

FLENDER COUPLINGS



- A 40-slide technical guide based on FLENDER Standard Couplings | Introduction (FLE 10)
- Coupling families • product series • selection • application factors • installation
- Prepared for MECHATRIC | Engineering knowledge presentation

FLENDER STANDARD COUPLINGS | INTRODUCTION

OUR COUPLING GROUPS AT A GLANCE

E

N-EUPEX, RUPEX and N-BIPEX
Flexible Couplings

Flexible Flender couplings have a wide range of possible applications. A broad standard modular system as well as specially designed application-specific couplings are available.

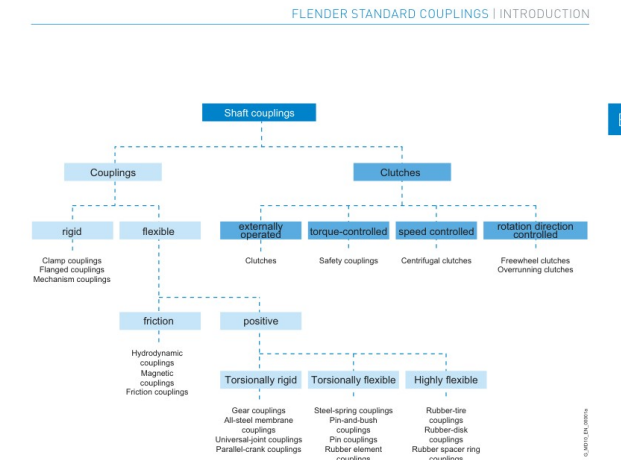
ELPEX, ELPEX-B and ELPEX-S
Highly Flexible Couplings

ELPEX® couplings are free of circumferential back-lash. Their damping capacity and low torsional stiffness make them especially well-suited for coupling machines with strongly non-uniform torque characteristics or large shaft misalignment.

 N-EUPEX cam couplings Rated torque: 19 Nm ... 85,000 Nm	 ELPEX elastic ring couplings Rated torque: 1,600 Nm ... 90,000 Nm
 RUPEX pin-and-bush couplings Rated torque: 200 Nm ... 1,690,000 Nm	 ELPEX-B elastic tire couplings Rated torque: 24 Nm ... 34,500 Nm
 N-BIPEX cam couplings Rated torque: 12 Nm ... 4,500 Nm	 ELPEX-S rubber disk couplings Rated torque: 330 Nm ... 63,000 Nm

E/6 FLENDER

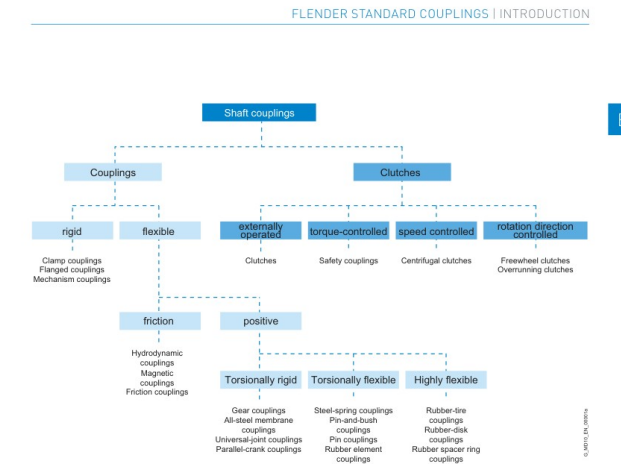
- Drive-train fundamentals and coupling functions
- Classification and FLENDER product portfolio
- Misalignment, balancing, shaft-hub connections
- Engineering selection, examples and verification



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- Typical architecture: motor → coupling → gear unit → coupling → driven machine
 - Couplings connect rotating assemblies and transmit torque and speed
 - Selection depends on the machine and the operating conditions
 - Couplings can incorporate brake disks, brake drums or speed pickup features

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- Transmit rotary motion and rated torque
 - Accommodate shaft displacement while controlling restoring loads
 - Influence torsional vibration and damping
 - Provide electrical/noise isolation or torque interruption when designed for it

- Main distinction: couplings versus clutches
- Couplings: rigid or flexible; flexible designs may be frictional or positive
- Positive flexible types: torsionally rigid, flexible and highly flexible
- Clutches: externally operated, safety, centrifugal and overrunning types



- High torsional stiffness with compensation for axial/radial displacement
- Examples: gear couplings and all-steel membrane couplings
- Torque is transmitted with little angular phase shift
- Selection must check torque, speed, misalignment and geometry

FLENDER STANDARD COUPLINGS | INTRODUCTION

FLUDEX
Hydrodynamic couplings

The FLUDEX hydrodynamic fluid coupling works according to the Föttinger principle. It functions entirely free of wear.

FLUDEX
fluid Couplings
Power:
1,2 kW ... 2,500 kW

Application-specific couplings

Couplings for rail vehicles must meet high demands. Due to their high degree of standardization and wide variety, they can be used in the most diverse vehicle types.

Railway coupling
Rated torque:
1,000 Nm ... 9,500 Nm

Each wind turbine coupling is designed to optimally meet the requirements of the respective wind turbine. The coupling connects the fast-running gear shaft with the generator shaft and is available for wind turbines with a capacity of up to 12 MW.

Wind turbine couplings
Rated torque:
10,000 Nm ... 60,000 Nm

ZAPEX gear couplings and ARPEX all-steel couplings
Torsionally rigid couplings

For transmission of high torques, we offer both ARPEX all-steel couplings and ZAPEX gear couplings in a range of versions. Their purposes of application vary according to specific requirements with respect to shaft misalignment, temperature and torque.

ZAPEX
gear couplings
Rated torque:
1,300 Nm ... 7,200,000 Nm

ARPEX
high Performance Couplings
Rated torque:
1,000 Nm ... 588,500 Nm

N-ARPEX and ARPEX
all-steel couplings
Rated torque:
92 Nm ... 2,000,000 Nm

BIPEX-S and SIPEX
Backlash-free couplings

The vibration-damping, electrically insulating plug-in BIPEX-S elastomer couplings and SIPEX metal bellows couplings with very high torsional stiffness deliver especially isogonal torque transmission.

