HTB, VF and MSC-SG

Hi-Tec Marine Propulsion Couplings

RENOLD

Superior Coupling Technology

Introduction

Over 50 years of experience
Renold Hi-Tec Couplings has been a world leader in the design and manufacture of torsionally flexible couplings for over 50 years.

Commitment to Quality and the Environment
Having gained both EN ISO 9001:2008 and EN ISO 14001:2004, Renold Hi-Tec Couplings can demonstrate their commitment to both quality and the environment.

World Class Manufacturing
Continual investment is being made to apply the latest machining and tooling technology. The application of lean manufacturing techniques in an integrated cellular manufacturing environment establishes efficient working practices.

Engineering Support
The experienced engineers at Renold Hi-Tec Couplings are supported by substantial facilities to enable the ongoing test and development of product. This includes the capability for:

- Measurement of torsional stiffness up to 220 kNm
- Full scale axial and radial stiffness measurement
- Misalignment testing of couplings up to 2 metres diameter
- Static and dynamic balancing
- 3D solid model CAD
- Finite element analysis

TVA Service
Our resident torsional analysts are able to provide a full Torsional Vibration Analysis service to investigate a customer's driveline and report on the system performance. This service, together with the facility for transient analysis, is available to anyone and is not subject to purchase of a Renold Hi-Tec product.

Marine Survey Society Approvals
Renold Hi-Tec Couplings work with all major marine survey societies to ensure their products meet the strict performance requirements.

Contents

HTB Flexible Coupling

High temperature blind assembly, coupling designed for bell housing applications.

Applications

- Marine propulsion
- Generator sets
- Pump sets
- Compressors
- Rail traction

Features

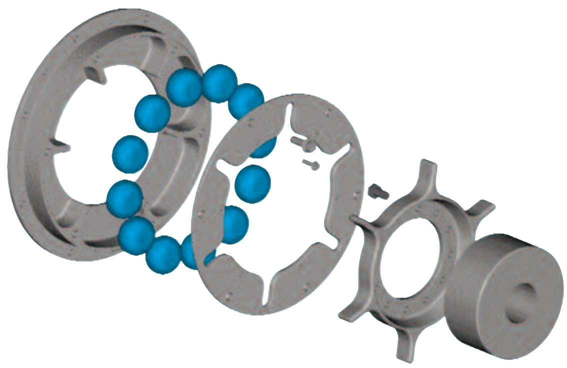
- Unique blind assembly
- High temperature capability (up to 200°C)
- Severe shock load protection
- Intrinsically fail safe
- Maintenance free
- Noise attenuation

Benefits

- Allows easy assembly for applications in bell housings
- Allows operation in bell housings where ambient temperatures can be high.
- Avoiding failure of the driveline under short circuit and other transient conditions.
- Ensuring continuous operation of the driveline in the unlikely event of rubber damage.
- No lubrication or adjustment required resulting in low running costs.
- Giving quiet running conditions in sensitive applications by the elimination of metal to metal contact.

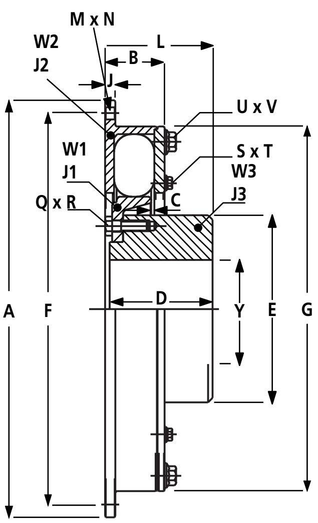
Construction Details

- Spheroidal Graphite to BS 2789 Grade 420/12
- High temperature elastomer with a 200°C temperature capability
- Keep plate integral with outer member
- Hub manufactured to meet application requirements

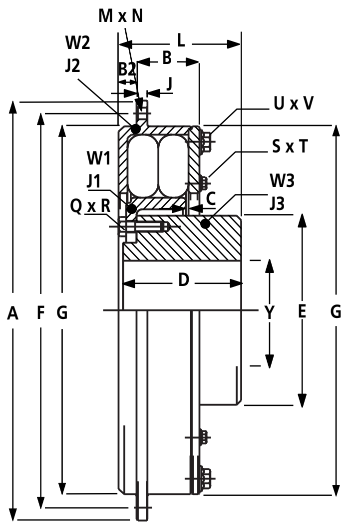


HTB Standard SAE Flywheel to Shaft

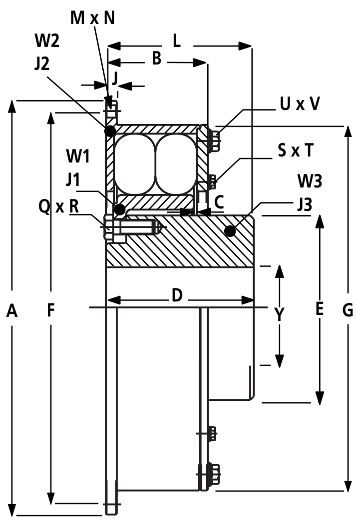
HTB1200 - HTB10000



HTB4500



HTB12000 - HTB40000



Dimensions, Weight, Inertia and Alignment

COUPLING SIZE		1200		3000		4500		6000		10000	12000		20000	30000	40000
		SAE11.5	SAE14	SAE14	SAE18	SAE14	SAE18	SAE18	SAE21	SAE21	SAE18	SAE21	SAE21	SAE24	
	A	352.4	466.7	466.7	571.5	466.7	571.5	571.5	673.1	673.1	571.5	673.1	673.1	733.42	860.0
	B	50.0	50.0	67.0	67.0	69.5	69.5	84.0	84.0	103.0	141.0	141.0	173.0	213	215.0
	B_2	-	-	-	-	20.0	20.0	-	-	-	-	-	-	-	-
	C	3.0	3.0	3.0	3.0	3.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	7.0	7.0
	D (STANDARD)	100.0	100.0	112.0	112.0	128.0	128.0	139.0	139.0	166.0	194.0	194.0	236.0	278	276
	D (DIN 6281)	100.0	85.8	105.0	105.0	105.0	105.0	-	-	-	-	-	-	-	-
	E	156.0	156.0	210.0	210.0	210.0	210.0	256.0	256.0	308.0	256.0	256.0	308.0	346	416.0
	F	333.4	438.2	438.2	542.9	438.2	542.9	542.9	641.4	641.4	542.9	641.4	641.4	692	820.0
	G	304.0	304.0	409.0	409.0	409.0	409.0	505.0	505.0	600.0	505.0	505.0	600.0	646	778.0
DIMENSIONS (mm)	J	10.0	10.0	12.0	12.0	12.0	12.0	16.0	16.0	20.0	16.0	16.0	20.0	20	22.0
	L (STANDARD)	106.6	106.6	120.0	120.0	136.0	136.0	150.0	150.0	180.0	205.0	205.0	250.0	300	300.0
	M	8	8	8	6	8	6	6	12	12	6	12	12	12	32
	N	10.5	13.5	13.5	17.0	13.5	17.0	17.0	17.0	17.0	17.0	17.0	17.0	22	21.0
	L (DIN 6281)	106.6	92.4	92.4	-	92.4	-	-	-	-	-	-	-	-	-
	Q	12	12	12	12	16	16	12	12	12	12	12	12	16	16
	R	M12	M12	M16	M16	M16	M16	M20	M20	M24	M20	M20	M24	M24	M24
	S	6	6	6	6	6	6	6	6	6	6	6	6	-	-
	T	M6	M6	M8	M8	M8	M8	M10	M10	M10	M10	M10	M10	-	-
	U	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	V	M12	M12	M14	M14	M14	M14	M16	M16	M20	M16	M16	M20	M24	M24
	Y (MAX)	85.0	85.0	115.0	115.0	115.0	115.0	150	150	170	150	150	170	215	220.0
	Y (MIN)	40.0	40.0	50.0	50.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0	60.0	90	110.0
	Z	16.0	16.0	20.0	20.0	0.0	0.0	29.0	29.0	36.0	29.0	29.0	36.0	-	-
RUBBER	PER CAVITY	1	1	1	1	2	2	1	1	1	2	2	2	2	2
ELEMENTS	PER COUPLING	12	12	12	12	24	24	12	12	12	24	24	24	24	24
MAXIMUM SPEED (rpm)	(1)	3730	2820	2820	2300	2820	2300	2300	1950	1950	2300	1950	1950	1850	1500
WEIGHT (kg)	W1	3.0	3.0	7.0	7.0	10.6	10.6	16.0	16.0	24.4	41.7	41.7	56.0	65.3	98.3
	W2	10.0	15.2	22.1	29.2	26.4	34.5	43.2	55.1	77.9	58.6	70.5	112.1	145.2	199.7
	W3 (STANDARD)	12.1	12.2	22.9	22.9	22.9	22.9	42.0	42.0	46.7	65.1	65.1	114.5	185.2	262.6
	W3 (DIN 6281)	12.2	10.3	20.5	-	20.5	-	-	-	-	-	-	-	-	-
	TOTAL (W1 & W2)	13.0	18.2	29.2	36.2	37.0	45.1	59.2	71.1	102.3	100.3		168.1	210.5	298.0
INERTIA (kg m²)	J1	0.03	0.03	0.09	0.09	0.15	0.15	0.26	0.26	0.64	0.98	0.98	1.92	3.07	5.97
	J2	0.19	0.42	0.75	0.93	0.88	0.92	2.26	3.35	5.39	2.79	3.95	6.63	12.21	23.68
	J3 (STANDARD)	0.04	0.04	0.14	0.14	0.17	0.17	0.37	0.37	1.00	0.58	0.58	1.47	2.92	5.96
	J3 (DIN 6281)	0.03	0.04	0.12	-	0.12	-	-	-	-	-	-	-	-	-
ALLOWABLE MISALIGNMENT															
RADIAL (mm)	ALIGN	0.25	0.25	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
	MAX	1.00	1.00	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
AXIAL (mm)	ALIGN	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	MAX	2.00	2.00	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
CONICAL (degree)		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

