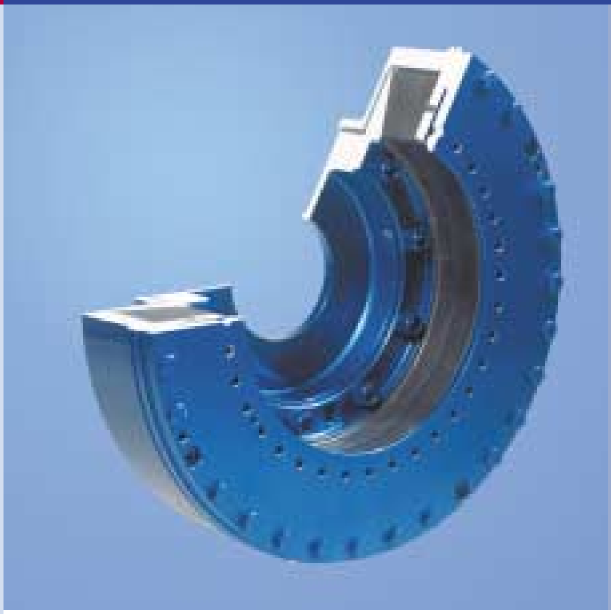
Voith Turbo

VOITH

Technical Information
Highly Flexible Couplings



The Voith Turbo product group Highly Flexible Couplings continues the proven Kuesel coupling technology.

For over 35 years, the cooperation with our customers has been based on expertise in drive chain systems subject to torsional vibration.

Our mission is:
increased lifetime of all drive chain components and the connected equipment.

Voith Turbo is the reliable partner of motor and engine manufacturers in all international markets. We equip applications in rail, construction, and marine industries as well as test rigs and many other application with our couplings. To complete our range of products, we also offer torsional vibration analysis and measurement facilities.

1 Contents

2 Technical information

2.1 Drive chain

A drive chain will normally consist of:
- a driving machine (prime mover)
- coupling elements (couplings, gears etc.)
- a driven machine (power consumer)

The drive chain transmits mechanical power that can be calculated from torque and speed.

Especially in mobile applications, reciprocating diesel engines are used as prime movers. The machines to be driven are often pumps, compressors or generators.

2.1.1 Vibrating drive chain

The individual components of a drive chain are made of elastic materials (e.g. steel) and have a mass. Accordingly, they represent a system susceptible to torsional vibration. If this system is incited, it will start vibrating with a determined frequency: its natural frequency f_{nat}.

In the case of linear, undamped two-mass resonators, the natural frequency can be calculated according to the following equation:
where m_1 and m_2 are the involved masses and $C_{1/2}$ is the elastic stiffness of the connection between the two masses.

$$f_{nat} = \frac{1}{2\pi} \sqrt{C_{1/2} \left(\frac{1}{m_1} + \frac{1}{m_2} \right)}$$

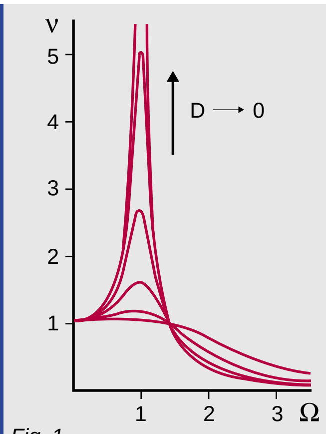


Fig. 1

If the system is incited with a frequency f which is equal to the natural frequency ($f = f_{nat}$), the vibration amplitude A will grow depending on the exciton amplitude A_A. If the vibration is not damped, the amplitude will continue to grow until the system is destroyed (fatal resonant rise).

If a damping D is introduced, the vibration amplitude will assume a finite value:

$$\nu = \frac{A}{A_A} = \sqrt{\frac{1 + D^2}{(1-\Omega)^2 + D^2}}$$

$$\text{where } \Omega = \frac{f}{f_e}$$

Torsional vibration in a drive chain can be regarded comparable. The stiffness is in this case called torsional stiffness, C_T, and the mass oscillating around the axis of rotation is characterised as the mass moment of inertia, J.

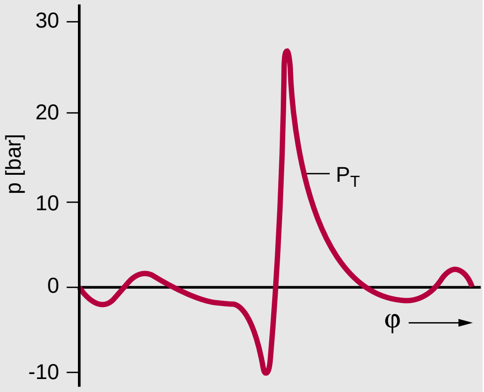


Fig. 2

2.1.2 Diesel engines as source of torsional vibration

A reciprocating diesel engine does not convey its capacity evenly over one rotation of the crankshaft. This is illustrated in figure 2: on principle, the torque transmitted to the crankshaft by each of the cylinders fluctuates very much. An increased number of cylinders and higher inertia weights (flywheel) will reduce the range of torque fluctuation. Nonetheless, a diesel engine strains the drive chain considerably, especially since the new injection technologies have been introduced and there is the trend towards ever lighter inertia weights.

Fig. 1:
Resonant rise function of a linear two-mass resonator according to the above equation.

Fig. 2:
Partial march of pressure in a 1-Cylinder motor at low speed

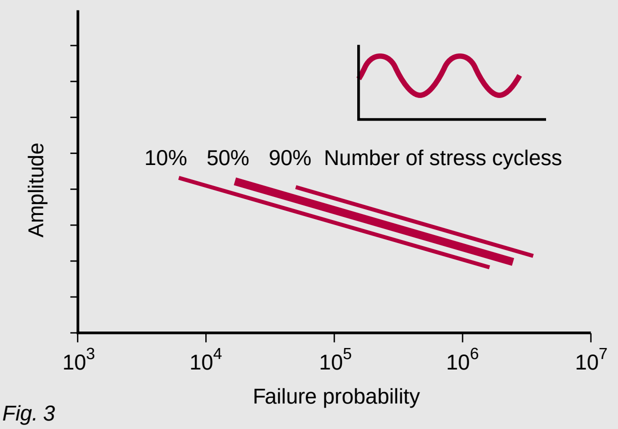


Fig. 3

Fig. 4

Fig. 3:
Stress-number line of elastomer under a dynamic load

Fig. 4:
Moment-Angle-Line of a Voith Elastomer element

Four-stroke engines produce per cylinder one torque peak in every two crankshaft revolutions. In multi-cylinder engines with even firing intervals, the excitation incidence (order) is therefore equal to the half of z, the number of cylinders. Considering the engine speed n, it is possible to calculate the excitation frequency f_{exc} for the drive chain and to compare it to the natural frequency f_{nat} of the drive chain:

$$f_A = \frac{z}{2} \cdot \frac{n/\mathrm{min}^{-1}}{60s}$$

In overcritical operating conditions ($f>f_{nat}$), it must be ensured that the minimum excitation frequency will in all operating points will remain to a sufficient degree above the natural frequency so that the rate of rise υ will remain below 1. The same applies to subcritical operating conditions ($f<f_{nat}$).

Also above the natural frequency of a drive chain, the dynamic stress resulting from the torque fluctuations of a diesel engine has detrimental effects on the lifetime of any component in it (i.e., joint shafts, gears etc.). Even a slight reduction in the dynamic vibration amplitude can multiply the lifetime of the drive chain components by several times! These facts are very clearly illustrated by the so-called Wöhler Diagram (a stress-number diagram, see fig. 3).

2.1.3 Torsional vibration damper "Voith Highly Flexible Couplings"

A useful operational strength and plant lifetime is often achieved only after a Highly Flexible Coupling has been installed in the drive chain.

In systems where a diesel engine acts as prime mover, the Highly Flexible Coupling has mainly two functions:

1. Shift the first natural frequency of the vibrating drive chain into an uncritical range.
2. Sufficiently damp any occurring vibration amplitudes.

Voith Highly Flexible Couplings are well-suited to these tasks. Special elastomers are employed in the spring elements that feature both high elasticity and excellent damping characteristics. The damping effect can be further increased using additional friction damping. A suitable design and material selection allows us to vary the characteristic data of a coupling and to adapt them to the customer's specific requirements.

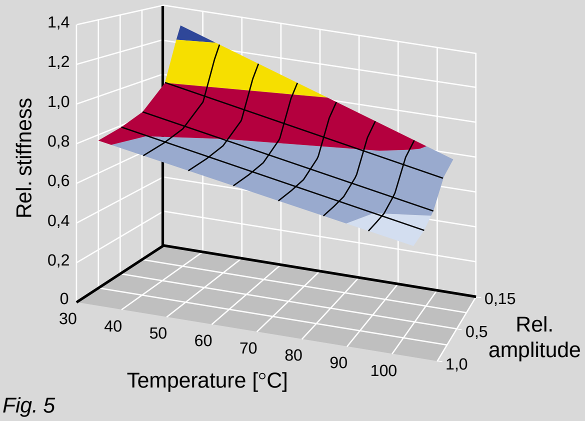


Fig. 5

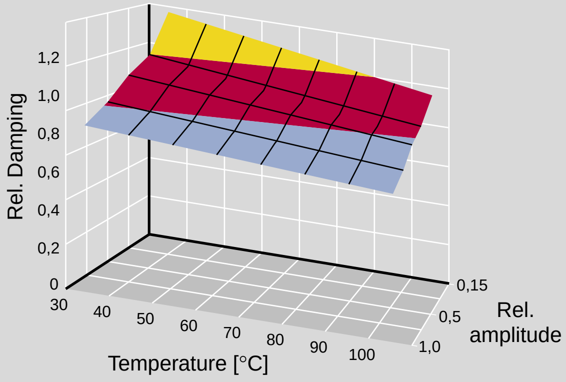


Fig. 6

2.2 Elastomer element

2.2.1 Characteristic features

The elastomer element is the basic functional and constructional component of Voith Highly Flexible Couplings. An essential characteristic feature of the elastomer element is its great capacity for deformation that is attained through the special molecular structure of the material and gives it an elastomeric-viscous quality.

When a elastomer element is deformed, the work of deformation (see fig. 4) is transformed to:

- Elastic energy which can be reconverted to mechanical work (spring-back to the initial position).
- Viscous energy which is dissipated in the form of heat.