BIPEX-S and SIPEX
Rated torque:
0.1 Nm ... 5,000 Nm

FLENDER E/7

- Elastomer elements provide torsional compliance and damping
- Element stiffness and material influence dynamic response
- Typical examples: cam and pin-and-bush couplings
- Misalignment is accommodated through deformation of the flexible element

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ELPEX
elastic ring couplings
Rated torque:
1,600 Nm ... 90,000 Nm



ELPEX-B
elastic tire couplings
Rated torque:
24 Nm ... 14,500 Nm



ELPEX-S
rubber disk couplings
Rated torque:
330 Nm ... 43,000 Nm

E/6 FLENDER

- Large-volume elastomer elements with low torsional stiffness
- Suited to irregular torque and applications needing greater damping
- FLENDER ELPEX, ELPEX-B and ELPEX-S families
- Always verify application-specific temperature and load factors

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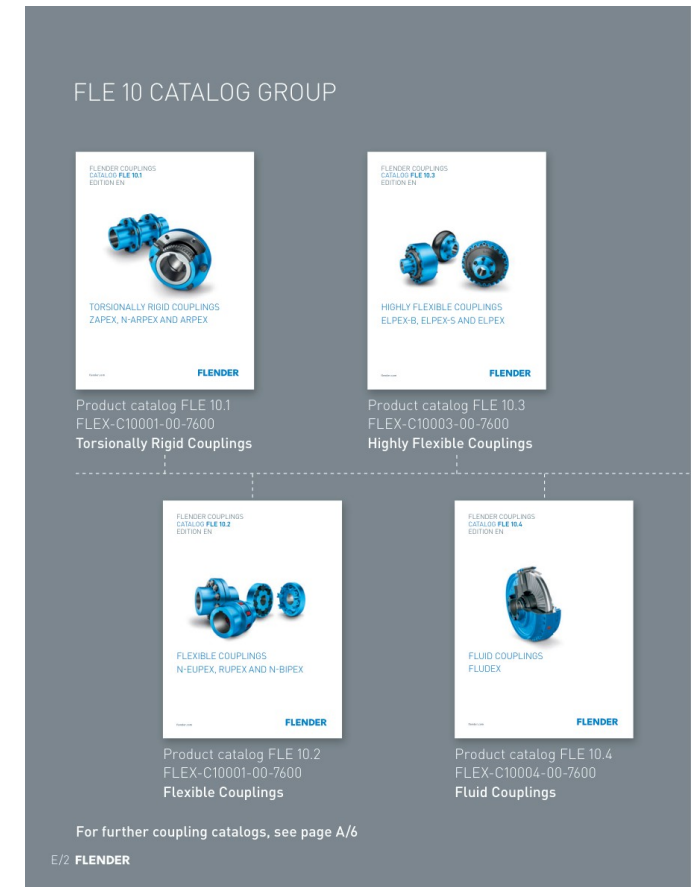
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E/6 FLENDER

- FLE 10.1: ZAPEX, N-ARPEX, ARPEX — torsionally rigid
- FLE 10.2: N-EUPEX, RUPEX, N-BIPEX — flexible
- FLE 10.3: ELPEX-B, ELPEX-S, ELPEX — highly flexible
- FLE 10.4: FLUDEX — hydrodynamic; FLE 10.5–10.7: specialty groups



- Torsionally flexible cam coupling with elastomeric elements
- Broad standard modular range for industrial machinery
- Introduction catalog rated torque overview: 19–85,000 Nm
- Check exact design, service factor, temperature and maximum speed

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E/6 FLENDER

- Flexible coupling using resilient pin-and-bush elements
- Used across general industrial power transmission
- Introduction catalog overview: 200–1,690,000 Nm
- Single-joint misalignment example provided in catalog: RWN 198 at 1,500 rpm

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E/6 FLENDER

- Compact torsionally flexible cam-type coupling
- Catalog overview rated torque: 12–4,650 Nm
- Elastomer selection affects damping and operating temperature
- Verify size-specific bore, torque and alignment limits

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Rated torque:
330 Nm ... 43,000 Nm

E/6 FLENDER

- Highly flexible elastomer-ring design
- Damping and low torsional stiffness for nonuniform torque
- Catalog overview rated torque: 1,600–90,000 Nm
- Assess torsional vibration, element temperature and service duty

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Rated torque:
330 Nm ... 43,000 Nm

E/6 FLENDER

- Highly flexible tire-type elastomer element
- Catalog overview rated torque: 24–14,500 Nm
- Accommodates drive-train movement within design limits
- Non-fail-safe overload behavior in the source classification

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Rated torque:
330 Nm ... 43,000 Nm

E/6 FLENDER

- Highly flexible rubber-disk design
- Catalog overview rated torque: 330–63,000 Nm
- Relevant for vibration-sensitive and irregular-load drives
- Check rubber grade, operating temperature and overload protection

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E/6 FLENDER

- Torsionally rigid gear coupling for high torque transmission
- Catalog overview rated torque: 1,300–7,200,000 Nm
- Gear design accommodates displacement subject to series limits
- Lubrication, inspection and application geometry require review

FLENDER STANDARD COUPLINGS | INTRODUCTION

ZAPEX gear couplings and ARPEX all-steel couplings
Torsionally rigid couplings
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ZAPEX gear couplings
 Rated torque: 1,300 Nm ... 7,200,000 Nm

ARPEX high Performance Couplings
 Rated torque: 1,000 Nm ... 588,500 Nm

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 Rated torque: 92 Nm ... 2,000,000 Nm

BIPEX-S and SIPEX
Backlash-free couplings
 The vibration-damping, electrically insulating plug-in BIPEX-S elastomer couplings and SIPEX metal bellows couplings with very high torsional stiffness deliver especially isogonal torque transmission.

BIPEX-S and SIPEX
 Rated torque: 0.1 Nm ... 5,000 Nm

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FLUDEX fluid Couplings
 Power: 1.2 kW ... 2,500 kW

Application-specific couplings
 Couplings for rail vehicles must meet high demands. Due to their high degree of standardization and wide variety, they can be used in the most diverse vehicle types.

Railway coupling
 Rated torque: 1,000 Nm ... 9,500 Nm

Each wind turbine coupling is designed to optimally meet the requirements of the respective wind turbine. The coupling connects the fast-running gear shaft with the generator shaft and is available for wind turbines with a capacity of up to 12 MW.

