm	$C_{A,100\%}$ N/mm	MTR kg	MTM kg	$\Delta K_{W,max.}$ deg.	C_W Nm/deg.
103	2.0	1 125	731	1 851	3.37	2.37	0.3	31
133	2.9	1 143	428	1 451	5.73	4.12	0.3	39
163	3.5	1 542	391	1 799	7.9	5.76	0.3	64
193	4.2	1 876	328	1 967	13.5	8.7	0.3	92
223	5.1	2 225	267	2 029	19.4	12.4	0.3	123
253	5.8	2 877	249	2 412	27.9	17.2	0.3	182
293	6.6	3 593	225	2 739	39.3	24.4	0.3	256
323	7.2	4 245	199	3 057	53.5	31.9	0.3	340
164	2.4	3 623	1 845	5 168	7.93	6.09	0.25	219
194	2.9	4 134	1 511	5 372	13.6	8.98	0.25	295
224	3.7	4 868	1 159	5 428	19.5	12.7	0.25	372
254	4.1	5 781	1 087	6 129	28	17.5	0.25	517
294	4.6	6 769	990	6 683	39.4	25.4	0.25	691
324	5.1	8 167	885	7 660	53.6	33.5	0.25	923
354	5.9	9 309	720	7 835	71.1	41.5	0.25	1 111
384	6.3	11 263	735	9 054	97.5	54	0.25	1 480
424	6.8	13 007	685	9 878	119	66.2	0.25	1 873
464	7.2	16 413	689	12 005	161	96.8	0.25	2 723
514	7.8	18 233	731	12 282	220	130	0.25	3 463
584	9.2	25 076	681	14 613	306	188	0.25	5 121
355	2.9	7 033	2 647	9 106	71.9	44	0.2	1 707
385	3.1	8 283	2 746	10 384	98.6	57.6	0.2	2 212
425	3.3	8 863	2 570	10 819	121	70.3	0.2	2 630
465	3.4	10 467	2 740	12 805	162	95.1	0.2	3 678
515	3.7	12 197	3 014	13 557	222	138	0.2	4 883
585	4.2	14 102	2 770	14 400	309	200	0.2	6 308
665	4.9	36 277	9 397	25 147	435	295	0.2	18 148

$K_{A,max.}$ permissible axial misalignment for the complete coupling

$F_{A,100\%}$ axial reaction force at 100 % axial misalignment

$C_{A,0\%}$ local axial stiffness at 0 % axial misalignment

$C_{A,100\%}$ local axial stiffness at 100 % axial misalignment

$\Delta K_{W,max.}$ permissible angular misalignment for one disk pack

C_W angular stiffness

m_{Sch} vibrating mass

Calculation of the permissible radial misalignment for Type MTR:
 $\Delta K_{R,max.} = \tan \Delta K_W \cdot (\text{total length} - 2 \cdot LP)$

Calculation of the permissible radial misalignment for Type MTM:
 $\Delta K_{R,max.} = \tan \Delta K_W \cdot (\text{total length} - 2 \cdot (LP+D))$

Angular misalignments already utilized have to be considered for the calculation.

LP, D: see dimension tables

Technology that sets the standards

Further products of our production range



- 1 Curved tooth coupling with hardened and ground external and internal teeth and tooth-by-tooth injection lubrication
- 2 High-speed diaphragm coupling Type MCN
- 3 Reflex® steel disk coupling Type MTP according to API 610



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