The stiffness represents the proportionality factor in the transformation of elastic energy to mechanical work. The static stiffness depends on the employed elastomeric material and the component geometry. The dynamic stiffness is influenced by the vibration amplitude, the material temperature and the vibration frequency (fig.5). It can be expressed only for a specific component geometry in specific operating conditions and is not constant.

Viscous energy is the waste product of the work of deformation which is transformed into heat in an elastomer element. It is called structural or internal damping of a material. The damping effect of the elastomer element depends on the elastomer material, the vibration amplitude, the vibration frequency and the elastomer temperature (fig.6). It is not constant and can only be stated for one determined operating condition.

Fig. 5:
Influence of temperature and vibration amplitude on stiffness

Fig. 6:
Dependence of the internal damping on temperature and vibration amplitude

An initial examination of the torsional vibration can be based on the following correction factors (catalogue value x correction factor):

Shore-Hardness (Natural rubber)	45-60 ShA		70 ShA	
Operating temperature (natural rubber)	20 °C	60 °C	20 °C	60 °C
Stiffness	1	0.8	1	0.6
Relative damping	1	0.8	1	0.6

These correction factors will normally yield sufficiently precise results. Exact correction factors for specific elastomeric materials can be obtained from of Voith Turbo.

Voith Turbo employs of natural rubber (N) and silicone (S) elastomeric materials in its Highly Flexible Couplings.

The natural rubber material (N) features excellent properties such as:
- linear stiffness
- high elasticity
- high damping capacity
- high dynamic strength
- very low ageing tendency at temperatures below 100 °C
- using different hardness, both torsional rigidity and torsional strength can be adjusted.

The silicone material (S) is used in conditions with high thermal stress and when a progressive characteristic is required. It is furthermore possible to use elastomeric materials that are electrically insulating (E).

2.3 Causes of failure

The dynamic stress during operation and the elastomeric properties, which change during operation, cause the Highly Flexible Coupling to be exposed to a complex stress pattern. However, the strain limit of the elastomeric element may not be exceeded.

The following 4 modes of failure determine the strain limits:
1. Fatigue (endurance limit)
2. Thermally induced failure (thermal degradation)
3. Forced rupture (overload)
4. Ageing

In most of the cases, the failure of a coupling can be attributed to fatigue and thermal destruction.

2.3.1 Fatigue

The material fails due to repeated stress. While the elastomeric material can endure numerous low-level stress cycles, it can withstand only a few high-level stress cycles. The frequency of stress recurrence must be so low that the material will not heat up.

2.3.2 Thermally induced failure

The material fails due to chemical decomposition (reversal) of the molecular structure caused by heat. The elastomer element can be heated up by high ambient temperatures as well as by damping work which arises due to continuous alternating effort at high frequencies. In practice, both causes of failure often occur simultaneously because they influence each other detrimentally.

2.3.3 Forced rupture (overload)

The elastomeric material fails due to a (quasi-) statical load above the ultimate strength. Preceding fatigue may already have caused cracks in the elastomer so that the rupture load causing failure is lowered due to the reduced remaining cross-sectional area of the elastomer element. The mechanical strength is reduced through the effects of heat even before the chemical reversal process starts so that again, the rupture load causing failure after starts is reduced even further.

2.3.4 Ageing

Chemical reactions of the elastomer element surface with media present in the environment result in a destruction of the molecular structure. This causes surface degradation which lower the strain limits for fatigue and forced rupture.

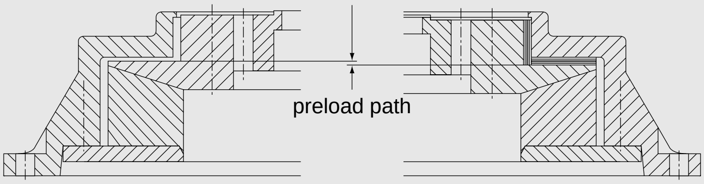


Fig. 7

Fig. 7:
Preloaded elastomer element and friction disk in the highly flexible coupling

2.4 Friction dampers

To maximise damping, Voith Highly Flexible Couplings can be equipped with an optional friction damper. This is a friction disk which is inserted between the primary and the secondary part of the coupling and is preloaded by the elastomer element (fig. 7). The required damping can be adjusted via the preload path of the element.

The friction disk has a further purpose: it acts as a thrust bearing for the elastomer element in the coupling. Thanks to the preload, the elastomer element is operated in a state of stress that is advantageous to the lifetime.

Friction converts mechanical power into heat energy and the friction material is continually being worn down. Over time, the normal force exerted on the friction disk will weaken due to the decrease in the elastomer element preload and the damping effect will diminish steadily. If the load spectrum is exactly known, the friction coefficient, normal force and wear behaviour of the friction pairing in the coupling can be dimensioned so that the wear limit coincides with the lifetime of the elastomer element. This avoids costly maintenance work and reduces the life cycle costs.

3 Applications

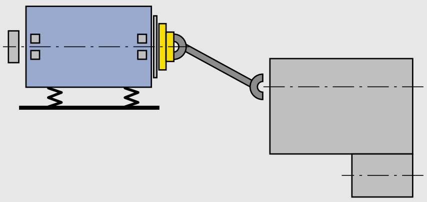


Fig. 8

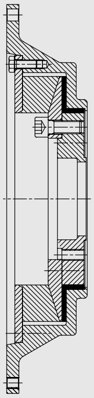


Fig. 9

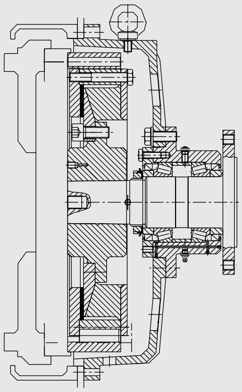


Fig. 10

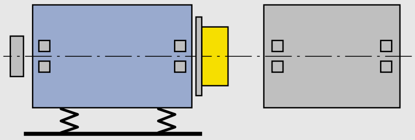


Fig. 11

With the reduction of dynamic torsional vibrating loads the Highly Flexible Coupling in drive chains performs additional functions that can be distinguished by the way the drive unit and power output are installed: Practically all drive chains can be divided into one of the 3 methods of installation:

3.1 Remote mounted arrangements

- Driver and driven machines are installed on different foundations and located relatively distant from each other.
- A joint shaft is employed as a shaft coupling.
- The Highly Flexible Coupling supports the weight of the joint shaft, guiding and stiffening it radially. The added benefit of this being that the shaft operates without any unbalance forces.
- For the remote mounted arrangements, Voith Turbo offers two different coupling designs according to size and length of the joint shaft:

3.1.1 Kuesel universal joint shaft couplings

- The bearing which guides the joint shaft is integrated into the coupling design.
- The weight of the joint shaft and coupling is transmitted to the rear crankshaft bearing.
- Depending on the coupling series, friction or antifriction bearings are used.
- These bearings follow any relative twist of the coupling performing an oscillating rotary movement. This is considered both in the bearing design and in the selection of the bearing materials.

3.1.2 Outrigger bearing couplings

- The coupling comprises of a bearing system for bell-house mounting if the crankshaft bearings of the diesel engine cannot support the weight of joint shaft and coupling.
- The bearing is located inside a bell-housing which is bolted to the engine flywheel housing.
- The weight of the joint shaft is transmitted to the engine flywheel housing.
- The bearing does not carry out a vibrating rotation, it rotates with the joint shaft, and for this reason needle roller bearings are used.

Fig. 8:
Schematic diagram of the joint shaft remote mounted arrangement.

Fig. 9:
Kuesel universal joint shaft coupling, e.g. Series 152.

Fig. 10:
Outrigger bearing coupling e.g. Series 144.

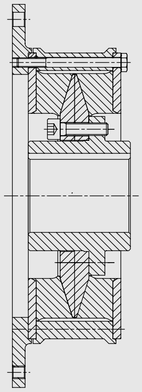


Fig. 12

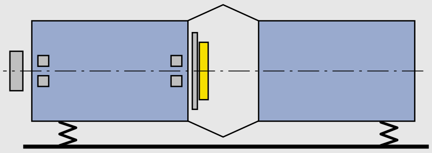


Fig. 13

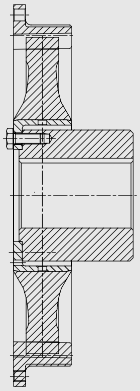


Fig. 14

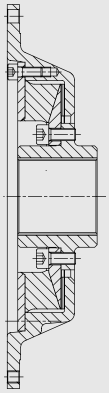


Fig. 15

3.2 Separate mounted arrangements

- Driver and driven machines are installed on different foundations and located relatively close to each other.
- Driver and driven machines have elastic supports and can therefore vibrate in the axial, radial and angular direction relative to one another.
- The coupling compensates for these movements by having additional flexibility in axial, radial and angular direction.
- For separate mounted arrangements, Voith Turbo offers different designs of the following couplings:

3.2.1 Universally flexible couplings

- The flexibility is adjusted via the elasticity of the elastomer element.

3.3 Bell-house mounted arrangements

- The driven machine is directly flanged onto the engine flywheel housing.
- The Highly Flexible Coupling is designed as a blind assembly unit since it needs to be mounted at the same time as the driver and driven machine are bolted together.
- For bell-house mounted arrangements, Voith Turbo offers different designs of the following couplings:

3.3.1 Blind assembly couplings

- The blind assembly capability can be implemented in different ways:
  - Toothing directly in the elastomer element (fig. 14)
  - Positive engagement between an inner and outer ring by means of pins
  - Positive engagement by means of splined hub and shaft (fig. 15)

Fig. 11:
Schematic diagram of a separate mounted arrangement.

Fig. 12:
Universally Flexible Coupling, e.g. Series 200.

Fig. 13:
Schematic diagram of a bell-house mounted arrangement.

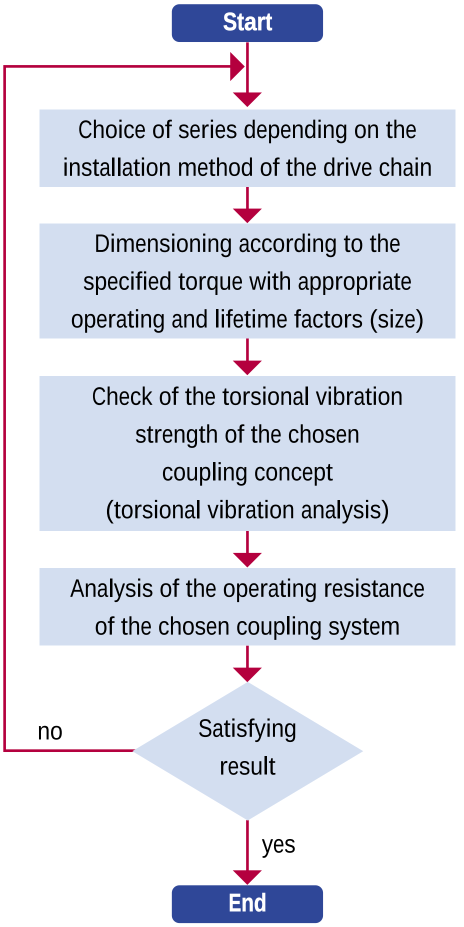
Fig. 14:
Blind assembly coupling with SK element, e.g. Series 316.