HTB Technical Data

1.1 Torque Capacity - Diesel Engine Drives

The HTB Coupling is selected on the "Nominal Torque T_{KN}" without service factors for Diesel Drive applications.

The full torque capacity of the coupling for transient vibration whilst passing through major criticals on run up, is published as the maximum torque T_{KMAX} .
($T_{KMAX} = 3 \times T_{KN}$).

There is additional torque capacity built within the coupling for short circuit and shock torques, which is 3 x T_{KMAX}.

The published "Vibratory Torque T_{KW}", relates to the amplitude of the permissible torque fluctuation. The vibratory torque values shown in the technical data are at the frequency of 10Hz. The allowable vibratory torque at higher or lower frequencies fe = $T_{KW} \sqrt{\frac{10Hz}{fe}}$

The measure used for acceptability of the coupling under vibratory torque, is published as "Allowable dissipated heat at ambient temperature 30ºC".

1.2 Transient Torques

Prediction of transient torques in marine drives can be complex. Normal installations are well provided for by selecting couplings based on the "Nominal Torque T_{Kn}". Transients, such as start up and clutch manoeuvre, are usually within the "Maximum Torque TKmax" for the coupling.

Care needs to be taken in the design of couplings with shaft brakes, to ensure coupling torques are not increased by severe deceleration.

Sudden torque applications of propulsion devices such as thrusters or waterjets, need to be considered when designing the coupling connection.

2.0 Stiffness Properties

The Renold Hi-Tec Coupling remains fully flexible under all torque conditions. The HTB series is a non-bonded type operating with the Rubber-in-Compression principle.

2.1 Axial Stiffness

When subject to axial misalignment, the coupling will have an axial resistance which gradually reduces due to the effect of vibratory torque.

The axial stiffness of the coupling is torque dependent, and variation is as shown in the technical data on page 8.

2.2 Radial Stiffness

The radial stiffness of the coupling is torque dependent, and is as shown in the technical data on page 8.

2.3 Torsional Stiffness

The torsional stiffness of the coupling is dependent upon applied torque and temperature as shown in the technical data on page 8.

2.4 Prediction of the System Torsional Vibration Characteristics

An adequate prediction of the system's torsional vibration characteristics, can be made by the following method:

2.4.1 Use the torsional stiffness as shown in the technical data, which is based upon data measured at a 30˚C ambient temperature.

2.4.2 Repeat the calculation 2.4.1, but using the maximum temperature correction factor S_{t100} (S_{t200} for Si70 rubber), and dynamic magnifier correction factor, M_{100} (M_{200} for Si70 rubber), for the selected rubber. Use tables on page 7 to adjust values for both torsional stiffness and dynamic magnifier. ie. $C_{T100} = C_{Tdyn} \times S_{t100}$

2.4.3 Review calculations 2.4.1 and 2.4.2 and if the speed range is clear of criticals which do not exceed the allowable heat dissipation value as published in the catalogue, then the coupling is considered suitable for the application with respect to the torsional vibration characteristics. If there is a critical in the speed range, then actual temperature of the coupling will need to be calculated at this speed.

HTB Technical data

Rubber Grade	$Temp_{max}$ °C	S_t
Si70	200	St_{200} = 0.48
SM60	100	St_{100} = 0.75
SM70	100	St_{100} = 0.63
SM80	100	St_{100} = 0.58
Si70 is considered "standard"		

Rubber Grade	Dynamic Magnifier at 30°C (M_{30})	Dynamic Magnifier at 100°C (M_{100})
Si70	7.5	M_{200} = 15.63
SM60	8	10.7
SM70	6	9.5
SM80	4	6.9
Si70 is considered "standard"		

2.5 Prediction of the actual coupling temperature and torsional stiffness

2.5.1 Use the torsional stiffness as published in the catalogue, this is based upon data measured at 30˚C and the dynamic magnifier at 30˚C. (M_{30})

2.5.2 Compare the synthesis value of the calculated heat load in the coupling (P_K) at the speed of interest, to the "Allowable Heat Dissipation" (P_{KW}).

The coupling temperature rise

$$°C = Temp_{coup} = \left(\frac{P_K}{P_{KW}}\right) \times 70 \text{ (170 for Si70 rubber)}$$

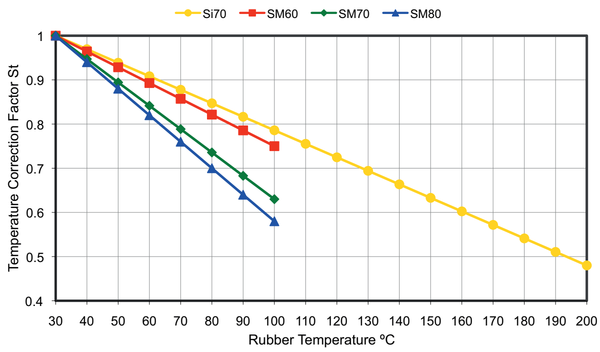
The coupling temperature = ϑ

$$\vartheta = Temp_{coup} + \text{Ambient Temp.}$$

2.5.3 Calculate the temperature correction factor, S_t, from 2.6 (if the coupling temperature > 100˚C (200˚C for Si70 rubber), then use S_{t100} (S_{t200} for Si70 rubber) . Calculate the dynamic Magnifier as per 2.7. Repeat the calculation with the new value of coupling stiffness and dynamic magnifier.

2.5.4 Calculate the coupling temperature as per 2.5. Repeat calculation until the coupling temperature agrees with the correction factors for torsional stiffness and dynamic magnifier used in the calculation.

