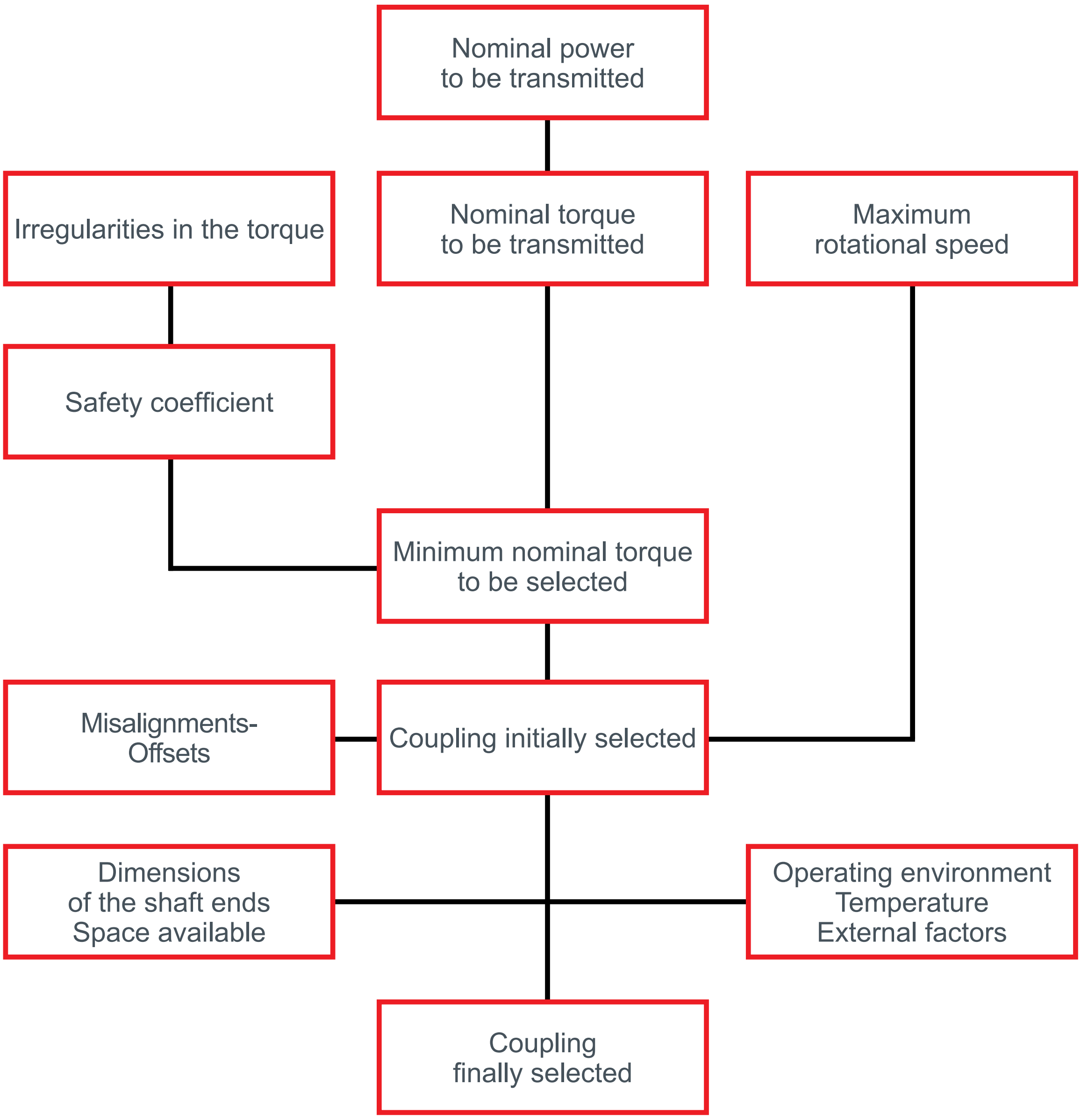
1.2 - Selection parameters

The procedure for selecting a coupling is set out below :



In order to select a flexible coupling, therefore, the following parameters should be known :

- **nominal torque to be transmitted;**
- **safety coefficient - Nominal torque of the coupling;**
- **stiffness - Misalignments - Offset;**
- **dimensions - Space available;**
- **operating environment - Temperature - External factors;**

1.2.1 - Nominal torque to be transmitted

The nominal torque is the main factor which determines the dimensions of the coupling between the shafts of the machines that are connected directly to it.
The nominal torque to be transmitted is a function of the nominal power to be transmitted and the rotational speed.

$$T\ (\text{N.m}) = \frac{7\ 024 \times P\ (\text{bhp})}{N\ (\text{rpm})}$$

$$T\ (\text{N.m}) = \frac{9\ 550 \times P\ (\text{Kw})}{N\ (\text{rpm})}$$

The nominal power to be transmitted is that of the driving machine expressed in kilowatts (Kw) or brake horsepower (bhp). The couplings in PAULSTRA's standard range can transmit power from 1 Kw to more than 2,000 Kw.