Wind turbine couplings
 Rated torque: 10,000 Nm ... 60,000 Nm

FLENDER E/7

- Torsionally rigid metallic flexible-element coupling
- Catalog overview N-ARPEX / ARPEX range: 92–2,000,000 Nm
- Selection depends on torque, speed, shaft spacing and temperature
- Two-joint arrangements use adapter length for radial offset capability

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FLENDER E/7

- All-steel torsionally rigid coupling family
- Special variants for high-performance and safety applications
- Standard balance-quality behavior is described separately in the catalog
- Use product-specific catalogs for final model selection

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FLENDER E/7

- Transmits torque using a fluid-filled hydrodynamic circuit
- Catalog power overview: 1.2–2,500 kW
- Enables motor acceleration before the driven machine accelerates
- Does not itself compensate shaft misalignment: use another suitable connection

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FLENDER E/7

- BIPEX-S: elastomer coupling with vibration damping and insulation
- SIPEX: metal-bellows coupling with high torsional stiffness
- Combined catalog overview: 0.1–5,000 Nm
- Selection must confirm torsional behavior and dimensional compatibility

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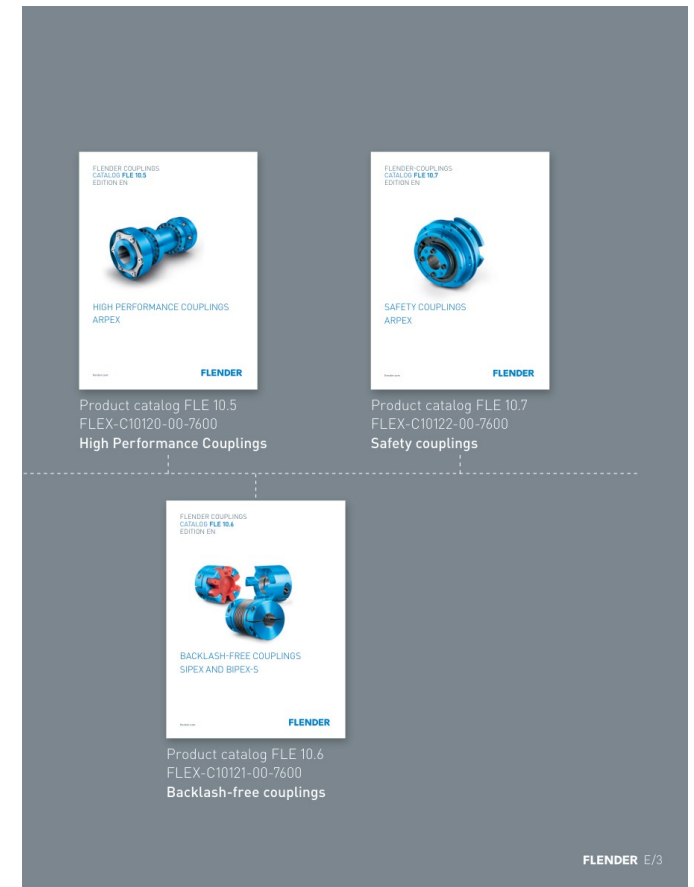
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FLENDER E/7

- FLE 10.5: high-performance ARPEX
- FLE 10.7: safety ARPEX
- Special variants serve demanding drive-train requirements
- Performance and protection features are configuration-dependent



- Railway couplings: catalog overview 1,000–9,500 Nm
- Wind-turbine couplings: catalog overview 10,000–60,000 Nm
- Wind turbine coupling connects high-speed gear shaft to generator
- Final design is application- and machine-specific

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FLENDER E/7

- Axial displacement ΔK_a : change along shaft axis
- Radial offset ΔK_r : parallel centerlines with lateral displacement
- Angular offset ΔK_w : intersecting centerlines at an angle
- Thermal expansion, foundations and installation affect alignment

TECHNICAL INFORMATION

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Shaft misalignment

Shaft misalignment is the result of displacement during assembly and operation and, where machines constructed with two radial bearings each are rigidly coupled, will cause high loads being placed on the bearings. Elastic deformation of base frame, foundation and machine housing will lead to shaft misalignment which cannot be prevented, even by precise alignment.

Furthermore, because individual components of the drive train heat up differently during operation, heat expansion of the machine housings causes shaft misalignment. Poorly aligned drives are often the cause of seal, rolling bearing or coupling failure. Alignment should be carried out by specialist personnel in accordance with operating instructions.

Depending on the direction of the effective shaft misalignment a distinction is made between:



Q1, 30070, 3X, 00002
Axial misalignment



Q1, 30070, 3X, 00003
Radial misalignment



Q1, 30070, 3X, 00004
Angular misalignment

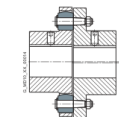
Couplings can be categorized into one of the following groups:

Single-joint couplings

Couplings with flexible elements mainly made of elastomer materials. Shaft misalignment results in deformation of the elastomer elements. The elastomer elements can absorb shaft misalignment as deformations in an axial, radial and angular direction. The degree of permissible misalignment depends on the coupling size, the speed and the type of elastomer element. Single-joint couplings do not require an adapter and are therefore short versions.

Example:

In the case of a RUPLEX RWN 198 coupling with an outer diameter of 198 mm and a speed of 1500 rpm, the permitted radial misalignment is $\Delta K_r = 0.3$ mm.



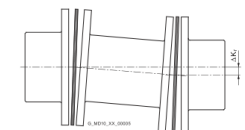
Q1, 30070, 3X, 00005

Two-joint couplings

Two-joint couplings are always designed with an adapter. The two joint levels are able to absorb axial and angular misalignment. Radial misalignment occurs via the gap between the two joint levels and the angular displacement of the joint levels. The permitted angular misalignment per joint level is frequently about 0.5° . The permitted shaft misalignment of the coupling can be adjusted via the length of the adapter. If there are more than two joint levels, it is not possible to define the position of the coupling parts relative to the axis of rotation. (The less frequently used parallel-crank couplings are an exception).

Example:

N-ARPEX ARN-6 NEN 217-6 with a shaft distance of 140 mm with a permitted radial misalignment of $\Delta K_r = 2.2$ mm (angle per joint level 1.0°).



Q1, 30070, 3X, 00006

- Single-joint designs typically accommodate displacement through one element
- Two-joint designs use an adapter between two joint levels
- Adapter length influences permissible radial offset
- Catalog example: N-ARPEX NEN arrangement, 140 mm shaft distance, $\Delta K_r = 2.2$ mm

FLENDER STANDARD COUPLINGS | INTRODUCTION

TECHNICAL INFORMATION

E Shaft misalignment

Shaft misalignment is the result of displacement during assembly and operation and, where machines constructed with two radial bearings each are rigidly coupled, will cause high loads being placed on the bearings. Elastic deformation of base frame, foundation and machine housing will lead to shaft misalignment which cannot be prevented, even by precise alignment.