Fig. 15:
Blind assembly coupling with friction damping, e.g. Series 362.

4 Dimensioning

4.1 Methodology

Dimensioning a Highly Flexible Coupling is an iterative process due to the complexity of the material stressing:



4.2 Selecting the Coupling Series

The criteria for the selection of the suitable Series are described in section 3.

The major aspects are:
- Mounting arrangement
- Power take-off (primary) and driven unit (secondary) shaft connections
- Available installation space
- Ease of installation and dismantling
- Maximum speed
- Flexibility

4.3 Selecting the Coupling Size

- A reference value for the selection of a coupling size is the torque consumed by the driven machine at the nominal (rated) speed: T_{nom}.
- Depending on the operating conditions of the drive system, an operational factor S_L determined that takes into account the following influencing variables:
  - Number and size of load impacts (e.g. transient effects)
  - Ratio of the primary and secondary mass moments of inertia
  - Extent of the difference between operating speed and natural frequency of the drive chain
  - Temperature in the coupling environment
- The selection of the coupling size aims chiefly at dimensioning its lifetime with respect to the causes of failure "elastomer element fatigue" (see section 2.3.1) and to the wear of a friction damper which is possibly installed (see section 2.4).
- When selecting the size, not all catalogue values need necessarily to be observed (section 7). If the catalogue values are exceeded, it is however mandatory to consult Voith Turbo.
- Furthermore, the German standard DIN 740 defines additional coupling characteristic data that can be used in dimensioning the coupling. This data is stated in the data sheets:

Term	Formula	Definition
Rated torque	T_{KN}	Continuous transferable torque
Maximum torque	T_{Kmax}	Maximum transferable torque, risingly to be endured at least 10^5 times and alternatingly at least $5x10^4$ times
Vibratory torque	T_{KW}	Torque amplitude, to be continuously endured at 10 Hz and 20 °C environment temperature
Maximum damping power	P_{KW}	Admissible damping power, to be continuously endured at 10 Hz and 20°C environment temperature
Axial misalignment	ΔKa_a	Axial misalignment tolerance of the half-coupling
Radial misalignment	ΔKr_r	Angular misalignment tolerance of the half-couplings
Torsional spring characteristic (stiffness)	ΔKw_w	Angular misalignment tolerance of the half-coupling
Rigidity of the torsion spring	C_{Tdyn}	$C_{Tdyn} = \frac{dT_K}{d\varphi}$
Relative damping	ψ	$\psi = \frac{A_D}{A_{el}}$ A_D: damping power of one vibration cycle A_{el}: elastic deformation energy

4.4 Torsional Vibration Analysis (TVA)

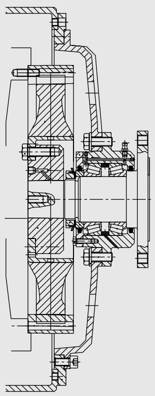
- The aim of the Torsional Vibration Analysis with regard to the elastomer coupling is to determine the permanently occurring vibrational torques in the coupling in different operating conditions.
- These alternating torques heat the elastomer element up due to the damping (power loss). The TVA is therefore essentially a check for cause of failure "Thermally induced failure"
  (also see section 2.3.2).
- At higher environment temperatures (e.g. installation inside a bell-housing), the Highly Flexible Coupling can dissipate less heat. This will reduce the maximum admissible dissipated power and the resulting admissible continuous alternating torque.
- If the elastomer element heats up, its stiffness will decrease. This leads to an increased angle of twist across the coupling. The lifetime of the elastomer element will therefore decrease accordingly.

4.5 Operational strength

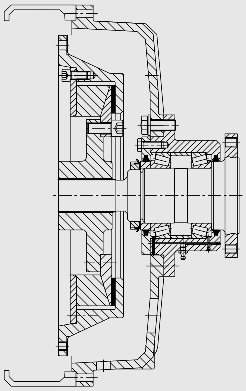
- The lifetime of an elastomeric coupling is limited by the dynamic operating stress by fatigue. Here, the decisive factors are the number and the force of load impacts (sudden load changes, load peaks) and the consequential damage.
- The relationship between the amount of partial damage through alternating loads and the size of a load impact is known for certain materials and can be found for others with the help of multiple-stage lifetime tests. It serves as a basis for detecting the (dynamic) operational stress using the methodology and processes made available by the operational strength. These can be considered in the dimensioning or to determine the lifetime of the coupling.
- An essential condition for this is that the dynamic operational loads are known in the form of a representative load spectrum. The loads can be determined with a TVM (Torsional Vibration Measurement) and can be converted into a load spectrum by means of an appropriate classification process.
  Using the relationship between load spectrum and partial damage, a damage accumulation can be carried out and the serviceable life of a coupling with the desired probability of failure can be predicted.

5 Overview of the Coupling Series

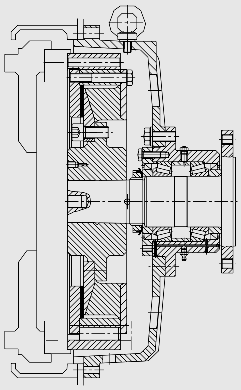
5.1 Coupling Series for remote mounted arrangements BR 140 – BR 152



BR 140



BR 142



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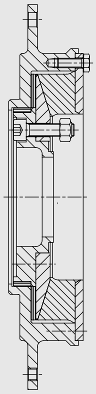

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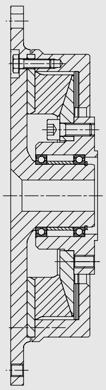

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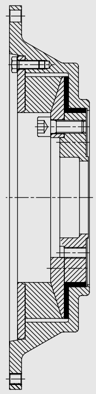
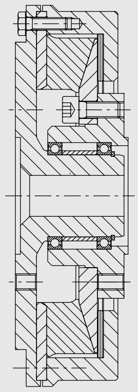


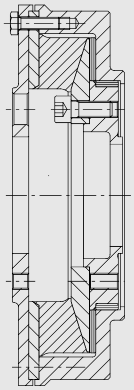
BR 152

Designation	Type of coupling	Bearing type	Frictional damping	Connection	Notes
BR 140	Centred single element coupling Coupling as flange bearing	Antifriction bearing	no	Engine flywheel housing – joint shaft	
BR 142	Centred single element coupling Coupling as flange bearing	Antifriction bearing	yes	Engine flywheel housing – joint shaft	Relatively small mass on the flywheel
BR 144	Centred single element coupling Coupling as flange bearing	Antifriction bearing	yes	Engine flywheel housing – joint shaft	Relatively big mass on the flywheel
BR 150	Centred single element coupling	Friction bearing	yes	Engine flywheel – joint shaft	Very short installed length
BR 151	Centred single element coupling	Antifriction bearing	yes	Engine flywheel – joint shaft	For higher speeds
BR 152	Centred single element coupling	Friction bearing	yes	Engine flywheel – joint shaft	

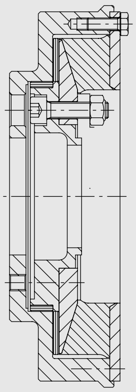
Coupling Series for remote mounted arrangements BR 153 – BR 159



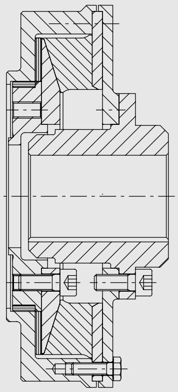
BR 153



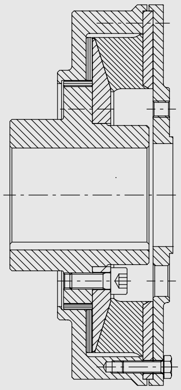
BR 154



BR 155



BR 157



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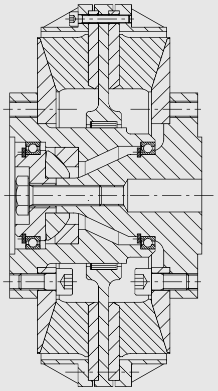
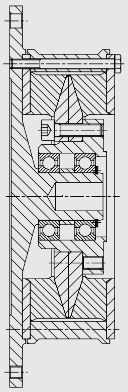


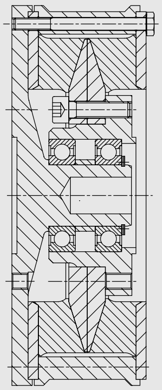
BR 159

Desig-nation	Type of coupling	Bearing type	Frictional damping	Connection	Notes
BR 153	Centred single element coupling	Antifriction bearing	yes	Flange – joint shaft	For higher speeds
BR 154	Centred single element coupling	Friction bearing	yes	Flange – joint shaft	
BR 155	Centred single element coupling	Friction bearing	yes	Flange – joint shaft	
BR 157	Centred single element coupling	Friction bearing	yes	Solid shaft – joint shaft	Smallest coupling inertia at universal joint shaft side.
BR 158	Centred single element coupling	Friction bearing	yes	Solid shaft – joint shaft	Biggest coupling inertia at universal joint shaft side.
BR 159	Centred twin element coupling with double torsional elasticity	Friction and antifriction bearings	no	Flange – joint shaft	Particularly suitable for engine test rigs

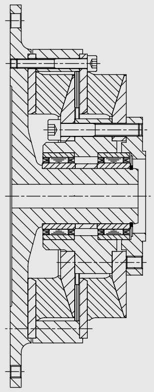
Coupling Series for remote mounted arrangements BR 160 – BR 173