2.6 Temperature Correction Factor



2.7 Dynamic Magnifier Correction Factor

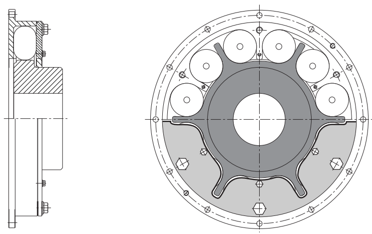
The Dynamic Magnifier of the rubber is subject to temperature variation in the same way as the torsional stiffness.

$$M_T = \frac{M_{30}}{S_t} \qquad \psi_T = \psi_{30} \times S_t$$

Rubber Grade	Dynamic Magnifier (M_{30})	Relative Damping ψ_{30}
Si70	7.5	0.83
SM60	8	0.78
SM70	6	1.05
SM80	4	1.57
Si70 is considered "standard"		

HTB Technical Data

End view



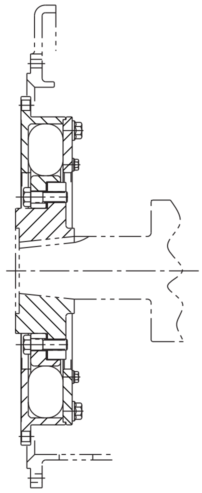
COUPLING SIZE			1200		3000		4500		6000		10000	12000		20000	30000	40000
			SAE11.5	SAE14	SAE14	SAE18	SAE14	SAE18	SAE18	SAE21	SAE21	SAE18	SAE21	SAE21	SAE24	
Nominal Torque T_{KN}	(kNm)		1.2	1.2	3.0	3.0	4.5	4.5	6.0	6.0	10.0	12.0	12.0	20.0	30.0	40.0
Maximum Torque T_{Kmax}	(kNm)		3.6	3.6	9.0	9.0	13.5	13.5	18.0	18.0	30.0	36.0	36.0	60.0	90.0	120.0
Vibratory Torque T_{KW}	(kNm)		0.4	0.4	1.0	1.0	1.5	1.5	2.0	2.0	3.3	4.0	4.0	6.6	10.0	13.3
Dynamic Torsional Stiffness		Si70	0.003	0.003	0.008	0.008	0.012	0.012	0.015	0.015	0.027	0.030	0.030	0.054	0.080	0.117
C_{Tdyn} (MNm/rad)		NM45	0.005	0.005	0.013	0.013	0.019	0.019	0.024	0.024	0.043	0.048	0.048	0.086	0.129	0.187
		SM50	0.006	0.006	0.015	0.015	0.022	0.022	0.028	0.028	0.050	0.056	0.056	0.100	0.150	0.218
10% Nominal Torque T_{KN}		SM60	0.007	0.007	0.018	0.018	0.027	0.027	0.034	0.034	0.061	0.068	0.068	0.122	0.183	0.265
		SM70	0.012	0.012	0.030	0.030	0.044	0.044	0.056	0.056	0.100	0.112	0.112	0.200	0.301	0.437
		SM80	0.018	0.018	0.045	0.045	0.067	0.067	0.085	0.085	0.152	0.170	0.170	0.304	0.456	0.663
		Si70	0.008	0.008	0.021	0.021	0.032	0.032	0.040	0.040	0.072	0.080	0.080	0.143	0.184	0.310
25% Nominal Torque T_{KN}		NM45	0.012	0.012	0.029	0.029	0.043	0.043	0.055	0.055	0.098	0.110	0.110	0.197	0.295	0.429
		SM50	0.012	0.012	0.030	0.030	0.045	0.045	0.057	0.057	0.102	0.114	0.114	0.204	0.306	0.445
		SM60	0.013	0.013	0.033	0.033	0.049	0.049	0.062	0.062	0.111	0.124	0.124	0.222	0.333	0.484
		SM70	0.020	0.020	0.050	0.050	0.075	0.075	0.095	0.095	0.170	0.190	0.190	0.340	0.510	0.741
		SM80	0.025	0.025	0.064	0.064	0.096	0.096	0.121	0.121	0.217	0.242	0.242	0.433	0.650	0.944
		Si70	0.022	0.022	0.056	0.056	0.086	0.086	0.105	0.105	0.188	0.210	0.210	0.376	0.565	0.819
50% Nominal Torque T_{KN}		NM45	0.024	0.024	0.060	0.060	0.089	0.089	0.113	0.113	0.202	0.226	0.226	0.404	0.606	0.880
		SM50	0.025	0.025	0.064	0.064	0.095	0.095	0.120	0.120	0.215	0.240	0.240	0.430	0.644	0.936
		SM60	0.028	0.028	0.070	0.070	0.105	0.105	0.133	0.133	0.238	0.266	0.266	0.476	0.714	1.037
		SM70	0.038	0.038	0.096	0.096	0.144	0.144	0.182	0.182	0.326	0.364	0.364	0.652	0.977	1.420
		SM80	0.051	0.051	0.130	0.130	0.194	0.194	0.245	0.245	0.439	0.490	0.490	0.877	1.315	1.911
		Si70	0.043	0.043	0.109	0.109	0.162	0.162	0.205	0.205	0.367	0.410	0.410	0.734	1.096	1.597
75% Nominal Torque T_{KN}		NM45	0.038	0.038	0.096	0.096	0.143	0.143	0.181	0.181	0.324	0.362	0.362	0.648	0.972	1.412
		SM50	0.042	0.042	0.106	0.106	0.158	0.158	0.200	0.200	0.358	0.400	0.400	0.716	1.074	1.560
		SM60	0.050	0.050	0.127	0.127	0.190	0.190	0.240	0.240	0.430	0.480	0.480	0.859	1.288	1.872
		SM70	0.063	0.063	0.158	0.158	0.235	0.235	0.298	0.298	0.533	0.596	0.596	1.067	1.600	2.324
		SM80	0.095	0.095	0.239	0.239	0.356	0.356	0.451	0.451	0.807	0.902	0.902	1.615	2.421	3.518
		Si70	0.074	0.074	0.178	0.178	0.265	0.265	0.335	0.335	0.600	0.670	0.670	1.200	1.790	2.609
100% Nominal Torque T_{KN}		NM45	0.054	0.054	0.137	0.137	0.205	0.205	0.259	0.259	0.464	0.518	0.518	0.927	1.390	2.020
		SM50	0.063	0.063	0.159	0.159	0.237	0.237	0.300	0.300	0.537	0.600	0.600	1.074	1.610	2.340
		SM60	0.080	0.080	0.201	0.201	0.300	0.300	0.380	0.380	0.680	0.760	0.760	1.360	2.040	2.964
		SM70	0.093	0.093	0.234	0.234	0.349	0.349	0.442	0.442	0.791	0.884	0.884	1.582	2.373	3.448
		SM80	0.155	0.155	0.391	0.391	0.582	0.582	0.737	0.737	1.319	1.474	1.474	2.638	3.956	5.749
Allowable Heat Loading		Si70	430	430	600	600	760	760	735	735	900	1150	1150	1425	1650	1800
@ 30°C Ambient P_{KW} (W)		NM45	140	140	215	215	260	260	300	300	385	420	420	535	645	750
		SM50	140	140	215	215	260	260	300	300	385	420	420	535	645	750
		SM60	140	140	215	215	260	260	300	300	385	420	420	535	645	750
		SM70	145	145	230	230	280	280	320	320	410	450	450	575	700	810
		SM80	155	155	245	245	300	300	350	350	450	500	500	635	750	900
Dynamic Magnifier (M)		Si70	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
		NM45	15	15	15	15	15	15	15	15	15	15	15	15	15	15
		SM50	10	10	10	10	10	10	10	10	10	10	10	10	10	10
		SM60	8	8	8	8	8	8	8	8	8	8	8	8	8	8
		SM70	6	6	6	6	6	6	6	6	6	6	6	6	6	6
		SM80	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Maximum Speed	(RPM)		3730	2820	2820	2300	2820	2300	2300	1950	1950	2300	1950	1950	1850	1500
Radial Stiffness (1)																
No Load	(N/mm)	Si70	520	520	710	710	1050	1050	900	900	1040	1800	1800	2080	2255	2430
@ TkN	(N/mm)	Si70	1655	1655	2275	2275	3360	3360	2875	2875	3325	5740	5740	6640	7195	7750
Axial Stiffness (1)																
No Load	(N/mm)	Si70	195	195	275	275	515	515	345	345	415	980	980	1150	1570	2650
@ TkN	(N/mm)	Si70	840	840	1180	1180	2210	2210	1490	1490	1790	4230	4230	4770	6782	8560

(1) Radial and Axial Stiffness values for other rubber grades are available on request.