Furthermore, because individual components of the drive train heat up differently during operation, heat expansion of the machine housings causes shaft misalignment. Poorly aligned drives are often the cause of seal, rolling bearing or coupling failure. Alignment should be carried out by specialist personnel in accordance with operating instructions.

Depending on the direction of the effective shaft misalignment a distinction is made between:



Axial misalignment



Radial misalignment



Angular misalignment

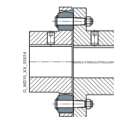
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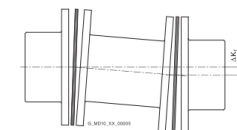


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Example:

N-ARPEX ARN-6 NEN 217-6 with a shaft distance of 140 mm with a permitted radial misalignment of $\Delta K_r = 2.2$ mm (angle per joint level 1.0°).



- Balance quality G is related to allowable residual eccentricity
- Catalog notes G 16 often sufficient; G 6.3 for vibration-sensitive drives
- Higher precision is application-dependent, not universally necessary
- DIN ISO 21940 and parallel-key conventions are cited in the source

Balancing

Balance quality levels

The so-called quality level G to DIN ISO 21940 indicates a range of permitted residual imbalance from zero up to an upper limit. Applications can be grouped on the basis of similarity analysis. For many applications a coupling balance quality of G 16 is sufficient. On drives susceptible to vibration the balance quality should be G 6.3. Only in special cases is a better balance quality required.

Balancing standard in accordance with DIN ISO 21940-32
Besides the required balance quality, it is necessary to set standards which define how the mass of the parallel key is to be taken into consideration when balancing. In the past, motor rotors have frequently been balanced in accordance with the full parallel key standard. The "appropriate" balance condition of the coupling hub was described as "balancing with open keyway" or "balancing after keyseating". Today it is usual for the motor rotor, as well as the gear unit and driven machine shaft, to be balanced in accordance with the half parallel key standard.

Full parallel key standard

The parallel key is inserted in the shaft keyway, then balancing is carried out. The coupling hub must be balanced without parallel key after keyseating.

Marking of shaft and hub with "F" (for "full").

Half parallel key standard

The balancing standard normally applied today. Before balancing, a half parallel key is inserted in the shaft and another in the coupling hub. Alternatively, balancing can be carried out before cutting the keyway.

The balanced parts must be marked with an "H". This marking can be dispensed with if it is absolutely clear which parallel key standard has been applied.

No parallel key standard

Balancing of shaft and coupling hub after keyseating, but without parallel key. Not used in practice. Marking of shaft and hub with "N" (for "no"). The length of the parallel key is determined by the shaft keyway. Coupling hubs may be designed considerably shorter than the shaft.

To prevent imbalance forces caused by projecting parallel key factors when balancing in accordance with the half parallel key standard in the case of applications with high balancing quality requirements, grooved spacer rings can be fitted or stepped parallel keys used.

Flender Balancing Standard

The balancing quality level, together with the operating speed, results in the maximum permissible eccentricity of the center of gravity of the coupling or the coupling subassembly. In the Flender article number the balancing quality can be preset with the help of the order code. Additionally, also the balance quality level to DIN ISO 21940 can be preset together with the operating speed belonging to it, which then be taken as priority.

Eccentricity of center of gravity of coupling e_{coupl}	Flender balancing quality	Order code
maximum 100 μm	standard balancing	without specification
maximum 40 μm	fine balancing	WB2
maximum 16 μm	micro-balancing	WB3
better than 16 μm	special balancing	on request

$$e_{\text{perm}} = 9550 \frac{G}{n}$$

$$e_{\text{coupl}} \leq e_{\text{perm}}$$

Permitted eccentricity of center of gravity	e_{perm}	in μm
Eccentricity of center of gravity of coupling	e_{coupl}	in μm
Balancing quality level	G	in mm/s
Coupling speed	n	in rpm

- Standard balancing: maximum 100 µm eccentricity
- Fine balancing: maximum 40 µm; order code W02
- Micro-balancing: maximum 16 µm; order code W03
- Better than 16 µm: special balancing on request

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Permitted eccentricity of center of gravity	e_{perm}	in µm
Eccentricity of center of gravity of coupling	e_{coupl}	in µm
Balancing quality level	G	in mm/s
Coupling speed	n	in rpm

- Half parallel key is the normal balancing convention
- Full key and no-key conventions require explicit consideration
- Catalog uses H, F and N designations for key standards
- Mismatch between rotor and hub conventions can introduce imbalance

Balancing

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Permitted eccentricity of center of gravity	e_{perm}	in μm
Eccentricity of center of gravity of coupling	e_{coupl}	in μm
Balancing quality level	G	in mm/s
Coupling speed	n	in rpm

-
- Parallel keys and cylindrical finished bores are common
 - Alternatives: taper clamping bushes, shrink fits, splines
 - Hub torque capability is not automatically equal to catalog coupling rating
 - Check axial retention, shaft geometry and connection stress

-
- DIN 740 and VDI 2240 for coupling engineering context
 - API 610 / ISO 13709 and API 671 / ISO 10441 appear in source references
 - DIN ISO 21940 and ISO 21940-32 for balancing/key conventions
 - Standards cited do not mean every coupling model is certified compliant

- Define drive-train layout, driving machine and driven machine
- Identify torque range, speed, torsional behavior and temperature
- Choose rigid, flexible, highly flexible or hydrodynamic family
- Then select series, size and mounting arrangement

FLENDER STANDARD COUPLINGS | INTRODUCTION

SELECTION OF THE COUPLING SERIES

E

The coupling series is frequently determined by the driven machine and the design of the drive train. Common selection criteria are listed below and assigned to coupling properties, which are used to select the coupling series. Additionally, the price of the coupling and availability are important criteria for determining the coupling series to be used.

The **FLUDEX** series operates positively and transmits the torque with the aid of a flowing oil or water filling.

FLUDEX couplings are used to reduce starting and/or overload torques. During starting, the motor may, for example, run up within a very short time, because of the FLUDEX coupling, the drive train with the driven machine may accelerate after a delay and without increased torque load.

The FLUDEX coupling cannot compensate for shaft misalignment and is therefore designed in combination with a displacement coupling, a cardan shaft or a belt drive. The displacement coupling may be selected in accordance with the criteria described below.