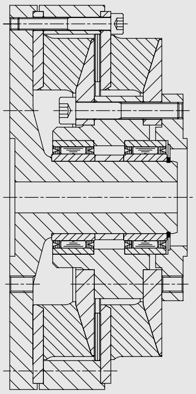
BR 160



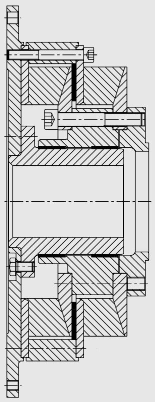
BR 161



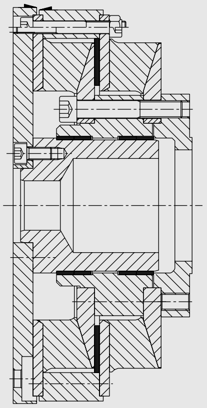
BR 170



BR 171

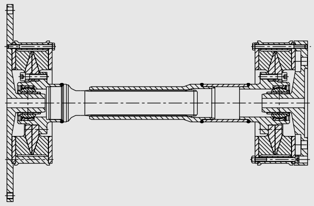


BR 172

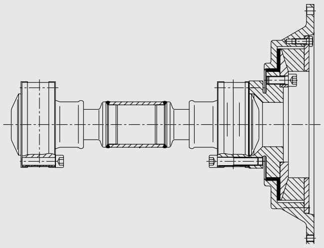


BR 173

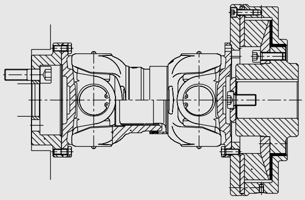
Desig-nation	Type of coupling	Bearing type	Frictional damping	Connection	Notes
BR 160	Centred twin element coupling	Antifriction bearing	no	Engine flywheel – joint shaft	For higher speeds
BR 161	Centred twin element coupling	Antifriction bearing	no	Flange – joint shaft	For higher speeds
BR 170	Centred twin element coupling	Antifriction bearing	yes	Engine flywheel – joint shaft	For higher speeds
BR 171	Centred twin element coupling	Antifriction bearing	yes	Flange – joint shaft	For higher speeds
BR 172	Centred twin element coupling	Friction bearing	yes	Engine flywheel – joint shaft	
BR 173	Centred twin element coupling	Friction bearing	yes	Flange – joint shaft	



BR 190



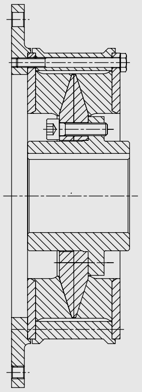
BR 198

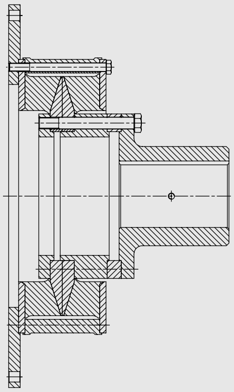


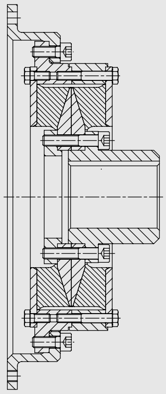
BR 199

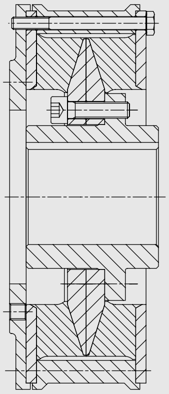
Desig-nation	Type of coupling	Bearing type	Frictional damping	Connection	Notes
BR 190	Coupling design with longitudinal expansion compensation shaft	Friction bearing	no	Engine flywheel – flange	Particularly suitable for engine test rigs
BR 198	Coupling design consisting of - highly flexible coupling - synchronising shaft	friction or antifriction bearings	yes	Engine flywheel – synchronising shaft	Specifically designed for small marine main propulsion drives (Aquadrive CVT®)
BR 199	Coupling design consisting of - highly flexible coupling - synchronising shaft - connecting elements, if required	–	–	–	

5.2 Coupling Series for separate mounted arrangements BR 200 – BR 240


BR 200


BR 210


BR 215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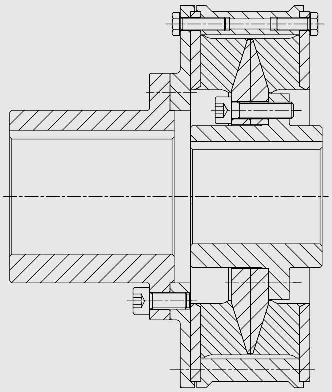
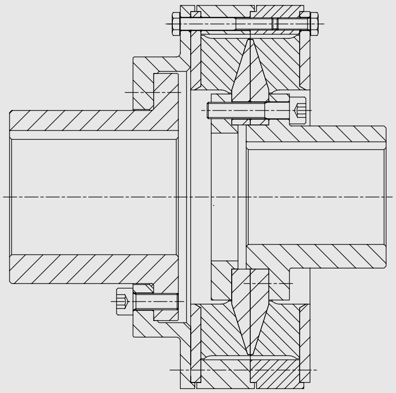
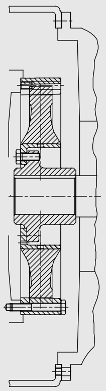
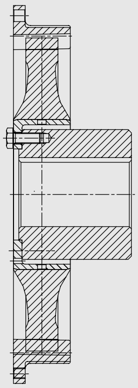

BR 230

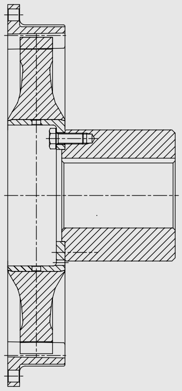

BR 240

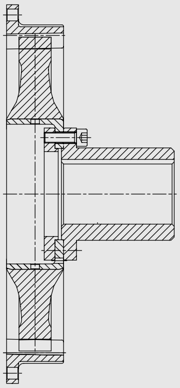
Desig-nation	Type of coupling	Bearing type	Frictional damping	Connection	Notes
BR 200	Universally flexible twin element coupling	–	no	Engine flywheel – solid shaft	
BR 210	Universally flexible twin element coupling	–	no	Engine flywheel – solid shaft	Elements can be dismantled radially via a split ring
BR 215	Universally flexible twin element coupling	–	no	Engine flywheel – solid shaft	Radially removable elements
BR 220	Universally flexible twin element coupling	–	no	Flange – solid shaft	
BR 230	Universally flexible twin element coupling	–	no	Solid shaft – solid shaft	
BR 240	Universally flexible twin element coupling	–	no	Solid shaft – solid shaft	Radially removable elements

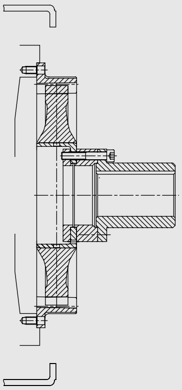
5.3 Coupling Series for bell-house mounted arrangements BR 311 – BR 321

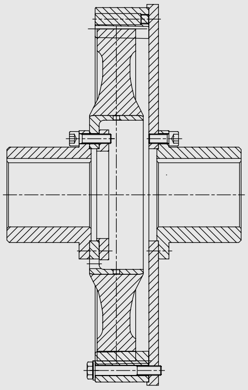

BR 311


BR 315


BR 316

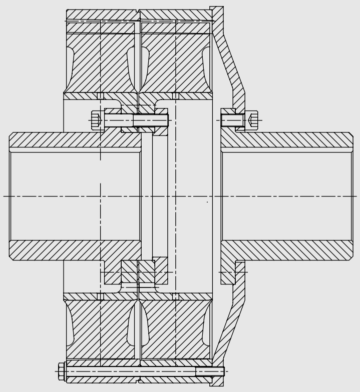

BR 317


BR 318

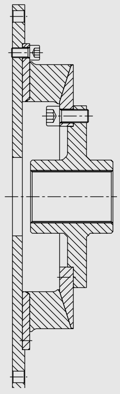

BR 321

Desig-nation	Type of coupling	Bearing type	Frictional damping	Connection	Notes
BR 311	Blind assembly coupling with disk element(s)	–	no	Engine flywheel – solid shaft	For generators according to DIN 6281
BR 315	Blind assembly coupling with disk element(s)	–	no	Engine flywheel – solid shaft	Standard design, short
BR 316	Blind assembly coupling with disk element(s)	–	no	Engine flywheel – solid shaft)	Standard design, long
BR 317	Blind assembly coupling with disk element(s)	–	no	Engine flywheel – solid shaft	Radially removable elements
BR 318	Blind assembly coupling with disk element(s)	–	no	Engine flywheel – solid shaft	Elements can be housing dismantled radially if the flywheel protrudes sufficiently
BR 321	Blind assembly coupling with disk element(s)	–	no	Solid shaft – solid shaft	

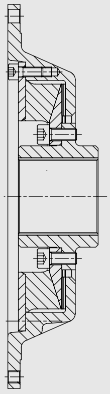
5.3 Coupling Series for bell-house mounted arrangements BR 322 – BR 371



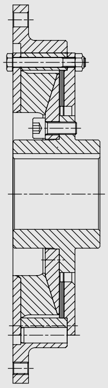
BR 322



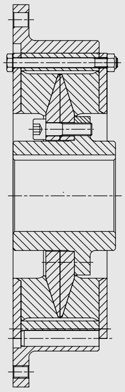
BR 340



BR 362



BR 364



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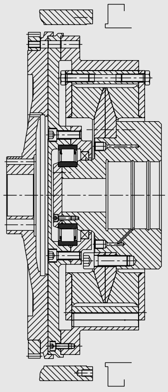
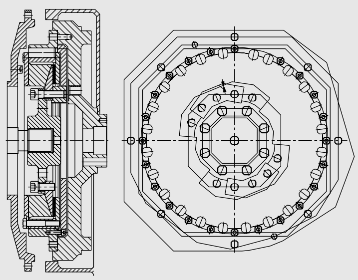
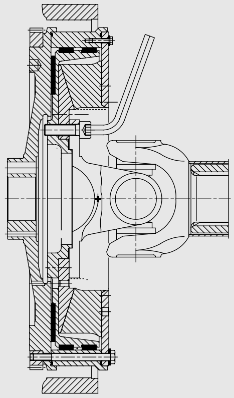


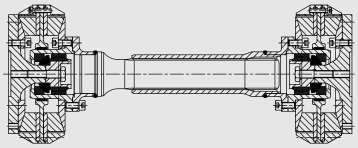
BR 371

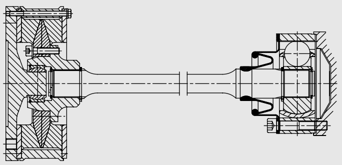
Desig-nation	Type of coupling	Bearing type	Frictional damping	Connection	Notes
BR 322	Blind assembly coupling with disk element(s)	–	no	Solid shaft – solid shaft	Radially removable elements
BR 340	Single element blind assembly coupling without preload	–	no	Engine flywheel – splined shaft	For light-duty applications
BR 362	Single element blind assembly coupling	–	yes	Engine flywheel – splined shaft	
BR 364	Single element blind assembly coupling	–	yes	Engine flywheel – solid shaft	
BR 366	Twin element blind assembly coupling	–	no	Engine flywheel – solid shaft	
BR 371	Twin element blind assembly coupling	–	no	Engine flywheel – generator solid shaft	For single-bearing generators