The rotational speed expressed in revolutions per minute is that of the driving machine and must be less than the maximum speed accepted by the coupling.

The couplings in PAULSTRA's standard range allow high speeds (up to 10,000 rpm), which is greater than electric motor speeds. The maximum speeds indicated can be achieved only if great care is taken during assembly.

In addition to its elastic properties, the rubber has **viscous damping** characteristics which dampen the oscillations and in particular the oscillations which might become excessive during transient periods of peak load.
The dampening effect is produced by irreversibly absorbing the energy which is thus converted into heat. In order to prevent the rubber being damaged by the resultant increase in temperature, especially if running at high speed, it is important to ensure the best possible alignment.

Once the coupling has been chosen, if difficult **peak load conditions** become evident, it would be advisable to choose a flexible coupling with different characteristics.

1.2.2 - Safety coefficient

The following factors should be taken into consideration when selecting the nominal torque of the coupling :
- irregularities in the torque characteristic of the driving and the driven machines (K_1);
- frequency of start-ups (K_2);
- number of hours in operation per day (K_3).

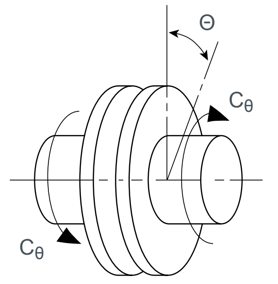
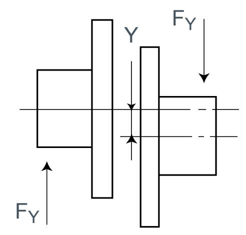
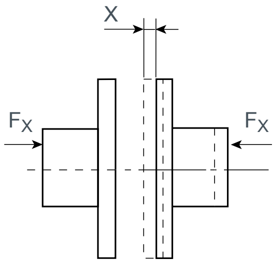
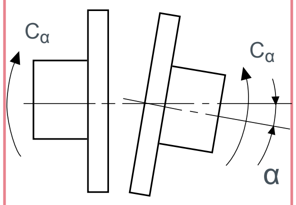
The product K of these three coefficients K_1, K_2, K_3, is called the safety coefficient or the load factor.

Nominal torque of the coupling = Nominal torque to be transmitted x safety coefficient.

An excessive safety coefficient should be avoided as this tends to lead to the selection of a coupling that is oversize and too stiff.

1.2.3 - Stiffness - misalignments - offsets

A flexible coupling always allows, to varying degrees depending on type, structure and dimensions, displacements in four ways : axial, radial, conical and torsional. A stiffness defined for each of these cases. The stiffness affects the way in which the coupling reacts when subjected to each of the various possible displacements.

Torsional or polar stiffness	Radial stiffness	Axial stiffness	Conical stiffness
			
$K_\theta = \frac{\text{Torque}}{\text{Angular}} = \frac{C_\theta}{\Theta}$ expressed in m.kN/radian	$K_y = \frac{\text{Radial force}}{\text{Corresponding radial displacement}} = \frac{F_y}{Y}$ expressed in m.kN/radian	$K_x = \frac{\text{Axial force}}{\text{Corresponding axial displacement}} = \frac{F_x}{X}$ expressed in daN/mm	$K_\alpha = \frac{\text{Misalignment torque}}{\text{Angular misalignment}} = \frac{C_\alpha}{\alpha}$ expressed in m.kN/radian

It can be seen that a coupling can absorb misalignment more easily if it is very flexible (ie it is less stiff). With flexible couplings «alignment» is not an arduous, high precision operation as is the case with rigid couplings.
The forces generated by flexible couplings, which are transmitted to the shafts and supports, are, of course, proportional to the magnitude of the misalignments.

1.2.4 - Dimensions – space occupied

When choosing the coupling, one should bear in mind :

- the dimensions (diameter and length) of the ends of the shafts to which the flanges of the coupling will be fitted;
- the space (diameter and length) available between the machines for the coupling.