Selection criteria		Torque range Rated coupling torque T_{RN}	Speed range Peripheral speed $v_{\text{DM}} = \pi \cdot d_{\text{DM}} \cdot n_{\text{DM}} / 60$	Torsional stiffness torsionally rigid	Torsionally flexible	Highly flexible	Operating temperature range
ZAPEX	800 ... 720000 Nm	40 m/s	■	—	—	—	-20 ... +80 °C
N-ARPEX	350 ... 200000 Nm	110 m/s	■	—	—	—	-50 ... +280 °C
ARPEX	92 ... 200000 Nm	100 m/s	■	—	—	—	-40 ... +280 °C
N-EUPEX	12 ... 93500 Nm	36 m/s	—	■	—	—	-50 ... +100 °C
N-EUPEX DS	19 ... 21200 Nm	36 m/s	—	■	—	—	-30 ... +80 °C
RUPEX	200 ... 130000 Nm	60 m/s	—	■	—	—	-60 ... +100 °C
N-BIPEX	12 ... 4450 Nm	65 m/s	—	■	—	—	-50 ... +100 °C
ELPEX-B	24 ... 14500 Nm	35 m/s	—	—	—	■	-50 ... +70 °C
ELPEX-S	330 ... 63000 Nm	66 m/s	—	—	—	■	-40 ... +120 °C
ELPEX	1600 ... 90000 Nm	60 m/s	—	—	—	■	-40 ... +80 °C

E/16 FLENDER

- ZAPEX, N-ARPEX and ARPEX: torsionally rigid
- N-EUPEX, RUPEX, N-BIPEX: torsionally flexible
- ELPEX, ELPEX-B, ELPEX-S: highly flexible
- Use source table on E/16 for series ranges and temperature limits

FLENDER STANDARD COUPLINGS | INTRODUCTION

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ELPEX-B	24 ... 14500 Nm	35 m/s	–	–	■	–50 ... +70 °C
ELPEX-S	330 ... 63000 Nm	66 m/s	–	–	■	–40 ... +120 °C
ELPEX	1400 ... 90000 Nm	40 m/s	–	–	■	–40 ... +80 °C

E/16 FLENDER

- Rated torque: $T_N \text{ [Nm]} = 9550 \times P_N \text{ [kW]} / n_N \text{ [rpm]}$
- Example: 250 kW at 1,500 rpm $\rightarrow T_N \approx 1,592 \text{ Nm}$
- Nominal torque is only the starting point of sizing
- Apply service and temperature factors as required by series

SELECTION OF THE COUPLING SIZE

E

The torque load of the coupling must be determined from the output of the driven machine and the coupling speed.

Rated coupling load $T_N = 9550 \times P_N / n_N$
(T_N in Nm; P_N in kW; n_N in rpm)

The rated coupling load obtained in this way must be multiplied by factors and compared with the rated coupling torque. An ideal but expensive method is to measure the torque characteristic on the coupling. For this, Flender offers special adapters fitted with torque measuring devices.

The rated coupling torque T_{RN} is the torque which can be transmitted by the coupling over an appropriate period of use if the load is applied to the coupling purely statically at room temperature.

Application factors are to express the deviation of the real coupling load from the "ideal" load condition.

Coupling load in continuous operation

The operating principles of the driving and driven machines are divided into categories and the application factor FB derived from these in accordance with DIN 3990-1.

Application factor for N-EUPEX, N-EUPEX-DS, RUPEX, N-BIPEX, ELPEX-B, N-ARPEX, ARPEX, ZAPEX and FLUDEX

Torque characteristic of the driving machine	Torque characteristic of the driven machine			
	uniform	uniform with moderate shock loads	non uniform	very rough
uniform	1.0	1.25	1.5	1.75
uniform with moderate shock loads	1.25	1.5	1.75	2.0
non uniform	1.5	1.75	2.0	2.5

Examples of torque characteristic of driving machines:

- uniform: Electric motors with soft starting, steam turbines
- uniform with moderate shock loads: Electric motors without soft starting, hydraulic motors, gas and water turbines
- non uniform: Internal-combustion engines

Examples of torque characteristic in driven machines:

- uniform: Generators, centrifugal pumps for light fluids
- uniform with moderate shock loads: Centrifugal pumps for viscous fluids, elevators, machine tool drives, centrifuges, extruders, blowers, crane drives
- non uniform: Excavators, kneaders, conveyor systems, presses, mills
- very rough: Crushers, excavators, shredders, iron/smelter machinery

- Service factor FB represents real duty relative to idealized loading
- Examples from source: centrifugal pump 1.0; belt conveyor 1.5
- Cement crusher 1.75; cement ball mill 1.75
- Use application table as guidance; project rules and experience take priority

Typical coupling solutions for different example applications

The specified application factors are recommendations; regulations, rules and practical experience take priority as assessment criteria.
No application factor need be taken into account with FLUDEX couplings.

In the case of highly flexible couplings of the ELPEX, ELPEX-S and ELPEX-B series, deviating application factors are stated in the product descriptions.
FLUDEX couplings are mostly mounted on the high-speed gear shaft.