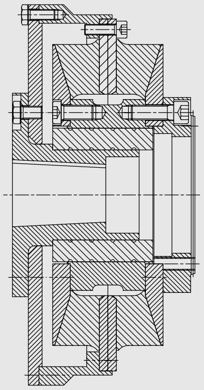
5.4 Examples of special coupling designs K…

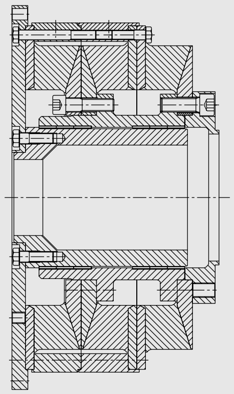

K 050 364 1105


K 056 900 1025


K 010 900 1265


K 015 900 1043


K 045 900 1050


K 080 900 1013

Desig-nation	Type of coupling	Bearing type	Frictional damping	Connection	Notes
K 050 0364 1105	Blind assembly coupling with failsafe protection	–	yes	Engine flywheel – solid shaft	Between a Diesel engine and a pump power take-off unit
K 056 900 1025	Kuesel universal joint shaft coupling with short installed length	Friction bearing	yes	Engine flywheel – joint shaft	For marine propulsions, engine flywheel is integrated into coupling
K 010 900 1265	Coupling shaft with quadruplicate and torsional flexibility	Friction and antifriction bearings	no	Flange – flange	Two Kuesel universal joint shaft BR 159 connected by a profile shaft
K 015 900 1043	Centred twin element coupling combined with synchronising joint	Antifriction bearing	no	Flange – flange	
K 045 900 1050	Centred twin element coupling, electrically insulated	Friction bearing	no	Solid shaft – joint shaft	Following prEN 50124, up to 1000 V
K 080 900 1013	Centred triple element coupling	Friction bearing	no	Flange – joint shaft	

6 Coupling identification

6.1 Couplings with standard elastomer element

K 010 152 1 111 N 50

Shore-Hardness

Elastomeric material:
N: Natural rubber
S: Silicone elastomer
E: Electrically insulating material

Consecutive number: 000…999

0: Standardised Coupling Series
1: Variant

Coupling Series : 100…399

Size

Identification

6.2 Couplings with disk elastomer element

SK 1000 315 03 1 111 N 50

Shore-Hardness

Elastomeric material:
N: Natural rubber
S: Silicone elastomer

Consecutive number: 000…999

0: Standardised Coupling Series
1: Variant

SAE flywheel connection: 01…09

Coupling Series : 300…399

Size

Identification

6.3 Outrigger bearing couplings

AL 1000 315 01 03 1 111 N 50

Shore-Hardness

Elastomeric material:
N: Natural rubber
S: Silicone elastomer

Consecutive number: 000…999

0: Standardised Coupling Series
1: Variant

SAE flywheel connection: 01…09

SAE engine casing connection: 00…09

Coupling Series : 100…999

Size

Identification

7 Measurement units and conversion factors

Unit	Conversion		
Length: l		**m**	**mm**
Inch	1 in	0.0254	25.4
Foot	1 ft	0.3048	304.8
Yard	1 yd	0.9144	914.4
Mile	1 mile	1609	
Nautic mile	1 mile	1853	
Mass: m		**kg**	**g**
Pound	1 lb	0.4536	453.6
Ounce	1 oz	0.02835	28.35
Force: F		**N = kg m s^{-2}**	
Pound force	1 lbf	4.448	
Kilopond	1 kp	9.807	
Mass moment of inertia: J		**kg m^2**	
Pound foot squared	1 lb ft^2	0.04214	
Pound inch squared	1 lb in^2	0.0002926	
Flywheel effect		**kp m^2 (= g · J)**	
	1 GD^2	4	
	1 WR^2	1	
Work: W		**J = N m**	**kJ**
Foot pound force	1 ft lbf	1.3564	
British thermal unit	1 BTU	1055	1.055
Great calorie	1 kcal	4.1868	
Power: P		**W**	**kW**
Horsepower, metric	1 PS	735.5	0.7355
Horsepower, imperial	1 HP	745.7	0.7457
Angle: φ		**rad**	
Degree	1°	0.01745	
Temperature:		**K**	
Degree Celsius			
Temperature difference	1 °C	1	
Ice point	0 °C	273.15	
Degree Fahrenheit			
Temperature difference	1 °F	1.8	$t_{°F} = [(9/5) \cdot t_{°C}] + 32$
Ice point	32 °F	273.15	

8 Coupling technical data

Single standard elastomer element, preloaded, with frictional damping

Coupling Series: BR 142, 144, 150, 151, 152, 153, 154, 155, 157, 158, 362, 364

Size	Shore hardness A	Nominal torque T_{KN} [Nm]	Max. torque T_{Kmax} [Nm]	Adm. cont. altern. torque T_{KW} [Nm]	Dyn. torsional rigidity C_{Tdyn} [Nm/rad]	Adm. power loss P_{KV} [W]	Relative damping ψ
K 005	N 45	180	540	65	950	90	1.6
	N 50	200	600	70	1400		
	N 60	220	660	75	2100		
	N 70	240	720	85	4100		
K 010	N 45	260	780	90	1300	110	1.6
	N 50	300	900	105	2000		
	N 60	330	990	115	3000		
	N 70	360	1080	125	6200		
K 015	N 45	350	1050	120	1700	130	1.6
	N 50	390	1170	135	2600		
	N 60	430	1290	150	4000		
	N 70	480	1440	170	8100		
K 020	N 45	450	1350	160	2100	150	1.6
	N 50	510	1530	180	3600		
	N 60	570	1710	200	5000		
	N 70	620	1860	215	10600		
K 025	N 45	590	1770	180	2800	170	1.6
	N 50	660	1980	200	4600		
	N 60	730	2190	220	6800		
	N 70	810	2430	245	13600		
K 030	N 45	750	2250	225	3600	200	1.6
	N 50	840	2520	250	6000		
	N 60	930	2790	280	8800		
	N 70	1030	3090	310	17950		
K 035	N 45	960	2880	290	4600	230	1.6
	N 50	1090	3270	325	7600		
	N 60	1210	3630	365	11700		
	N 70	1330	3990	400	22600		
K 040	N 45	1240	3720	370	6000	260	1.6
	N 50	1400	4200	420	9800		
	N 60	1550	4650	465	15000		
	N 70	1710	5130	515	29100		
K 045	N 45	1680	5040	420	8500	310	1.6
	N 50	1890	5670	470	13300		
	N 60	2100	6300	525	20400		
	N 70	2310	6930	580	39500		

Dynamic torsional rigidity at 20 °C

Adm. temperature at the natural rubber surface between -40 to +90 °C

Size	Shore hardness A	Nominal torque T_{KN} [Nm]	Max. torque T_{Kmax} [Nm]	Adm. cont. altern. torque T_{KW} [Nm]	Dyn. torsional rigidity C_{Tdyn} [Nm/rad]	Adm. power loss P_{KV} [W]	Relative damping ψ
K 050	N 45	2170	6510	540	10500	350	1.6
	N 50	2440	7320	610	17100		
	N 60	2710	8130	680	26000		
	N 70	2990	8970	750	50000		
K 055	N 45	2990	8970	750	14600	420	1.6
	N 50	3360	10080	840	23600		
	N 60	3730	11190	935	36400		
	N 70	4110	12330	1030	70500		
K 060	N 45	4400	13200	1100	21400	510	1.6
	N 50	4950	14850	1240	34700		
	N 60	5500	16500	1375	53000		
	N 70	6050	18150	1515	103400		
K 065	N 45	6300	18900	1260	31000	630	1.6
	N 50	7100	21300	1420	50000		
	N 60	7900	23700	1580	77000		
	N 70	8700	26100	1740	149500		
K 070	N 45	9100	27300	1820	44300	760	1.6
	N 50	10200	30600	2040	71500		
	N 60	11400	34200	2280	110000		
	N 70	12500	37500	2500	213400		
K 075	N 45	12400	37200	2480	61000	900	1.6
	N 50	14000	42000	2800	98000		
	N 60	15500	46500	3100	151000		
	N 70	17100	51300	3420	290000		
K 080	N 45	16900	50700	3380	82300	1060	1.6
	N 50	19000	57000	3800	133000		
	N 60	21100	63300	4220	205000		
	N 70	23200	69600	4640	397000		
K 085	N 45	23900	71700	4780	117000	1280	1.6
	N 50	26900	80700	5380	188000		
	N 60	29900	89700	5980	290000		
	N 70	32900	98700	6580	562000		
K 090	N 45	33300	99900	6660	162000	1530	1.6
	N 50	37500	112500	7500	262000		
	N 60	41600	124800	8320	400000		
	N 70	45800	137400	9160	783000		

Dynamic torsional rigidity at 20 °C

Adm. temperature at the natural rubber surface between -40 to +90 °C

Twin standard elastomer elements in parallel, preloaded, with friction damping
Coupling Series: BR 170, 171, 172, 173

Size	Shore hardness A	Nominal torque T_{KN} [Nm]	Max. torque T_{Kmax} [Nm]	Adm. cont. altern. torque T_{KW} [Nm]	Dyn. torsional rigidity C_{Tdyn} [Nm/rad]	Adm. power loss P_{KV} [W]	Relative damping ψ
K 005	N 45	360	1080	130	1900	140	1.6
	N 50	400	1200	140	2800		
	N 60	440	1320	150	4200		
	N 70	480	1440	170	8200		
K 010	N 45	520	1560	180	2600	175	1.6
	N 50	600	1800	210	4000		
	N 60	660	1980	230	6000		
	N 70	720	2160	250	12400		
K 015	N 45	700	2100	240	3400	205	1.6
	N 50	780	2340	270	5200		
	N 60	860	2580	300	8000		
	N 70	960	2880	340	16200		
K 020	N 45	900	2700	320	4200	235	1.6
	N 50	1020	3060	360	7200		
	N 60	1140	3420	400	10000		
	N 70	1240	3720	430	21200		
K 025	N 45	1180	3540	360	5600	270	1.6
	N 50	1320	3960	400	9200		
	N 60	1460	4380	440	13600		
	N 70	1620	4860	490	27200		
K 030	N 45	1500	4500	450	7200	310	1.6
	N 50	1680	5040	500	12000		
	N 60	1860	5580	560	17600		
	N 70	2060	6180	620	35900		
K 035	N 45	1920	5760	580	9200	355	1.6
	N 50	2180	6540	650	15200		
	N 60	2420	7260	730	23400		
	N 70	2660	7980	800	45200		
K 040	N 45	2480	7440	740	12000	405	1.6
	N 50	2800	8400	840	19600		
	N 60	3100	9300	930	30000		
	N 70	3420	10260	1030	58200		
K 045	N 45	3360	10080	840	17000	480	1.6
	N 50	3780	11340	940	26600		
	N 60	4200	12600	1050	40800		
	N 70	4620	13860	1160	79000		