HTB Design Variations

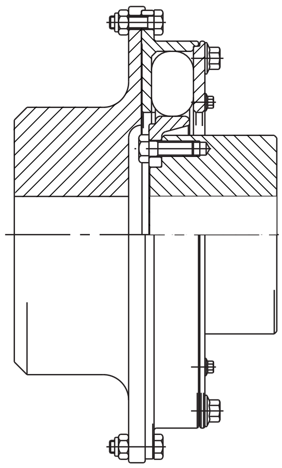
The HTB coupling can be adapted to meet customer requirements as, can be seen from some of the design variations below. For a more comprehensive list contact Renold Hi-Tec.

Coupling to Suit Existing Hub



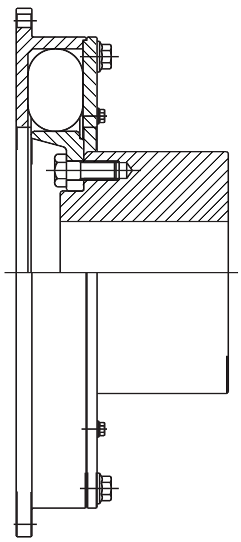
Existing hub fitment. Coupling inner member designed to suit existing hub design.

Shaft to Shaft Coupling



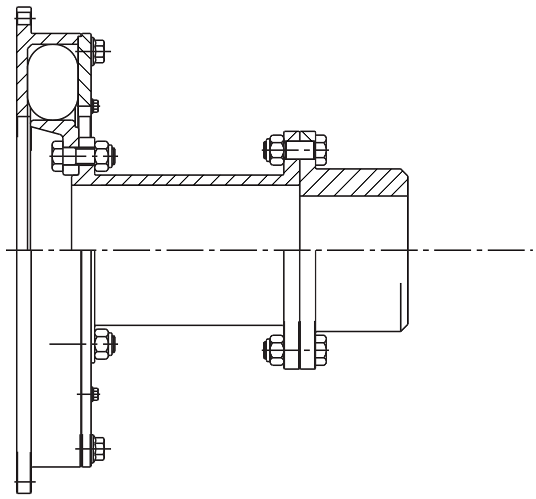
Shaft to Shaft Coupling. Designed for use on electric motor drives and power take off applications.

Reversed Inner Member Coupling



Coupling with reversed inner member to increase distance between flywheel face and shaft end.

Spacer Coupling



Spacer coupling. Used to increase the distance between shaft ends and allow easy access to driven and driving machine.

VF Highly Flexible Coupling

The highly flexible VF coupling has been designed for diesel engines that are mounted separately from the marine gear and which can be placed on flexible mounts. These flexible mounts provide optimum isolation of the vibrations of the diesel engine from the hull.

The VF coupling can dampen torsional vibrations, tune the torsional response of the system and absorb the unavoidable substantial misalignments between the engine and the gear, it is specially suitable for high speed diesel engines with SAE flywheels from 14 to 21 and for power take offs up to a torque of 18.0 kNm.

The standard range comprises

- Flywheel to shaft
- Shaft to shaft
- Flywheel to flange

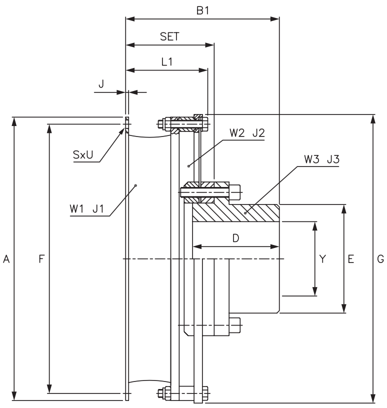
Flexible Mounts

Renold Hi-Tec Couplings can also supply a large range of flexible mounts to be used in conjunction with the VF coupling, please email sales@hitec.renold.com with all your application details if you require further details.

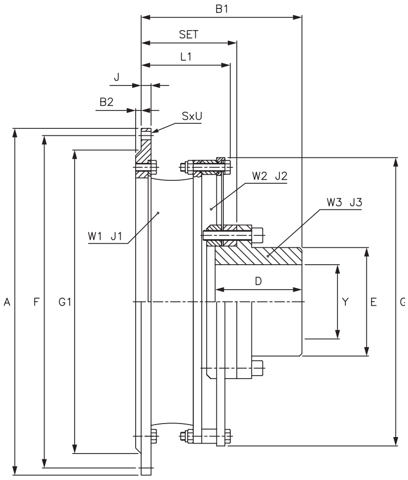
Features	Benefits
• Radial removal of rubber elements	• Allows rubber elements to be changed without moving driven or driving machine.
• Low linear stiffness	• Achieving low vibratory loads in the driveline components by selection of optimum stiffness characteristics
• High misalignment capability	• Allows axial and radial misalignment between the driving and driven machines
• Zero backlash	• Eliminating torque amplifications through pre-compression of the rubber elements
• Noise attenuation	• Giving quiet running conditions in sensitive applications by the elimination of metal to metal contact
• Tune the torsional response of the system	• Achieving low vibratory loads in the driveline components by selection of optimum stiffness characteristics

VF Flexible Coupling - Dimensional Data

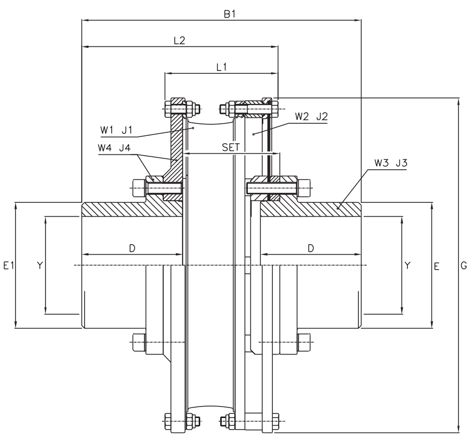
Flywheel to shaft



Flywheel to shaft with adaptor plate



Shaft to shaft



Coupling Size		VF5000			VF10000			VF18000	
		SAE14	SAE18	Shaft-Shaft	SAE18	SAE21	Shaft-Shaft	SAE21	Shaft-Shaft
Dimensions, mm	A	466.7	571.5	–	571.5	673.1	–	673.1	–
	B1	254	265	404	310	326	485	340	525
	B2	–	13	–	–	19	–	–	–
	D	150	150	150	175	175	175	185	185
	E	174	174	174	219	219	219	244	244
	E1	–	–	174	–	–	219	–	244
	F	438.15	542.92	–	542.92	641.35	–	641.35	–
	G	475	475	475	582	582	582	685	685
	G1	–	493	–	–	583	–	–	–
	J	6	15	–	6	20	–	6	–
	L1	128.8	139.8	153.8	165.8	181.8	196.8	194.8	230.8
	L2	–	–	278.8	–	–	340.8	–	379.8
	S, Qty	8	12	–	12	12	–	12	–
	U, Dia	13	17	–	17	17	–	17	–
	Y (Max)	120	120	120	150	150	150	170	170
	SET	131.4	142.4	131.4	168.6	184.6	168.6	199.8	199.8
Weight (kg) (1)	W1	7.65	24.23	7.65	13.48	45.42	13.48	24.24	24.24
	W2	28.9	28.9	28.9	56.23	56.23	56.23	92.54	92.54
	W3	18.3	18.3	18.3	35.34	35.34	35.34	46.16	46.16
	W4	–	–	41.21	–	–	74.01	–	114.77
Inertia ($Kg\ m^2$) (1)	J1	0.262	0.756	0.262	0.663	3.331	0.663	1.619	1.619
	J2	0.897	0.897	0.897	2.625	2.625	2.625	5.646	5.646
	J3	0.123	0.123	0.123	0.383	0.383	0.383	0.640	0.640
	J4	–	–	0.809	–	–	2.166	–	4.984

(1) Weights and Inertias based on maximum bore diameter.