Example applications	Application factor FB	Example applications	Application factor FB	Example applications	Application factor FB
Electric motor without gear unit		Compressed air, screw-type compressors	1.25	Woodworking - reciprocating saws	1.5
Centrifugal pumps	1.0	Air - Blowers	1.5	Grinding machines	1.5
Piston pumps	1.5	Air - Cooling tower fans	1.5	Textile machines - winders	1.5
Vacuum pumps	1.5	Air - Turbine blowers	1.5	Textile machines - printing machines	1.5
Fans with T_L less than 75 Nm	1.5	Generators, converters	1.25	Textile machines - tanning vats	1.5
Fans with T_L from 75 to 750 Nm	1.75	Welding generators	1.25	Textile machines - shrewlers	1.5
Fans with T_L larger than 750 Nm	1.75			Textile machines - looms	1.5
Blowers	1.5	Metal production, iron and steel works		Packaging machines	1.5
Frequency converters / generators	1.25	Plate fillers	1.5	Brick molding machines	1.75
Reciprocating compressors	1.75	Ingot pushers	1.75	Transport and logistics	
Screw-type compressors	1.5	Slabbing mill	1.75	Passenger transport - elevators	1.5
Internal-combustion engine without gear unit		Cooling machines	1.5	Passenger transport - escalators	1.5
Generators	1.75	Roller straightening machines	1.5	Conveyor systems - bucket elevators	1.5
Pumps	1.5	Roller tables	1.75	Conveyor systems - hauling winches	1.5
Fans	1.75	Shears	1.75	Conveyor systems - belt conveyors	1.5
Hydraulic pumps, excavators, construction machines	1.5	Rollers	1.75	Conveyor systems - endless-chain conveyors	1.5
Compressors / screw-type compressors	1.5	Metal working machines		Conveyor systems - circular conveyors	1.5
Agricultural machinery	1.75	Plate bending machines	1.5	Conveyor systems - screw conveyors	1.5
Other		Plate straightening machines	1.5	Conveyor systems - inclined hoists	1.5
Turbine gear units	1.5	Hammers	1.75	Crane travelling gear	1.5
Electric motor with gear unit		Planing machines	1.75	Hoisting gear	1.5
Chemical industry		Presses, forging presses	1.75	Crane lifting gear	2.0
Extruders	1.5	Shears	1.5	Crane travelling gear	1.5
Pumps - centrifugal pumps	1.0	Grinding machines	1.25	Crane sawing gear	1.5
Pumps - piston pumps	1.75	Punches	1.5	Crane fly jib hoists	1.5
Pumps - plunger pumps	1.5	Machine tools: Main drives	1.5	Cable railways	1.5
Reciprocating compressors	1.75	Machine tools: Auxiliary drives	1.25	Drag lifts	1.5
Calenders	1.5	Food industry		Winches	1.5
Kneaders	1.75	Filling machines	1.25	Cellulose and paper	
Cooling drums	1.25	Kneading machines	1.5	Paper-making machines, all	1.5
Mixers	1.25	Mashers	1.5	Pulper drives	1.5
Stemmers	1.25	Sugar cane production	1.5	Cement industry	
Toasters	1.25	Production machines		Crushers	1.75
Drying drums	1.25	Construction machines	1.25	Rotary furnaces	1.5
Centrifuges	1.25	Construction machines, traversing gears	1.5	Hammer mills	1.75
Crushers	1.5	Construction machines, suction pumps	1.5	Ball mills	1.75
Power generation and conversion		Construction machines, concrete mixers	1.5	Pug mills	1.75
Compressed air, reciprocating compressors	1.75	Printing machines	1.25	Mixers	1.5
		Woodworking - barking drums	1.5	Pipe mills	1.5
		Woodworking - planing machines	1.5	Beater mills	1.75
				Separators	1.5
				Roller presses	1.75

- Catalog criterion: $TKN \geq TN \times FB \times FT$
- FT accounts for elastomer temperature behavior when applicable
- For ARPEX and ZAPEX source indicates $FT = 1.0$
- Always verify against the selected series technical data

Coupling		Elastomer material		Low temperature		Temperature T_a on the coupling		up to		up to		up to		up to		up to	
				°C		under		-20 °C		-20 °C		up to		up to		up to	
N-EUPEX	NR	NBR		-30		1.0		1.0		1.0		1.0		1.0		1.0	
N-EUPEX	NR	NR		-50		1.1 ¹⁾		1.0		1.0		1.0		1.0		1.0	
N-EUPEX	HNBR	HNBR		-10		1.0		1.0		1.0		1.0		1.25		1.25	
N-EUPEX	TPU	TPU		-50		1.0		1.0		1.05		1.10		1.15		1.15	
N-EUPEX DS	NR	NBR		-30		1.0		1.0		1.0		1.0		1.0		1.0	
RUPEX	NR	NBR		-30		1.0		1.0		1.0		1.0		1.0		1.0	
RUPEX	NR	NR		-50		1.1		1.0		1.0		1.0		1.0		1.0	
RUPEX	HNBR	HNBR		-10		1.0		1.0		1.0		1.0		1.25		1.25	
N-BIPEX	TPU	TPU		-50		1.0		1.0		1.0		1.0		1.0		1.3	
ELPEX	NR	NR		-40		1.1		1.0		1.25		1.40		1.40		1.40	
ELPEX-B	NR	NR		-50		1.1		1.0		1.0		1.0		1.0		1.0	
ELPEX-B	CR	CR		-15		1.0		1.0		1.0		1.0		1.0		1.0	
ELPEX-S	NR	NR		-40		1.1		1.0		1.25		1.40		1.40		1.40	
ELPEX-S	SN, NN, WN	VMQ		-40		1.1		1.0		1.0		1.0		1.1		1.25	
ELPEX-S	NK	VMQ		-40		1.1		1.0		1.0		1.0		1.1		1.25	

NR = natural rubber, natural-synthetic rubber mixture
 NBR = nitrile-butadiene-rubber (Perbunan)
 HNBR = hydrogenated acrylonitrile-butadiene rubber
 CR = chloroprene rubber (Buna S, anti-static)
 VMQ = silicone
 TPU = polyurethane

¹⁾ The N-EUPEX coupling is not suitable for shock loads when used at low temperatures.

Coupling size $T_{RN} \geq T_R \cdot FB \cdot FT$

In the case of ARPEX and ZAPEX coupling types, no temperature factor (FT = 1.0) need be taken into account.

Coupling load at maximum and overload conditions

The maximum torque is the highest load acting on the coupling in normal operation.
 Maximum torques at a frequency of up to 25 times an hour are permitted and must be lower than the maximum coupling torque. Examples of maximum torque conditions are: Starting operations, stopping operations or usual operating conditions with maximum load.

$$T_{RM} \geq T_{RM} \cdot FT$$

Overload torques are maximum loads which occur only in combination with special, infrequent operating conditions. Examples of overload torque conditions are: Motor short circuit, emergency stop or blocking because of component breakage. Overload torques at a frequency of once a month are permitted and must be lower than the maximum overload torque of the coupling. The overload condition may last only a short while, i.e. fractions of a second.

$$T_{RO} \geq T_{OL} \cdot FT$$

Coupling load due to dynamic torque load

Applying the frequency factor FF, the dynamic torque load must be lower than the coupling fatigue torque.

Dynamic torque load

$$T_{RN} \geq T_R \cdot FF$$

Frequency of the dynamic torque load $f_{dyn} < 10$ Hz frequency factor FF = 1.0

Frequency of the dynamic torque load $f_{dyn} > 10$ Hz frequency factor $FF = \sqrt{f_{dyn}/10 \text{ Hz}}$

For the ZAPEX and ARPEX series, the frequency factor is always FF = 1.0.