1.2.5 - Operating conditions – temperature – external factors

The natural rubber which has been selected for most of our standard couplings on the basis of its good dynamic qualities :

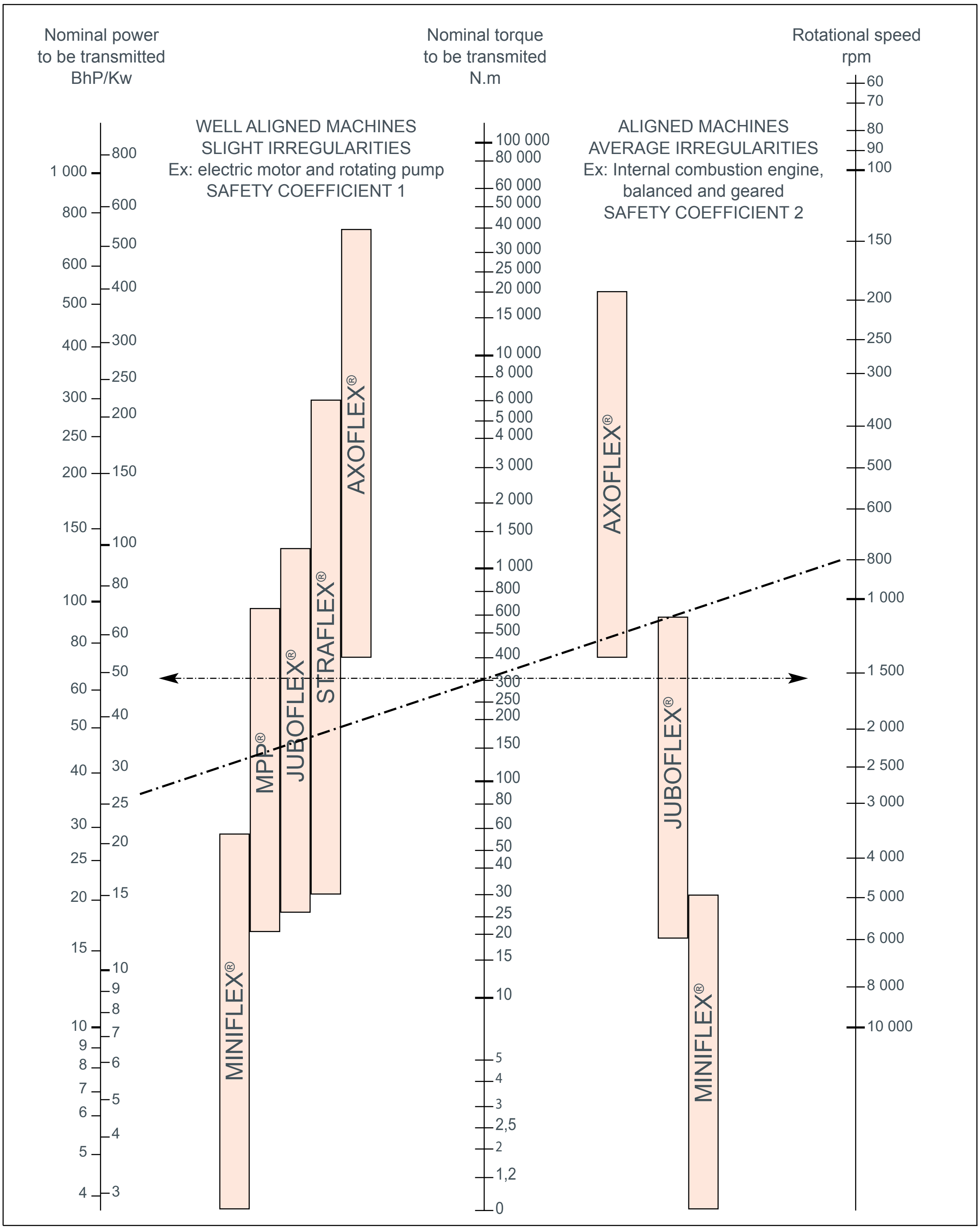
- is very good for the operating environment of most machines;
- is not affected by accidental contact with oil or petrol;
- easily withstands temperatures up to 70°C.

A temperature which is permanently higher will lead to progressive deterioration in the properties of the rubber and it would therefore be advisable to consider special compounds.
Most PAULSTRA flexible couplings can be made using various types of special compounds that can withstand above average temperatures and remain serviceable in unusual conditions: prolonged contact with hydrocarbons, acids, alkalis or with unusual gases (ozone, chlorine . .).