VF Flexible Coupling - Technical Data

TECHNICAL DATA										
VF COUPLING		**5000**			**10000**			**18000**		
Rubber Grade		**F50**	**F60**	**F70**	**F50**	**F60**	**F70**	**F50**	**F60**	**F70**
Nominal Torque T_{KN}	1. kNm	4.0	5.0	5.0	8.0	10.0	10.0	14.4	18.0	18.0
Transient Torque T_{Kmax1}	2. kNm	5.2	7.5	7.5	10.7	15.0	15.0	19.2	27.0	27.0
Maximum Torque T_{Kmax2}	3. kNm	12.0	15.0	15.0	24.0	30.0	30.0	43.2	54.0	54.0
Maximum Torque Range ΔT_{max}	4. kNm	5.0	7.0	9.0	10.0	14.0	18.0	18.0	25.0	32.0
Vibratory Torque T_{KW}	5. kNm	1.55	1.67	1.67	2.67	3.20	3.33	4.80	5.75	6.00
Dyn' Torsional Stiffness C_{Tdyn}	6. kNm/rad	25	35	75	50	68	148	90	128	278
Allowable Heat Loading @30°C P_{Kw}	7. W	195	310	340	280	400	430	370	500	565
Dynamic Magnifier	8. M	8.0	5.2	3.5	8.0	5.2	3.5	8.0	5.2	3.5
Maximum Speed	9. RPM	2460	2820		2000	2300		1800	1950	
Radial misalignment Δ K'r	10. mm	4.0	3.0	2.0	6.0	4.5	3.0	8.0	6.0	4.0
Radial misalignment installation		0.5	0.4	0.3	0.7	0.5	0.4	1.0	0.7	0.5
Radial Stiffness C_r	N/mm	440	690	1500	870	1400	2900	1600	2550	5500
Axial misalignment ΔKa_1	11	1.2			1.5			2		
Axial misalignment ΔKa_2	12 mm	3.5			4.5			6.0		
Axial misalignment installation		0.3			0.4			0.6		
Axial Load @ 1 mm	13kN	0.2			0.15			0.42		

1.0 Prediction of the System Torsional Vibration Characteristics

A simple verification of the system's torsional vibration characteristic can be made by analysis at the extremes of the coupling allowable temperature to ensure that within this range there are no criticals which exceed the allowable heat dissipation values.

Assume torsional stiffness and dynamic magnifier as published above, i.e. at 30°C and 10 Hz.

Analyse the torsional system to determine criticals within the speed range.

Repeat the analysis after using this spreadsheet to determine coupling stiffness and magnifier at 100°C.

Review the analysis and if the speed range is clear of criticals which exceed the heat dissipation values in the technical data then the coupling can be considered suitable for the application, with respect to the torsional vibration characteristics.

If there is a critical within the speed range, then the actual rubber temperature, vibratory torque and frequency should be calculated at this speed.

1.1 Prediction of Actual Coupling Torsional Stiffness and Dynamic Magnifier

Analyse the torsional system using as a starting point the torsional stiffness and dynamic magnifier as published above. This is based on data at 30°C.

Compare the synthesis value of the calculated heat load in the coupling (P_K) at the speed of interest to the Allowable Heat Dissipation (P_{KW})

The rise in rubber temperature:

$$°C \text{ rise} = (P_K / P_{KW}) \times 70$$

The rubber temperature ϑ = °C rise + Ambient Temperature

The torsional stiffness and dynamic magnifier of the coupling is dependent upon, rubber temperature, vibratory torque and frequency. In order to simplify the determination of the torsional stiffness and dynamic magnifier of the coupling with these variables a computer programme has been produced to calculate these values. This program is accessible through the Renold website www.renold.com. The program is located under 'Useful Tools'. From the home page go to 'Support' and then 'International Links and Tools' from the drop down menu. The progam VF Torsional Stiffness' is located in 'Useful Tools'. The program is password protected and you will need to contact the Renold Hi-Tec Sales office to be issued with a password.

1.2 Torsional Responsibility

The responsibility for ensuring that there are no torsional resonances within the operating speed range rests with the final assembler. Renold Hi-Tec Couplings as a component supplier is not responsible for such calculation and can not accept any liability for coupling damage or gearbox noise or damage caused by torsional vibrations. Renold Hi-Tec Couplings recommend that a torsional vibration calculation is carried out on the complete drive train prior to start up of the machinery to ensure that the loading on the equipment within the system are within the manufactures declared allowable value for loading. Renold Hi-Tec Couplings can provide a Torsional Vibration Analysis to help customers to investigate their drivelines.

VF Flexible Coupling - Technical Data

1. Select coupling T_{KN} to match the nominal torque of the engine, without considering transient peak torques.
   The values of T_{KN} , T_{Kmax} and T_{KW} are based on an ambient temperature of 30°C. For high ambient temperatures (above 60°C) or high thermal loads a factor of 80% should be applied to T_{KN}, T_{Kmax} and T_{KW}

2. T_{Kmax1} refers to a normal transient torque e.g. stops and starts

3. T_{Kmax2} refers to an abnormal transient torque e.g. short circuit torque.

4. Maximum Torque Range ΔT_{max} refers to the torque range during a normal transient e.g. stops and starts

5. T_{KW} is the permissible vibratory torque, but must be considered in conjunction with the synthesis value of power loss loading.
   T_{KW} is the permissible vibratory torque at 10 Hz, for other frequencies, fe : $T_{KW} = (10 / fe)^{0.5}$

6. The value of dynamic torsional stiffness, Ctdyn, was tested at Frequency of 10 Hz, rubber temperature of 30°C and vibratory torque of T_{KW}. At other temperatures the dynamic torsional stiffness, Ctdyn, can be established from 1.1.

7 For temperatures above 30°C
   Allowable $P_{Kw} = P_{Kw30}$ (110 - Temp°C) / 80
   The power loss should be calculated for each order of vibration and added by: $\Sigma T_{wi}^2 \omega / 2 C_{Tdyn} M$
   Where:
   - T_{wi} = vibratory torque at order i (kNm)
   - ω = Frequency (rad/sec)
   - C_{Tdyn} = dynamic torsional stiffness (kNm/rad)
   - i = order number
   - M = dynamic Magnifier

8. The value of quoted dynamic Magnifier, M, was tested at 30°C. For other temperatures M can be determined from 1.1.
   Relative damping, $\psi = 2\pi / M$

9. Couplings may be supplied for higher speed, contact Renold.

10. Steady state Radial misalignment, ΔWr should not exceed the permissible radial displacement, ΔKr

    ΔKr can be calculated using the computer program, see 1.1.

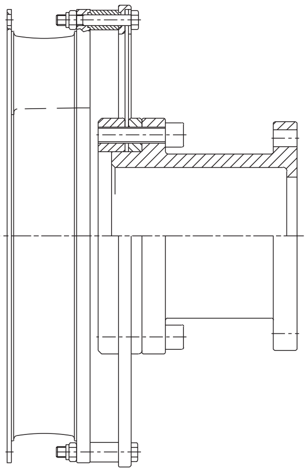
11. ΔKa1 is dynamic misalignment tested to 10^6 cycles

12. ΔKa2 is steady misalignment typically due to thermal growth.

13. The axial load at 1mm is shown as the axial stiffness is non linear, refer to Renold for other values.

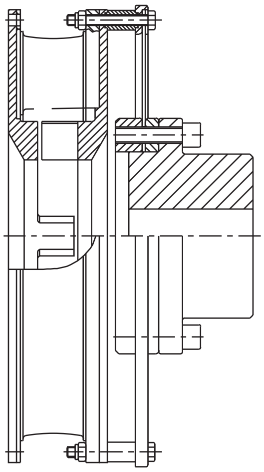
VF Design Variations

Spacer Coupling



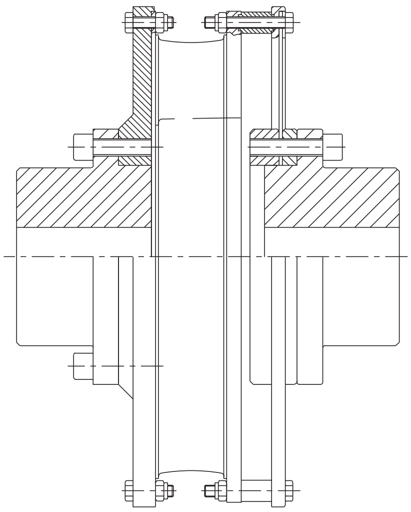
Spacer Coupling. Used to increase the distance between the Flywheel face and the shaft end.