- Frequent maximum load: $TK_{max} \geq T_{max} \times FT$
- Rare overload: $TKOL \geq TOL \times FT$
- Dynamic load: $TKW \geq TW \times FF$
- Review transient torque, excitation frequency and torsional resonance

Temperature factor FT												
Coupling	Elastomer material	Low temperature	Temperature T_a on the coupling									
			under -50 °C	under -30 °C	up to -10 °C	up to 10 °C	up to 30 °C	up to 50 °C	up to 70 °C	up to 90 °C	up to 110 °C	up to 130 °C
N-EUPEX NBR	-30	-	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	-
N-EUPEX NR	-50	1.1	1.0	-	-	-	-	-	-	-	-	-
N-EUPEX HNBR	-10	-	1.0	1.0	1.0	1.0	1.25	1.25	-	-	-	-
N-EUPEX TPU	-50	1.0	1.0	1.05	1.10	1.15	-	-	-	-	-	-
N-EUPEX OS	-30	-	1.0	1.0	1.0	1.0	-	-	-	-	-	-
RUPEX NBR	-30	-	1.0	1.0	1.0	1.0	-	-	-	-	-	-
RUPEX NR	-50	1.1	1.0	-	-	-	-	-	-	-	-	-
RUPEX HNBR	-10	-	1.0	1.0	1.0	1.0	1.25	1.25	-	-	-	-
Bi-PEX TPU	-50	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.3	1.5	-	-
ELEX NR	-40	1.1	1.0	1.25	1.40	1.60	-	-	-	-	-	-
ELEX-B NR	-50	1.1	1.0	-	-	-	-	-	-	-	-	-
ELEX-B CR	-15	-	1.0	1.0	1.0	-	-	-	-	-	-	-
ELEX-S NR	-40	1.1	1.0	1.25	1.40	1.60	-	-	-	-	-	-
SA-N-NIN VMO	-41	1.1	1.0	1.0	1.0	1.0	1.1	1.25	1.4	1.6	-	-

- Confirm $n_{Kmax} \geq$ maximum operating speed
- Confirm actual displacement is below permitted values
- Verify finished bore, keyway, mounting space and adapter geometry
- Check hub fit and axial securing arrangements

SELECTION OF THE COUPLING SIZE

E

Checking the maximum speed

For all load situations $n_{Kmax} \geq n_{max}$

Checking permitted shaft misalignment

For all load situations, the actual shaft misalignment must be less than the permitted shaft misalignment.

Checking bore diameter, mounting geometry and coupling design

The check must be made on the basis of the dimension tables. The maximum bore diameter applies to parallel keyways to DIN 6885. For other keyway geometries, the maximum bore diameter can be reduced.

On request, couplings with adapted geometry can be provided.

Coupling behavior under overload conditions

The ZAPEX, N-ARPEX, ARPEX, N-EUPEX, RUPEX and N-BIPEX coupling series can withstand overloads until the breakage of metal parts. These coupling series are designated as fail-safe.

The N-EUPEX DS, ELPEX-B, ELPEX-S and ELPEX coupling series throw overload. The elastomer element of these couplings is irreparably damaged without damage to metal parts when subjected to excessive overload.

These coupling series are designated as non-fail-safe. These types that fail can be fitted with a so-called fail-safe device. This additional component enables emergency operation, even after the rubber element of the coupling has been irreparably damaged.

Checking shaft-hub connection

The torques specified in the tables of power ratings data of the coupling series do not necessarily apply to the shaft-hub connection. Depending on the shaft-hub connection, proof of form stability is required. Flender recommends obtaining proof of form strength by using calculation methods in accordance with the current state of the art.

Fitting recommendations for the shaft-hub connection are given in the **Appendix**.

The coupling hub is frequently fitted flush with the shaft end face. If the shaft projects, the risk of collision with other coupling parts must be checked. If the shaft is set back, in addition to the load-bearing capacity of the shaft-hub connection, the correct positioning of the hub must be ensured as well. If the bearing hub length is insufficient, restorative forces may cause tilting movements and so wear to and impairment of the axial retention. Also, the position of the set screw to be positioned on sufficient shaft or parallel key material must be noted.

Shaft-hub connection	Suggestion for calculation method
Keyway connection to DIN 4885-1	DIN 4892
Shrink fit	DIN 7190
Spline to DIN 5480	
Bolted flange connection	VDI 2230
Flange connection with close-fitting bolts	

Checking low temperature and chemically aggressive environment

The minimum permitted coupling temperature is specified in the Temperature factor FT table. In the case of chemically aggressive environments, please consult the manufacturer.

- Source groups ZAPEX, N-ARPEX, ARPEX, N-EUPEX, RUPEX, N-BIPEX as fail-safe
- Source groups N-EUPEX DS, ELPEX-B, ELPEX-S, ELPEX as non-fail-safe
- Non-fail-safe elastomer failure can interrupt torque transmission
- Emergency-operation devices may be available for specific designs

SELECTION OF THE COUPLING SIZE

E

Checking the maximum speed

For all load situations $n_{kmax} \geq n_{max}$

Checking permitted shaft misalignment

For all load situations, the actual shaft misalignment must be less than the permitted shaft misalignment.

Checking bore diameter, mounting geometry and coupling design

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Checking low temperature and chemically aggressive environment

The minimum permitted coupling temperature is specified in the Temperature factor FT table. In the case of chemically aggressive environments, please consult the manufacturer.

- Cement: crushers, rotary kilns, ball mills, roller presses
- Steel: roller tables, shears, coiling machines
- Process industries: pumps, compressors, blowers, mixers
- Logistics: conveyors, bucket elevators, crane drives

Typical coupling solutions for different example applications

The specified application factors are recommendations, regulations, rules and practical experience take priority as assessment criteria.
No application factor need be taken into account with FLUDEX couplings.

In the case of highly flexible couplings of the ELPEX, ELPEX-S and ELPEX-B series, deviating application factors are stated in the product descriptions.
FLUDEX couplings are mostly mounted on the high-speed gear shaft.