Dynamic torsional rigidity at 20 °C

Adm. temperature at the natural rubber surface between -40 to +90 °C

Size	Shore hardness A	Nominal torque T_{KN} [Nm]	Max. torque T_{Kmax} [Nm]	Adm. cont. altern. torque T_{KW} [Nm]	Dyn. torsional rigidity C_{Tdyn} [Nm/rad]	Adm. power loss P_{KV} [W]	Relative damping ψ
K 050	N 45	4340	13020	1080	21000	545	1.6
	N 50	4880	14640	1220	34200		
	N 60	5420	16260	1360	52000		
	N 70	5980	17940	1500	100000		
K 055	N 45	5980	17940	1500	29200	650	1.6
	N 50	6720	20160	1680	47200		
	N 60	7460	22380	1870	72800		
	N 70	8220	24660	2060	141000		
K 060	N 45	8800	26400	2200	42800	795	1.6
	N 50	9900	29700	2480	69400		
	N 60	11000	33000	2750	106000		
	N 70	12100	36300	3030	206800		
K 065	N 45	12600	37800	2520	62000	975	1.6
	N 50	14200	42600	2840	100000		
	N 60	15800	47400	3160	154000		
	N 70	17400	52200	3480	299000		
K 070	N 45	18200	54600	3640	88600	1180	1.6
	N 50	20400	61200	4080	143000		
	N 60	22800	68400	4560	220000		
	N 70	25000	75000	5000	426800		
K 075	N 45	24800	74400	4960	122000	1390	1.6
	N 50	28000	84000	5600	196000		
	N 60	31000	93000	6200	302000		
	N 70	34200	102600	6840	580000		
K 080	N 45	33800	101400	6760	164600	1640	1.6
	N 50	38000	114000	7600	266000		
	N 60	42200	126600	8440	410000		
	N 70	46400	139200	9280	794000		
K 085	N 45	47800	143400	9560	234000	1975	1.6
	N 50	53800	161400	10760	376000		
	N 60	59800	179400	11960	580000		
	N 70	65800	197400	13160	1124000		
K 090	N 45	66600	199800	13320	324000	2360	1.6
	N 50	75000	225000	15000	524000		
	N 60	83200	249600	16640	800000		
	N 70	91600	274800	18320	1566000		

Dynamic torsional rigidity at 20 °C

Adm. temperature at the natural rubber surface between -40 to +90 °C

Twin standard elastomer elements in parallel, preloaded, without friction damping

Coupling Series: BR 160, 161, 200, 210, 215, 220, 230, 240, 366, 371

Size	Shore hardness A	Nominal torque T_{KN} [Nm]	Max. torque T_{Kmax} [Nm]	Adm. cont. altern. torque T_{KN} [Nm]	Dyn. torsional rigidity T_{Kmax} [Nm]	Axial spring rigidity C_{ax} [N/mm]	Radial spring rigidity C_{rad} [Nm/mm]	Adm. power loss P_{KV} [W]	Relative damping ψ
K 005	N 45	360	1080	130	1900	4400	700	100	0.75
	N 50	400	1200	140	2800	6000	900		0.75
	N 60	440	1320	150	4200	7200	1300		0.95
	N 70	480	1440	170	8200	12000	2500		1.15
K 010	N 45	520	1560	180	2600	5200	800	130	0.75
	N 50	600	1800	210	4000	6800	1000		0.75
	N 60	660	1980	230	6000	8000	1400		0.95
	N 70	720	2160	250	12400	13600	2800		1.15
K 015	N 45	700	2100	240	3400	6000	900	150	0.75
	N 50	780	2340	270	5200	7600	1100		0.75
	N 60	860	2580	300	8000	8800	1600		0.95
	N 70	960	2880	340	16200	15600	3100		1.15
K 020	N 45	900	2700	320	4200	6800	1000	170	0.75
	N 50	1020	3060	360	7200	8800	1200		0.75
	N 60	1140	3420	400	10000	10000	1700		0.95
	N 70	1240	3720	430	21200	17600	3400		1.15
K 025	N 45	1180	3540	360	5600	7600	1100	200	0.75
	N 50	1320	3960	400	9200	10000	1300		0.75
	N 60	1460	4380	440	13600	11600	1900		0.95
	N 70	1620	4860	490	27200	20000	3600		1.15
K 030	N 45	1500	4500	450	7200	8400	1300	220	0.75
	N 50	1680	5040	500	12000	11600	1500		0.75
	N 60	1860	5580	560	17600	13200	2100		0.95
	N 70	2060	6180	620	35900	22400	4200		1.15
K 035	N 45	1920	5760	580	9200	9600	1500	250	0.75
	N 50	2180	6540	650	15200	13200	1700		0.75
	N 60	2420	7260	730	23400	15200	2500		0.95
	N 70	2660	7980	800	45200	25200	4800		1.15
K 040	N 45	2480	7440	740	12000	10800	1600	290	0.75
	N 50	2800	8400	840	19600	14000	1900		0.75
	N 60	3100	9300	930	30000	17600	2800		0.95
	N 70	3420	10260	1030	58200	28000	5300		1.15
K 045	N 45	3360	10080	840	17000	12000	1800	340	0.75
	N 50	3780	11340	940	26600	16000	2100		0.75
	N 60	4200	12600	1050	40800	20000	3000		0.95
	N 70	4620	13860	1160	79000	32000	5900		1.15

Dynamic torsional rigidity at 20 °C

Adm. temperature at the natural rubber surface between -40 to +90 °C

Size	Shore hardness A	Nominal torque T_{KN} [Nm]	Max. torque T_{Kmax} [Nm]	Adm. cont. altern. torque T_{KN} [Nm]	Dyn. torsional rigidity T_{Kmax} [Nm]	Axial spring rigidity C_{ax} [N/mm]	Radial spring rigidity C_{rad} [Nm/mm]	Adm. power loss P_{KV} [W]	Relative damping ψ
K 050	N 45	4340	13020	1080	21000	13200	2000	390	0.75
	N 50	4880	14640	1220	34200	18000	2300		0.75
	N 60	5420	16260	1360	52000	22400	3300		0.95
	N 70	5980	17940	1500	100000	36000	6400		1.15
K 055	N 45	5980	17940	1500	29200	14800	2200	460	0.75
	N 50	6720	20160	1680	47200	20000	2600		0.75
	N 60	7460	22380	1870	72800	25000	3800		0.95
	N 70	8220	24660	2060	141000	40000	7300		1.15
K 060	N 45	8800	26400	2200	42800	16400	2600	570	0.75
	N 50	9900	29700	2480	69400	22000	3000		0.75
	N 60	11000	33000	2750	106000	27600	4400		0.95
	N 70	12100	36300	3030	206800	44000	8400		1.15
K 065	N 45	12600	37800	2520	62000	19200	2900	690	0.75
	N 50	14200	42600	2840	100000	26000	3400		0.75
	N 60	15800	47400	3160	154000	32000	4900		0.95
	N 70	17400	52200	3480	299000	52000	9500		1.15
K 070	N 45	18200	54600	3640	88600	22000	3300	840	0.75
	N 50	20400	61200	4080	143000	30000	3900		0.75
	N 60	22800	68400	4560	220000	37600	5700		0.95
	N 70	25000	75000	5000	426800	60000	10900		1.15
K 075	N 45	24800	74400	4960	122000	25000	3800	980	0.75
	N 50	28000	84000	5600	196000	34000	4400		0.75
	N 60	31000	93000	6200	302000	43200	6400		0.95
	N 70	34200	102600	6840	580000	68000	12300		1.15
K 080	N 45	33800	101400	6760	164600	28000	4300	1160	0.75
	N 50	38000	114000	7600	266000	38000	5000		0.75
	N 60	42200	126600	8440	410000	49000	7300		0.95
	N 70	46400	139200	9280	794000	76000	14000		1.15
K 085	N 45	47800	143400	9560	234000	32000	5000	1390	0.75
	N 50	53800	161400	10760	376000	42000	5800		0.75
	N 60	59800	179400	11960	580000	54000	8400		0.95
	N 70	65800	197400	13160	1124000	84000	16400		1.15
K 090	N 45	66600	199800	13320	324000	36000	5800	1660	0.75
	N 50	75000	225000	15000	524000	48000	6800		0.75
	N 60	83200	249600	16640	800000	59000	8900		0.95
	N 70	91600	274800	18320	1566000	92000	19000		1.15

Dynamic torsional rigidity at 20 °C

Adm. temperature at the natural rubber surface between -40 to +90 °C

Twin standard elastomer elements in series, preloaded, without friction damping

Coupling Series: BR 159

Size	Shore hardness A	Nominal torque T_{KN} [Nm]	Max. torque T_{Kmax} [Nm]	Adm. cont. altern. torque T_{KW} [Nm]	Dyn. torsional rigidity C_{Tdyn} [Nm/rad]	Adm. power loss P_{KV} [W]	Relative damping ψ
K 005	N 45	180	540	65	475	100	0.75
	N 50	200	600	70	700		0.75
	N 60	220	660	75	1050		0.95
	N 70	240	720	85	2050		1.15
K 010	N 45	260	780	90	650	130	0.75
	N 50	300	900	105	1000		0.75
	N 60	330	990	115	1500		0.95
	N 70	360	1080	125	3100		1.15
K 015	N 45	350	1050	120	850	150	0.75
	N 50	390	1170	135	1300		0.75
	N 60	430	1290	150	2000		0.95
	N 70	480	1440	170	4050		1.15
K 020	N 45	450	1350	160	1050	170	0.75
	N 50	510	1530	180	1800		0.75
	N 60	570	1710	200	2500		0.95
	N 70	620	1860	215	5300		1.15
K 025	N 45	590	1770	180	1400	200	0.75
	N 50	660	1980	200	2300		0.75
	N 60	730	2190	220	3400		0.95
	N 70	810	2430	245	6800		1.15
K 030	N 45	750	2250	225	1800	220	0.75
	N 50	840	2520	250	3000		0.75
	N 60	930	2790	280	4400		0.95
	N 70	1030	3090	310	9000		1.15
K 035	N 45	960	2880	290	2300	250	0.75
	N 50	1090	3270	325	3800		0.75
	N 60	1210	3630	365	5850		0.95
	N 70	1330	3990	400	11300		1.15
K 040	N 45	1240	3720	370	3000	290	0.75
	N 50	1400	4200	420	4900		0.75
	N 60	1550	4650	465	7500		0.95
	N 70	1710	5130	515	14550		1.15
K 045	N 45	1680	5040	420	4250	340	0.75
	N 50	1890	5670	470	6650		0.75
	N 60	2100	6300	525	10200		0.95
	N 70	2310	6930	580	19750		1.15