Coupling with Drive Plates



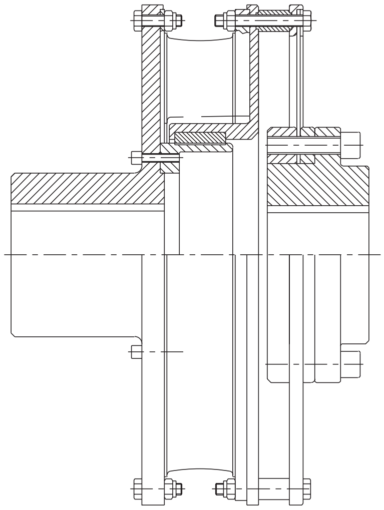
Drive Plate Coupliong. Ensuring continuous operation of the driveline in the event of rubber failure.

Shaft to Shaft Coupling



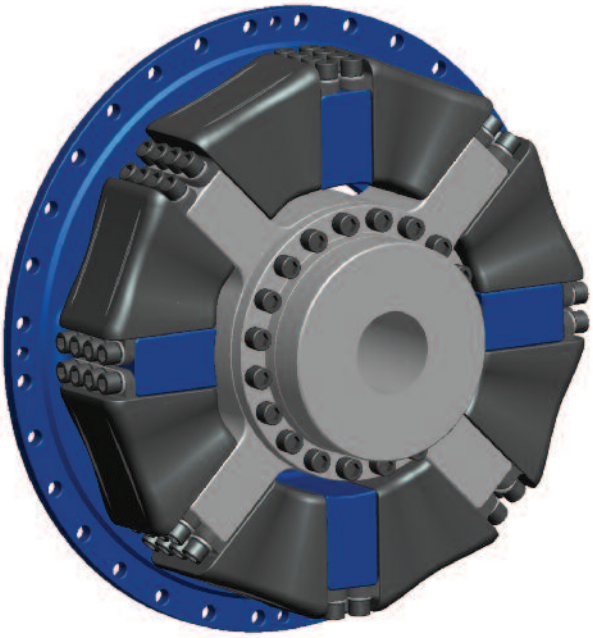
Shaft to shaft Coupling. Designed for use on electric motor drives and power take off applications.

Coupling with Radial Support Bearing



Radial support bearing. Designed to carry radial loads.

MSC-SG Flexible Coupling



Innovative coupling designed to satisfy a vast spectrum of diesel drive and compressor applications.

The standard range comprises

- Flywheel to shaft
- Shaft to shaft

Applications

- Marine propulsion
- High power generator sets
- Reciprocating compressors

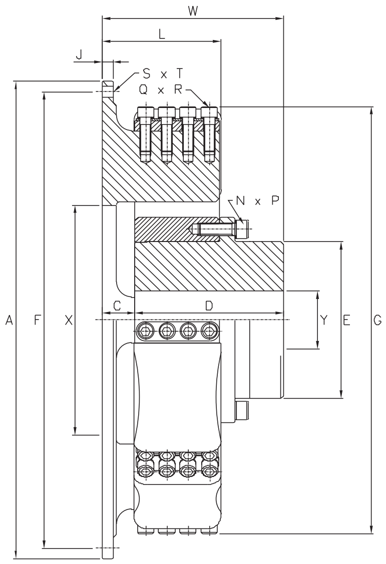
Features	Benefits
• Radial removal of rubber elements	• Allows rubber elements to be changed without moving driven or driving machine.
• Low linear stiffness	• Achieving low vibratory loads in the driveline components by selection of optimum stiffness characteristics.
• Maintenance free	• With no lubrication or adjustment required resulting in low running costs.
• Severe shock load protection	• Avoiding failure of the driveline under short circuit and other transient conditions.
• Misalignment capability	• Allows axial and radial misalignment between the driving and driven machines.
• Zero backlash	• Eliminating torque amplifications through pre - compression of the rubber elements.
• Noise attenuation	• Giving quiet running conditions in sensitive applications by the elimination of metal to metal contact.

Construction details

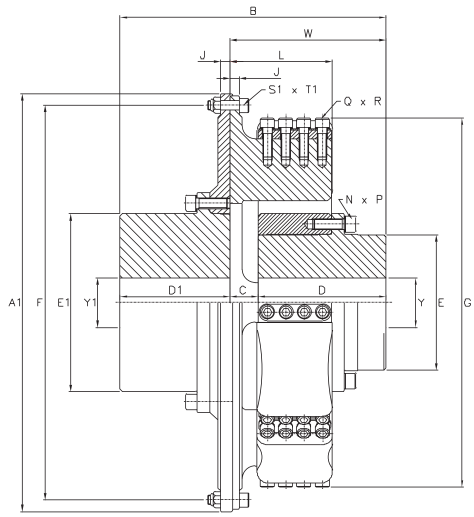
- The driving member is manufactured in S. G. Iron to BS2789 Grade 420/12
- The inner member is manufactured in S. G. Iron to BS2789 Grade 420/12
- The driving flange is manufactured in a material to suit the shaft fit
- Rubber elements can be fitted and removed without moving the driving or driven machine

MSC-SG Flywheel to Shaft

MSC-SG Flywheel to Shaft



MSC-SG Shaft to Shaft

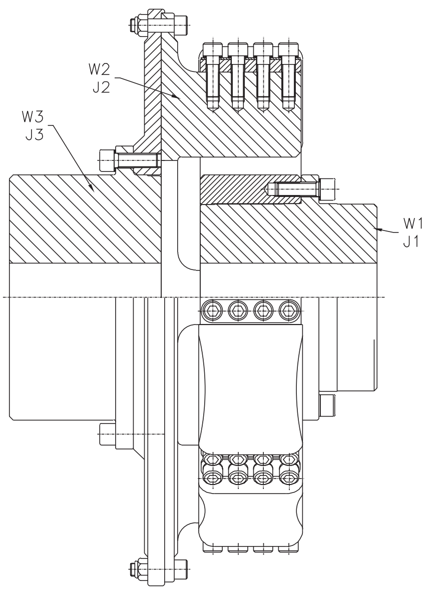


Dimensions and Tighening Torques

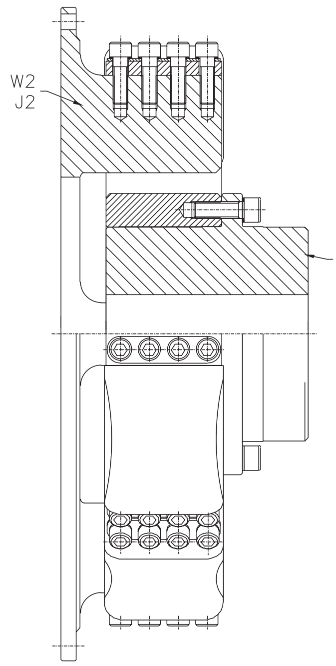
COUPLING SIZE		20 STD	20 SAE21	31.5	40	63	80
DIMENSIONS (mm)	A	680	673	790	860	995	1070
	A1	690		800	870	1010	1090
	B	426		509	557	639.5	732
	C	46	46	54	57	65.5	89
	D	200	200	245	265	300	346
	D1	180		210	235	274	297
	E	239	239	259	319	337	417
	E1	290		340	380	440	475
	F	650	641.35	755	820	950	1025
	G	609	609	706	833	871	1041
	J	17	17	18	19	22	29
	L	162	162	196	219	246	295
	N	20	20	20	20	20	20
	P	M16	M16	M20	M20	M24	M24
	Q	64	64	64	64	80	80
	R	M16	M16	M18	M22	M20	M30
	S	32	24	32	32	32	32
	S1	32		32	32	32	32
	T	17	17	19	21	23	25
	T1	M16		M18	M20	M22	M24
	W	246	246	299	322	365	435
	X	330	330	380	445	460	567
	MAX. Y	160	160	180	225	225	278
	MIN. Y	90	90	105	120	155	170
	MAX. Y1	180		210	235	273	297
	MIN. Y1	90		105	120	155	170
TIGHTENING TORQUE FOR R (Nm)		220	220	250	470	360	1250
TIGHTENING TORQUE FOR P (Nm)		220	220	360	360	625	625