Example applications	Application factor F _B	Example applications	Application factor F _B	Example applications	Application factor F _B
Electric motor without gear unit		Compressed air, screw-type compressors	1.25	Woodworking - reciprocating saws	1.5
Centrifugal pumps	1.0	Air - Blowers	1.5	Grinding machines	1.5
Piston pumps	1.5	Air - Cooling tower fans	1.5	Textile machines - winders	1.5
Vacuum pumps	1.5	Air - Turbine blowers	1.5	Textile machines - printing machines	1.5
Fans with T ₉₀ less than 75 Nm	1.5	Generators, converters	1.25	Textile machines - tanning vats	1.5
Fans with T ₉₀ from 75 to 750 Nm	1.75	Welding generators	1.25	Textile machines - shrewlers	1.5
Fans with T ₉₀ larger than 750 Nm	1.75			Textile machines - looms	1.5
Blowers	1.5	Metal production, iron and steel works		Packaging machines	1.5
Frequency converters / generators	1.25	Plate fillers	1.5	Brick molding machines	1.75
Reciprocating compressors	1.75	Ingot pushers	1.75	Transport and logistics	
Screw-type compressors	1.5	Slabbing mill	1.75	Passenger transport - elevators	1.5
Internal-combustion engine without gear unit		Coiling machines	1.5	Passenger transport - escalators	1.5
Generators	1.75	Roller straightening machines	1.5	Conveyor systems - bucket elevators	1.5
Pumps	1.5	Roller tables	1.75	Conveyor systems - hauling winches	1.5
Fans	1.75	Shears	1.75	Conveyor systems - belt conveyors	1.5
Hydraulic pumps, excavators, construction machines	1.5	Rollers	1.75	Conveyor systems - endless-chain conveyors	1.5
Compressors / screw-type compressors	1.5	Metal working machines		Conveyor systems - circular conveyors	1.5
Agricultural machinery	1.75	Plate bending machines	1.5	Conveyor systems - screw conveyors	1.5
Other		Plate straightening machines	1.5	Conveyor systems - inclined hoists	1.5
Turbine gear units	1.5	Hammers	1.75	Crane travelling gear	1.5
Electric motor with gear unit		Planing machines	1.75	Hoisting gear	1.5
Chemical industry		Presses, forging presses	1.75	Crane lifting gear	2.0
Extruders	1.5	Shears	1.5	Crane travelling gear	1.5
Pumps - centrifugal pumps	1.0	Grinding machines	1.25	Crane sawing	1.5
Pumps - piston pumps	1.75	Punches	1.5	Crane fly jib hoists	1.5
Pumps - plunger pumps	1.5	Machine tools: Main drives	1.5	Cable railways	1.5
Reciprocating compressors	1.75	Machine tools: Auxiliary drives	1.25	Drag lifts	1.5
Calenders	1.5	Food industry		Winches	1.5
Kneaders	1.75	Filling machines	1.25	Cellulose and paper	
Cooling drums	1.25	Kneading machines	1.5	Paper-making machines, all	1.5
Mixers	1.25	Mashers	1.5	Pulper drives	1.5
Stirrers	1.25	Sugar cane production	1.5	Cement industry	
Toasters	1.25	Production machines		Crushers	1.75
Drying drums	1.25	Construction machines, hydraulic pumps	1.25	Rotary furnaces	1.5
Centrifuges	1.25	Construction machines, traversing gears	1.5	Hammer mills	1.75
Crushers	1.5	Construction machines, suction pumps	1.5	Ball mills	1.75
Power generation and conversion		Construction machines, concrete mixers	1.5	Pug mills	1.75
Compressed air, reciprocating compressors	1.75	Printing machines	1.25	Mixers	1.5
		Woodworking - barking drums	1.5	Pipe mills	1.5
		Woodworking - planing machines	1.5	Beater mills	1.75
				Separators	1.5
				Roller presses	1.75

- Motor power, rated speed, duty cycle, driver and driven equipment
- Nominal, peak, overload and reversing torque if applicable
- Shaft diameters, keys/fits, shaft distance and mounting constraints
- Operating temperature, misalignment, balancing and standards requirements

FLENDER STANDARD COUPLINGS | INTRODUCTION

SELECTION OF THE COUPLING SIZE

E

The torque load of the coupling must be determined from the output of the driven machine and the coupling speed.

Rated coupling load $T_R = 9550 \times P_N / n_N$
(T_R in Nm; P_N in kW; n_N in rpm)

The rated coupling load obtained in this way must be multiplied by factors and compared with the rated coupling torque. An ideal but expensive method is to measure the torque characteristic on the coupling. For this, Flender offers special adapters fitted with torque measuring devices.

The rated coupling torque T_{RN} is the torque which can be transmitted by the coupling over an appropriate period of use if the load is applied to the coupling purely statically at room temperature.

Application factors are to express the deviation of the real coupling load from the "ideal" load condition.

Coupling load in continuous operation

The operating principles of the driving and driven machines are divided into categories and the application factor FB derived from these in accordance with DIN 3990-1.

Application factor for N-EUPEX, N-EUPEX-DS, RUPEX, N-BIPEX, ELPEX-B, N-ARPEX, ARPEX, ZAPEX and FLUDEX

Torque characteristic of the driving machine	Torque characteristic of the driven machine			
	uniform	uniform with moderate shock loads	non uniform	very rough
uniform	1.0	1.25	1.5	1.75
uniform with moderate shock loads	1.25	1.5	1.75	2.0
non uniform	1.5	1.75	2.0	2.5

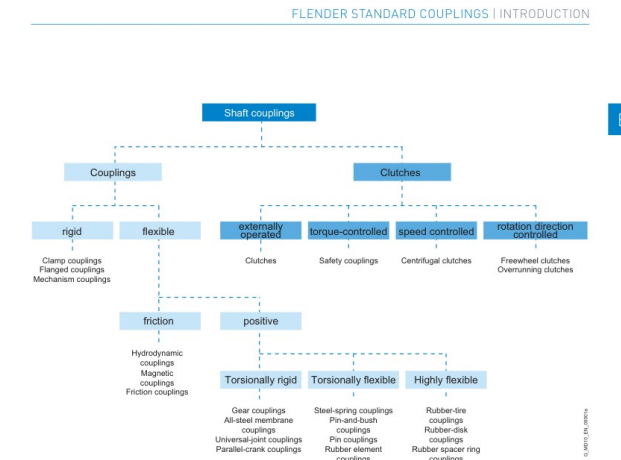
Examples of torque characteristic of driving machines:

- uniform: Electric motors with soft starting, steam turbines
- uniform with moderate shock loads: Electric motors without soft starting, hydraulic motors, gas and water turbines
- non uniform: Internal-combustion engines

Examples of torque characteristic in driven machines:

- uniform: Generators, centrifugal pumps for light fluids
- uniform with moderate shock loads: Centrifugal pumps for viscous fluids, elevators, machine tool drives, centrifuges, extruders, blowers, crane drives
- non uniform: Excavators, kneaders, conveyor systems, presses, mills
- very rough: Crushers, excavators, shredders, iron/smelter machinery

- Select the coupling family for torsional and displacement behavior
- Verify torque under continuous, peak and dynamic conditions
- Check speed, temperature, bore, shaft-hub fit and alignment
- Primary source: FLENDER Standard Couplings | Introduction, E/2–E/21



THANK YOU FOR YOUR ATTENTION

We Welcome Your Questions, Comments & Feedback

MECHATRIC

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