Dynamic torsional rigidity at 20 °C

Adm. temperature at the natural rubber surface between -40 to +90 °C

Size	Shore hardness A	Nominal torque T_{KN} [Nm]	Max. torque T_{Kmax} [Nm]	Adm. cont. altern. torque T_{KW} [Nm]	Dyn. torsional rigidity C_{Tdyn} [Nm/rad]	Adm. power loss P_{KV} [W]	Relative damping ψ
K 050	N 45	2170	6510	540	5250	390	0.75
	N 50	2440	7320	610	8550		0.75
	N 60	2710	8130	680	13000		0.95
	N 70	2990	8970	750	25000		1.15
K 055	N 45	2990	8970	750	7300	460	0.75
	N 50	3360	10080	840	11800		0.75
	N 60	3730	11190	935	18200		0.95
	N 70	4110	12330	1030	35250		1.15
K 060	N 45	4400	13200	1100	10700	570	0.75
	N 50	4950	14850	1240	17350		0.75
	N 60	5500	16500	1375	26500		0.95
	N 70	6050	18150	1515	51700		1.15
K 065	N 45	6300	18900	1260	15500	690	0.75
	N 50	7100	21300	1420	25000		0.75
	N 60	7900	23700	1580	38500		0.95
	N 70	8700	26100	1740	74750		1.15
K 070	N 45	9100	27300	1820	22150	840	0.75
	N 50	10200	30600	2040	35750		0.75
	N 60	11400	34200	2280	55000		0.95
	N 70	12500	37500	2500	106700		1.15
K 075	N 45	12400	37200	2480	30500	980	0.75
	N 50	14000	42000	2800	49000		0.75
	N 60	15500	46500	3100	75500		0.95
	N 70	17100	51300	3420	145000		1.15
K 080	N 45	16900	50700	3380	41150	1160	0.75
	N 50	19000	57000	3800	66500		0.75
	N 60	21100	63300	4220	102500		0.95
	N 70	23200	69600	4640	198500		1.15
K 085	N 45	23900	71700	4780	58500	1390	0.75
	N 50	26900	80700	5380	94000		0.75
	N 60	29900	89700	5980	145000		0.95
	N 70	32900	98700	6580	281000		1.15
K 090	N 45	33300	99900	6660	81000	1660	0.75
	N 50	37500	112500	7500	131000		0.75
	N 60	41600	124800	8320	200000		0.95
	N 70	45800	137400	9160	391500		1.15

Dynamic torsional rigidity at 20 °C

Adm. temperature at the natural rubber surface between -40 to +90 °C

Two couplings in series with two parallel standard elastomer elements each, preloaded without friction damping

Coupling Series: BR 190

Size	Shore hardness A	Nominal torque T_{KN} [Nm]	Max. torque T_{Kmax} [Nm]	Adm. cont. altern. torque T_{KW} [Nm]	Dyn. torsional rigidity C_{Tdyn} [Nm/rad]	Adm. power loss P_{KV} [W]	Relative damping ψ
K 005	N 45	360	1080	130	950	200	0.75
	N 50	400	1200	140	1400		0.75
	N 60	440	1320	150	2100		0.95
	N 70	480	1440	170	4100		1.15
K 010	N 45	520	1560	180	1300	260	0.75
	N 50	600	1800	210	2000		0.75
	N 60	660	1980	230	3000		0.95
	N 70	720	2160	250	6200		1.15
K 015	N 45	700	2100	240	1700	300	0.75
	N 50	780	2340	270	2600		0.75
	N 60	860	2580	300	4000		0.95
	N 70	960	2880	340	8100		1.15
K 020	N 45	900	2700	320	2100	340	0.75
	N 50	1020	3060	360	3600		0.75
	N 60	1140	3420	400	5000		0.95
	N 70	1240	3720	430	10600		1.15
K 025	N 45	1180	3540	360	2800	400	0.75
	N 50	1320	3960	400	4600		0.75
	N 60	1460	4380	440	6800		0.95
	N 70	1620	4860	490	13600		1.15
K 030	N 45	1500	4500	450	3600	440	0.75
	N 50	1680	5040	500	6000		0.75
	N 60	1860	5580	560	8800		0.95
	N 70	2060	6180	620	17950		1.15
K 035	N 45	1920	5760	580	4600	500	0.75
	N 50	2180	6540	650	7600		0.75
	N 60	2420	7260	730	11700		0.95
	N 70	2660	7980	800	22600		1.15
K 040	N 45	2480	7440	740	6000	580	0.75
	N 50	2800	8400	840	9800		0.75
	N 60	3100	9300	930	15000		0.95
	N 70	3420	10260	1030	29100		1.15
K 045	N 45	3360	10080	840	8500	680	0.75
	N 50	3780	11340	940	13300		0.75
	N 60	4200	12600	1050	20400		0.95
	N 70	4620	13860	1160	39500		1.15

Dynamic torsional rigidity at 20 °C

Adm. temperature at the natural rubber surface between -40 to +90 °C

Size	Shore hardness	Nominal torque	Max. torque	Adm. cont. altern. torque	Dyn. torsional rigidity	Adm. power loss	Relative damping
	A	T_{KN} [Nm]	T_{Kmax} [Nm]	T_{KW} [Nm]	C_{Tdyn} [Nm/rad]	P_{KV} [W]	ψ
K 050	N 45	4340	13020	1080	10500	780	0.75
	N 50	4880	14640	1220	17100		0.75
	N 60	5420	16260	1360	26000		0.95
	N 70	5980	17940	1500	50000		1.15
K 055	N 45	5980	17940	1500	14600	920	0.75
	N 50	6720	20160	1680	23600		0.75
	N 60	7460	22380	1870	36400		0.95
	N 70	8220	24660	2060	70500		1.15
K 060	N 45	8800	26400	2200	21400	1140	0.75
	N 50	9900	29700	2480	34700		0.75
	N 60	11000	33000	2750	53000		0.95
	N 70	12100	36300	3030	103400		1.15
K 065	N 45	12600	37800	2520	31000	1380	0.75
	N 50	14200	42600	2840	50000		0.75
	N 60	15800	47400	3160	77000		0.95
	N 70	17400	52200	3480	149500		1.15
K 070	N 45	18200	54600	3640	44300	1680	0.75
	N 50	20400	61200	4080	71500		0.75
	N 60	22800	68400	4560	110000		0.95
	N 70	25000	75000	5000	213400		1.15
K 075	N 45	24800	74400	4960	61000	1960	0.75
	N 50	28000	84000	5600	98000		0.75
	N 60	31000	93000	6200	151000		0.95
	N 70	34200	102600	6840	290000		1.15
K 080	N 45	33800	101400	6760	82300	2320	0.75
	N 50	38000	114000	7600	133000		0.75
	N 60	42200	126600	8440	205000		0.95
	N 70	46400	139200	9280	397000		1.15
K 085	N 45	47800	143400	9560	117000	2780	0.75
	N 50	53800	161400	10760	188000		0.75
	N 60	59800	179400	11960	290000		0.95
	N 70	65800	197400	13160	562000		1.15
K 090	N 45	66600	199800	13320	162000	3320	0.75
	N 50	75000	225000	15000	262000		0.75
	N 60	83200	249600	16640	400000		0.95
	N 70	91600	274800	18320	783000		1.15

Dynamic torsional rigidity at 20 °C

Adm. temperature at the natural rubber surface between -40 to +90 °C

Disk couplings, no preload
Coupling Series: BR 311, 315, 316, 317, 318, 322

Size	Shore hardness A	Nominal torque T_{KN} [Nm]	Max. torque T_{Kmax} [Nm]	Adm. cont. altern. torque T_{KN} [Nm]	Dyn. spring rigidity T_{Kmax} [Nm]	Adm. power loss P_{KV} [W]	Relative damping ψ	Adm. speed n [min^{-1}]
1 Disk coupling element								
SK 400	N 50	400	1200	140	1600	65	0.75	4200
	N 60	500	1200	170	2400		0.9	
	N 70	500	1200	170	4500		1.15	
SK 630	N 50	630	1900	220	2500	90	0.75	3800
	N 60	800	1900	280	4000		0.9	
	N 70	800	1900	280	6800		1.15	
SK 1000	N 50	1000	3000	350	4600	120	0.75	3500
	N 60	1250	3000	440	6000		0.9	
	N 70	1250	3000	440	11000		1.15	
SK 1600	N 50	1600	4800	560	8000	160	0.75	2900
	N 60	2000	4800	700	9800		0.9	
	N 70	2000	4800	700	22500		1.15	
SK 2500	N 50	2500	7500	870	14600	210	0.75	2700
	N 60	3150	7500	1100	18800		0.9	
	N 70	3150	7500	1100	44200		1.15	
SK 4000	N 50	4000	12000	1400	23500	280	0.75	2500
	N 60	5000	12000	1700	32000		0.9	
	N 70	5000	12000	1700	86000		1.15	
SK 6300	N 50	6300	19000	2200	37000	360	0.75	2300
	N 60	8000	19000	2800	50000		0.9	
	N 70	8000	19000	2800	155000		1.15	
2 Disk coupling elements in parallel								
SK 4002	N 50	8000	24000	2800	47000	560	0.75	2500
	N 60	10000	24000	3400	64000		0.9	
	N 70	10000	24000	3400	172000		1.15	
SK 6302	N 50	12600	38000	4400	74000	720	0.75	2300
	N 60	16000	38000	5600	100000		0.9	
	N 70	16000	38000	5600	310000		1.15	