MSC-SG Shaft to Shaft

MSC-SG Shaft to Shaft



MSC-SG Flywheel to Shaft



Weights, Inertia, Speed and Alignment

COUPLING SIZE		20 STD	20 SAE21	31.5	40	63	80
WEIGHT	W1	131.5	131.5	205.8	323.0	376.6	675.4
(kg)	W2	89.2	88.2	139.5	200.3	274.6	412.8
	W3	147.0		220.0	287.3	443.1	599
	W1+W2	220.7	219.7	345.3	523.3	651.2	1088.2
INERTIA (2)	J1	3.3	3.3	7.1	16.7	21.6	51.85
(kgm^2)	J2	5.5	5.4	11.4	22.2	33.5	69.51
	J3	5.1		10.0	14.9	31.6	51.4
Rubber Elements per Coupling		8	8	8	8	8	8
Maximum Speed (rev/min)		2050	2050	1700	1600	1350	1250
ALLOWABLE MISALIGNMENT							
RADIAL (mm)		6.0	6.0	6.0	8.0	8.0	9.0
AXIAL (mm)		6.0	6.0	6.0	8.0	8.0	9.0
CONICAL (degree)		0.5	0.5	0.5	0.5	0.5	0.5

Weights and Inertias are based on minimum bore diameter

(1) Weights and inertias are based on minimum bore diameter.

(2) For operation above 80% of the declared maximum coupling speed it is recommended that the coupling is balanced.

(3) Installations should be initially aligned as accurately as possible. In order to allow for deterioration in alignment over time it is recommended that initial alignment should not exceed 25% of the above noted data. The forces on the driving and driven machinery should be calculated to ensure that these do not exceed the manufacturers allowables.

MSC-SG Technical Data

1.1 Torque Capacity - Diesel Engine Drives

The MSC-SG Coupling is selected on the "nominal torqueT_{KN}" without service factors.

The full torque capacity of the coupling for transient vibration whilst passing through major criticals on run up is published as the Maximum Torque T_{KMAX}

$T_{KMAX} = 3 \times T_{KN}$.

There is additional torque capacity built within the coupling for short circuit torques.

The Published "Vibratory Torque, T_{KW}" is a fatigue function according to DIN740 and not so significant in diesel engine drives, the vibratory torque values shown in the Technical Data are at a frequency of 10Hz. The measure acceptability of the coupling for vibrating drives is published as "Allowable Dissipated Heat at Ambient Temperature 30°C".

1.2 Transient Torques

Prediction of transient torques in a marine drive can be more complex. Normal installations are well provided by the selection of the coupling based on the "Nominal Torque T_{KN}." Transients such as start up and clutch manoeuvre are usually within the "Maximum Torque" T_{KMAX} for the coupling.

Care needs to be taken in the design of couplings with shaft brakes to ensure the coupling torques are not increased by severe deceleration.

Sudden torque applications of propulsion devices such as the thrusters or water jets need to be considered when designing the coupling connection.

2.0 Stiffness Properties

The MSC-SG coupling consists of rubber elements in compression and in tension. It is available in four different stiffnesses which are F60, F70, a combination of F60 and F50 and a combination of F70 and F60. The coupling rubber grade is defined as shown below:

F (compression elements) - F (tension elements)

For example F60 - F50 is a coupling with F60 rubber in the compression elements and F50 in the tension elements. The harder rubber should always be used in the compression elements therefore it is important to know the direction of rotation of the coupling to ensure that the elements are fitted in the correct position.

If all the elements are of one rubber hardness, that is F60 - F60, the direction of rotation is not required.

2.1 Axial Stiffness

The axial stiffness of the coupling is linear and independent of applied torque as shown on page 19.

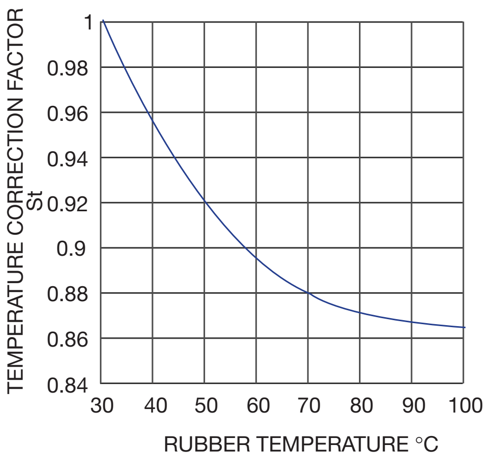
2.2 Radial Stiffness

The radial stiffness of the coupling is linear and independent of applied torque as shown on page 19.

2.3 Torsional Stiffness

The torsional stiffness of the coupling is linear as shown on page 19, but it should be corrected for temperature as per graph 2.3.1 below.

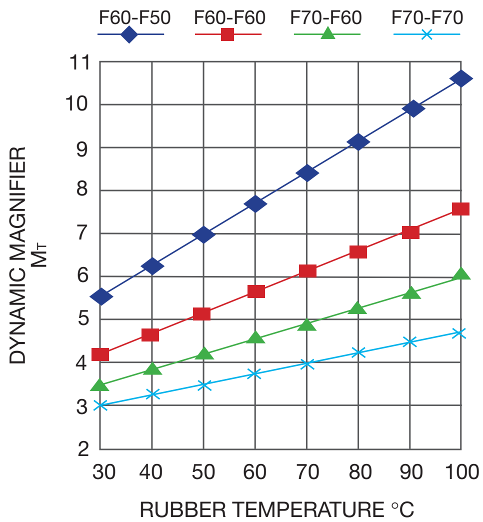
2.3.1 Temperature Correction Factor for all rubber grades



2.4 Dynamic Magnifier

The Dynamic Magnifier of the rubber is dependent on rubber temperature and can be established from graph 2.4.1 below

2.4.1 Dynamic Magnifier



2.5 Prediction of the system torsional vibration characteristics

An adequate prediction of the system torsional vibration characteristics can be made by the following method.

2.5.1 Use the torsional stiffness as published below which is based upon data measured at a 30°C ambient temperature.

2.5.2 Repeat the calculation made as 2.5.1 but using the maximum temperature correction factor and dynamic magnifier at 100°C (St100 and M100) for the rubber selected for both torsional stiffness and dynamic magnifier from the graph on page 18.

2.5.3 Review the calculations 2.5.1 and 2.5.2 and if the speed range is clear of criticals which do not exceed the allowable heat dissipation value as published in the catalogue, the coupling is then considered suitable for the application with respect to the torsional vibration characteristics. If there is a critical in the speed range the actual temperature of the coupling will need to be calculated at this speed.

2.6 Prediction of the actual coupling temperature and torsional stiffness

2.6.1 Use the torsional stiffness as published below which is based upon data measured at a 30°C and the dynamic magnifier at 30°C. (M_{30})

2.6.2 Compare the synthesis value of the calculated heat load in the coupling (Pk) at the speed of interest to the "Allowed Heat Dissipation"(Pkw).

The coupling temperature rise

$$ºC = Temp_{coup} = \left(\frac{P_K}{P_{KW}}\right) \times 70$$

The coupling rubber temperature =

$$= Temp_{coup} + \text{Ambient Temp}$$

2.6.3 Calculate the temperature correction factor S_t from 2.3.1 (if the coupling temperature > 100°C, then use S_{t100}). Establish the dynamic magnifier from 2.4.1. Repeat the calculation with the new value of coupling stiffness and dynamic magnifier.

2.6.4 Calculate the coupling temperature as per 2.6. Repeat calculation until the coupling temperature agrees with the calculation factors for torsional stiffness and dynamic magnifier used in the calculation.