Dynamic torsional rigidity at 20 °C
Adm. temperature at the natural rubber surface between -40 to +90 °C

9 Maximum admissible speeds

Coupling Series	BR 151, 153, 160, 161, 190, 200, 210, 215, 220, 230, 240, 362.			BR 170, 171, 172, 173		BR 150, 152, 154, 155, 157, 158			BR 364, 366			BR 159
	Material											
Size	**GG 25**	**GGG 40**	**C 45**	**GG 25**	**GGG 40**	**GG 25**	**GGG 40**	**C 45**	**GG 25**	**GGG 40**	**C 45**	
005	4700	6700	9800	4700	5600	3000	3000	3000	4300	6100	9800	5600
010	4250	6050	8700	4250	4950	3000	3000	3000	3900	5550	8700	4950
015	4000	5700	8100	4000	4600	3000	3000	3000	3600	5200	8100	4600
020	3500	4950	7300	3500	4150	3000	3000	3000	3200	4500	7300	4150
025	3300	4650	6800	3300	3900	3000	3000	3000	3000	4300	6800	3900
030	2900	4200	6000	2900	3400	2900	3000	3000	2700	3900	6000	3400
035	2750	3900	5600	2750	3200	2750	3000	3000	2500	3600	5600	3200
040	2500	3500	5100	2500	2900	2500	3000	3000	2300	3300	5100	2900
045	2300	3300	4700	2300	2700	2300	3000	3000	2100	3000	4700	2700
050	2100	2900	4200	2100	2400	2100	2900	3000	1900	2700	4200	2400
055	1800	2600	3700	1800	2100	1800	2600	3000	1700	2400	3700	2100
060	1600	2300	3300	1600	1900	1600	2300	3000	1500	2200	3300	1900
065	1500	2100	2900	1500	1700	1500	2100	2900	1350	1900	2900	1700
070	1300	1900	2600	1300	1500	1300	1900	2600	1200	1700	2600	1500
075	1200	1700	2350	1200	1300	1200	1700	2350	1100	1600	2350	1300
080	1100	1500	2100	1100	1200	1100	1500	2100	1000	1400	2100	1200
085	1000	1400	1900	1000	1100	1000	1400	1900	900	1300	1900	1100
090	900	1200	1700	900	950	900	1200	1700	800	1100	1700	950

All speeds stated in min^{-1}.

Higher speeds can be achieved upon request, please contact Voith Turbo for further information.

10 Admissible shaft misalignments

Size	Maximum admissible radial misalignment during load peaks [mm]	Continuous admissible radial misalignment r at 600 min^{-1} [mm]	Continuous admissible axial misalignment [mm]	Continuous admissible angular misalignment at 600 min^{-1} [°]	
				BR 200, 210, 215, 220, 230, 240	**BR 190**
K 005	1.5	1.0	0.9	1	0.5
K 010	1.5	1.2	1.0	1	0.5
K 015	1.7	1.3	1.2	1	0.5
K 020	3.0	1.4	1.4	1	0.5
K 025	3.5	1.5	1.5	1	0.5
K 030	4.0	1.6	1.7	1	0.5
K 035	4.0	1.7	1.8	1	0.5
K 040	4.0	1.8	2.0	1	0.5
K 045	4.0	2.0	2.1	1	0.5
K 050	5.0	2.2	2.3	1	0.5
K 055	5.0	2.4	2.8	1	0.5
K 060	5.0	2.7	3.1	1	0.5
K 065	5.0	3.0	3.5	1	0.5
K 070	5.0	3.5	3.9	1	0.5
K 075	6.0	3.6	4.3	1	0.5
K 080	6.0	4.0	4.8	1	
K 085	6.0	4.4	5.3	1	
K 090	7.0	4.8	6.0	1	

- The recommended alignment tolerances are 10% of the stated admissible shaft misalignment.
- Radial displacement of couplings:

  The admissible radial displacements for couplings can be stated only with reference to one determined speed since any radial displacement causes additional thermal stress. The continuous displacement is stated for 600 min^{-1}; at higher speeds n_x,

  $r_{adm} = r \cdot \sqrt{\frac{600}{n_x}}$, n_x: max. speed

11 Questionnaire

Please complete the following questionnaire as detailed as possible, in order for a detailed design of a Voith Turbo Highly Flexible Coupling to be achieved.

Basic information

Customer enquiry no.:		
Name:		Date:
Company:		Department:
Street / P.O.B.:		
Postcode (zip):	Town:	
Country:		
Telephone:		Fax:
E-mail:		WWW:

Configuration

Remote mounted arrangement (Voith-Kuesel universal joint couplings)

Joint shaft manufacturer:		Size:	
Deflection angle vertical:	Degrees	Deflection angle horizontal:	Degrees
Mass moment of inertia:	kgm^2	Dynamic torsional rigidity of the shaft:	Nm/rad
Flange diameter:	mm	Bolt circle diameter:	mm
Centering diameter:	mm		
Centering, height:	mm	Centering, depth:	mm
Number of bores:		Bore diameter:	mm
Max. ambient temperature:	°C		

Joint shaft flange: ☐ DIN flange ☐ Löbro/CV ☐ Mechanics ☐ Spicer/SAE ☐ Others

Separate mounted arrangement (Universally flexible couplings)

Arrangement between:			and			
Expected misalignment:	axial	mm	radial	mm	angular	Degrees
Short-time load peaks:	axial	mm	radial	mm	angular	Degrees

Bell-house mounted arrangement (Blind assembly couplings)

Coupling installed inside bell-housing:	☐ yes	☐ no
Max. ambient temperature:	°C	

In case of installation inside bell-housing, please attach drawing illustrating the available space; else, state the connection dimensions (see "gears").

Prime mover (driving machine)

Manufacturer:		Model:	
Int. combustion engine		**Motor**	
☐ Diesel	☐ Gasoline	☐ Asynchronous	☐ Synchronous

Int. combustion engines

☐ 2-Stroke:	☐ 4-Stroke:	No. of cylinders:	
☐ In-line engine:	☐* V-engine:	* Included angle between cyl. banks:	Degrees
Rated power:	kW	Rated engine speed:	min^{-1}
Max. Power:	kW	Max. engine speed:	min^{-1}
Max. torque**:	Nm	** at speed:	min^{-1}
Idle speed:	min^{-1}	Ignition speed:	min^{-1}
Displacement:	Litres	Stroke length:	mm
Ignition intervals:	Degrees	Mass moment of inertia incl. flywheel: 1)	kgm^2

Dimensions of flywheel connection

Flywheel SAE size:			
Centering diameter:	mm	Bolt circle diameter:	mm
Number of bores:		Bore diameter:	mm

In case of narrow installation space and particular connection dimensions, please attach a drawing or sketch.

Dimensions of flywheel housing connection

Flywheel housing SAE size:			
Centering diameter:	mm	Bolt circle diameter:	mm
Number of bores:		Bore diameter:	mm

Motors

Asynchronous		**Synchronous**	
Rated power:	kW	Rated power:	kW
Rated speed:	min^{-1}	Synchronous speed:	min^{-1}
Stalling torque:	Nm	Starting torque:	Nm

Dimensions of the connection

Shaft diameter:	mm	Shaft length:	mm
Feather key dimensions:	x	mm	according to DIN 6885 sheet 1
Other dimensions:			

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1) Necessary for the resonance assessment

Driven machine (power consumer)

Manufacturer:	Model:

Category

☐ Mechanical gearbox	☐ Automatic transmission***	☐ with / ☐ without converter lockup ***	
☐ Generator	☐ Reciprocating pump	☐ Rotary pump	☐ Blower
☐ Power brake	Other		

Power data

Max. Power:	kW	Max. engine speed:	min^{-1}
Max. torque****:	Nm	****at speed:	min^{-1}
Mass moment of inertia:	kgm^2		

For marine propulsion

Number of propeller blades:	☐ Constant-pitch propeller	☐ Variable-pitch propeller	☐ Waterjet
Torsional rigidity of the shafting:	Nm/rad		

Please enclose drawing of the propeller shaft (length and diameter dimensions).

Mass moment of inertia:	Ahead: kgm^2	Astern: kgm^2	Neutral: kgm^2

Please enclose a scheme of the elastic system of masses.

For gearboxes

Description:

Transmission ratio:

Mass moment of inertia: kgm^2

Please enclose a scheme of the elastic system of masses.

For pumps/compressors

Alternating torque induced to the crankshaft:

Alternating torque +:	Nm	Alternating torque –:	Nm
Frequency:	Hz		

Dimensions of the connection

Flange diameter:	mm	Bolt circle diameter:	mm
Centering diameter:	mm		
Height:	mm	Depth:	mm
Number of bores:		Bore diameter:	mm
Shaft diameter:	mm	Shaft length:	mm

Feather key dimensions: x mm according to DIN 6885 sheet 1

Other dimensions:

12 Technical services

The design of drive chains subject to torsional vibration requires many years of experience, especially for diesel engine applications. Voith Turbo provides its customers with this experience in the form of extensive design and operating services. These are in particular:

- Torsional Vibration Analysis/Calculations (TVA/TVC):
  We offer the dynamic consideration of complete drive chains in the time and frequency area (e.g. during startup and shutdown, rated operation, idling, acceleration/deceleration, short circuit etc.).
- Torsional Vibration Measurements (TVM):
  We offer measurements of complete drive chains, i.e. the measurement of torsional torques, angles of twist and temperatures directly on site.
- Determination of load spectrums:
  Based on the results of torsional vibration measurements, we offer to determine application-specific load spectrums.
  Using these load spectrums, it is possible to dimension the coupling lifetime precisely and specifically.
- Repair:
  We offer fast, expert and cost-efficient repair of coupling systems, restoring to an as-new condition.
- Service by field fitters:
  We offer to send you specialised mechanics for any commissioning work or other service work.

13 Certification

ZERTIFIKAT

We are committed to the application of an effective quality management system. Accordingly, we are certified according to DIN ISO 9001.

If desired, we can certify Voith Turbo Highly Flexible Couplings according to guideline 94/9/EG (ATEX 100a).

14 Marine classification societies

We offer to have our coupling designs approved, among others, by the following classification societies:

BV

Bureau Veritas,
France

GL

Germanischer Lloyd,
Germany

LRoS

Lloyds Register
of Shipping,
United Kingdom

ABS

American Bureau of
Shipping, USA

DNV

Det Norske Veritas,
Norway

RINA

Registro Italiano
Navale, Italy

KRoS

Korean Register
of Shipping,
Republic Korea

Other classification societies upon request.

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