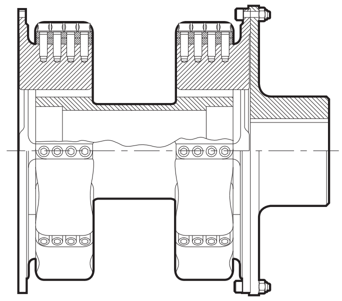
MSC-SG Technical Data

COUPLING SIZE		20	31.5	40	63	80
NORMAL TORQUE T_{KN} (kNm)	F60-F50	20.0	31.5	40.0	63.0	80.0
	F60-F60	20.0	31.5	40.0	63.0	80.0
	F70-F60	25.0	40.0	50.0	80.0	100.0
	F70-F70	25.0	40.0	50.0	80.0	100.0
MAXIMUM TORQUE T_{Kmax} (kNm)	F60-F50	60.0	94.5	120.0	189.0	240.0
	F60-F60	60.0	94.5	120.0	189.0	240.0
	F70-F60	60.0	94.5	120.0	189.0	240.0
	F70-F70	60.0	94.5	120.0	189.0	240.0
VIBRATORY TORQUE T_{KW} (kNm)	F60-F50	5.6	8.8	11.5	17.5	22.4
	F60-F60	5.6	8.8	11.5	17.5	22.4
	F70-F60	7.0	11.5	14.0	22.4	28.0
	F70-F70	7.0	11.5	14.0	22.4	28.0
ALLOWABLE DISSIPATED HEAT AT AMB. TEMP. 30°C P_{KW} (W)	F60-F50	660	715	875	1100	1250
	F60-F60	660	715	875	1100	1250
	F70-F60	680	780	1075	1250	1400
	F70-F70	680	780	1075	1250	1400
DYNAMIC TORSIONAL STIFFNESS C_{Tdyn} (MNm/rad)	F60-F50	0.29	0.45	0.57	0.90	1.10
	F60-F60	0.36	0.56	0.71	1.12	1.40
	F70-F60	0.63	1.00	1.27	2.00	2.50
	F70-F70	0.89	1.40	1.75	2.80	3.20
RADIAL STIFFNESS K_r (N/mm)	F60-F50	1.8	2.3	2.3	2.6	3.0
	F60-F60	2.3	3	3.1	3.5	4.0
	F70-F60	3.4	4.4	4.5	5.1	5.8
	F70-F70	4.5	5.8	6	6.7	7.6
AXIAL STIFFNESS K_a (N/mm)	F60-F50	1.7	2	2.1	2.5	2.8
	F60-F60	2	2.5	2.6	3	3.3
	F70-F60	3	3.9	4	4.5	5.0
	F70-F70	3.7	4.7	4.8	8.2	9.2
DYNAMIC MAGNIFIER (M) AT AMB. TEMP. 30°C	F60-F50	7.0	7.0	7.0	7.0	7.0
	F60-F60	5.2	5.2	5.2	5.2	5.2
	F70-F60	4.4	4.4	4.4	4.4	4.4
	F70-F70	3.5	3.5	3.5	3.5	3.5

MSC-SG Design Variations

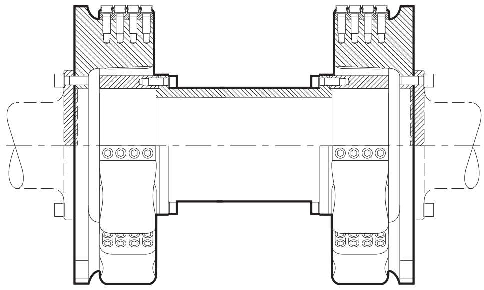
The MSC-GS coupling is available in both flywheel to shaft and shaft to shaft applications. The MSC-SG coupling can be adapted to meet customer needs as can be seen from some of the design variations shown below.

Cardan Shaft Coupling



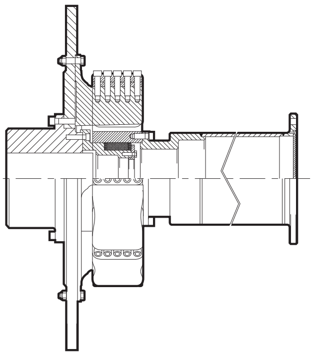
Cardan shaft coupling to give high misalignment capability, low axial and angular stiffness and high noise attenuation.

Lightweight Anti-Magnetic Coupling



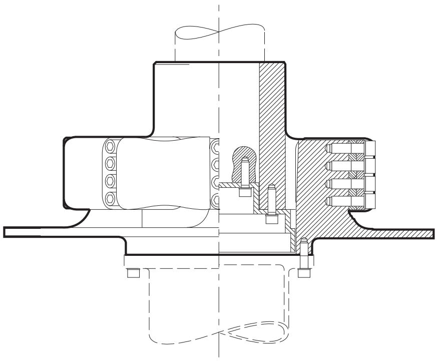
Aluminium coupling for use on military applications requiring low weight, high misalignment and low magnetic permeability.

Coupling with Radial Support Bearing



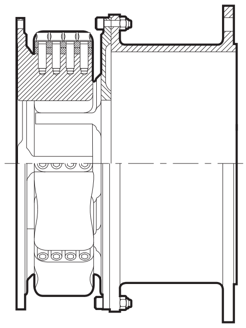
Coupling with radial support bearing for high speed applications or to support intermediate shafts.

Vertical Coupling



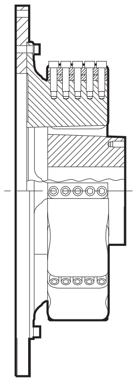
Coupling with brake disc, radial support bearing and end plate for vertical applications.

Spacer Coupling



Spacer coupling to increase the distance between the flange faces and to allow easy access to driven and driving machines.

Adaptor Plate Coupling

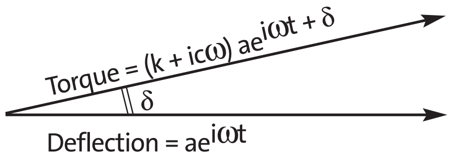


Adaptor plate coupling for adapting standard MSC-SG coupling to meet customer requirements.

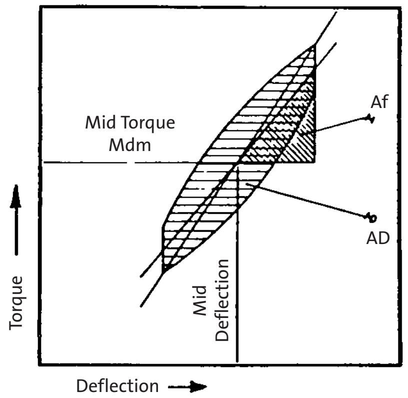
Damping Characterisics

Coupling damping varies directly with torsional stiffness and inversely with frequency for a given rubber grade. This relationship is conventionally described by the dynamic magnifier M, varying with hardness for the various rubber types.

$$M = \frac{K}{C\omega}$$



$$\tan\delta = \frac{C\omega}{K} = \frac{1}{M}$$



$$\psi = \frac{AD}{Af} = \frac{2\pi}{M}$$

This property may also be expressed as the Damping Energy Ratio or Relative Damping, ψ, which is the ratio of the damping energy, AD, produced mechanically by the coupling during a vibration cycle and converted into heat energy, to the flexible strain energy Af with respect to the mean position.

Where C = Specific Damping (Nms/rad)

K = Torsional Stiffness (Nm/rad)

ω = Frequency (Rad/s)

M = Dynamic Magnifier

δ = Phase Angle Rad

ψ = Damping Energy Ratio

The rubber compound dynamic magnifier values are shown in the table below.

Rubber grade	M
NM 45	15
SM 50	10
SM 60	8
SM 70	6
SM 80	4
F50	8
F60	5.2
F70	3.5

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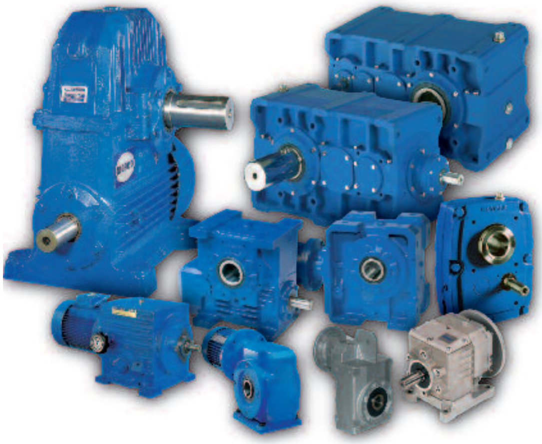

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Gears and Coupling Product Range

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