If operating conditions are different from those defined for our standard couplings, contact our Technical Department.

2 - SELECTING A COUPLING

2.1 - Calculating the nominal torque to be transmitted



Example : to calculate the torque, draw a straight line between the points representing the power to be transmitted and the rotational speed of the machine. The intersection at the central scale indicates the torque value.
Ex. : 25 Kw at 800 rpm 300 N.m. Draw an horizontal line through this point.
The type of coupling will then be selected, bearing in mind the safety coefficient to be applied and the flexibility required. Refer to the selection chart, page 300.

2.2 - Safety coefficient

2.2.1 - Coefficient k_1 = driving machine/driven machine

Driving Machine			Driven machine	Examples of driven machines
Electr. motor or turbine	Piston Engine			
	4 to 6 cylin.	1 to 3 cylin.		
1	1,2	1,4	① Smooth operation - Very low inertia	• Lay shaft • Lighting generator • Series of shafts • Centrifugal pump • Centrifugal fan...
1,2	1,4	1,7	② Irregular operation - Low inertia	• Fluid agitator • Conveyor belt • Lift • Rotating machine tools for wood and metal • Light textile machines • Folding machines • Geared pumps • Paddle pumps • Fans...
1,4	1,7	2	③ Irregular operation - Average inertia	• Agitator for heavy liquid • Rotary compressor • Roller conveyor • Shredders • Rotary ovens • Wood machinery (planing machine, band-saw . . .) • Printing machines • Mixers • Hoists • Punch • Centrifugal pump for loaded liquid...
1,7	2	2,4	④ Irregular operation - Average inertia - Average shocks	• Concrete mixer • Bar shredder • Shot blaster • Piston compressor with fly wheel • Chain conveyor • Crane • Light rolling mill • Flour mills • Power hammer • Loom • Piston pump with fly wheel • Horizontal mills • Winches • Mine fans...
2	2,4	2,8	⑤ Irregular operation - High inertia - Hard shocks	• Hammer crushers • Calender (rubber, textiles...) • Piston compressor with low inertia fly wheel • Wood shredder • Excavator • Rolling mill • Piston pump with low inertia fly wheel • Forging press • Paper press • Vibrating sieve...
2,4	2,8	3,3	⑥ Irregular operation - Very high inertia - Very hard shocks	• Piston compressor without fly wheel • Crusher • Welding generator • Heavy rolling mill • Brick press • Piston pump without fly-wheel...

2.2.2 - Coefficient k_2 = number of start-ups

Depending on driving machine - driven machine See table K1	NUMBER OF START-UPS PER HOUR				
	1	10	30	60	120
①	1	1,2	1,3	1,5	1,6
② ③	1	1,1	1,2	1,3	1,4
④ ⑤ ⑥	1	1,05	1,1	1,2	1,2

2.2.3 - Coefficient k_3 = number of hours of daily operation

Number of operating hours per day	0 - 2	2 - 8	8 - 16	16 - 24
Coefficient K3	0,9	1	1,1	1,2

2.2.4 - Nominal torque of the coupling

**Nominal torque of the coupling = Nominal torque to be transmitted x safety coefficient.
The safety coefficient, K, is the product of the three coefficients K_1, K_2 and K_3.**

The above parameters should enable one or two types of coupling to be selected which are suitable for the application required.
The final choice will be made on the basis of the data sheets for the coupling selected, checking :

- the dimensions allowed for the shaft ends;
- the space available;
- the exact values of the misalignements, offset, stiffness;
- and any other parameter (eg : installation).

2.3 - Examples

2.3.1 - Electric motor – pump

Driving machine	Driven machine :
Standard electric motor 160 M	Standard C2 water pump
Power : 15 Kw	End of shaft Ø : 32 mm - length : 80 mm
Speed : 3000 rpm	30 start-ups/hour
End of shaft Ø : 42 mm - length : 110 mm	8 hours operation per day

Nominal torque to be transmitted : chart indicates 5 N.m.
Safety coefficient : $K_1 = 1$ $K_2 = 1.3$ $K_3 = 1$ hence $K = K_1 \times K_2 \times K_3 = 1.3$.
Nominal torque of coupling : NT = 50 N.m x 1.3 = 65 N.m.

For machines which have a regular cyclic operation with correct alignment, it is not essential to have a highly flexible coupling and so the following couplings would be pre-selected :

CARDAFLEX	80 N.m
PAULSTRA MPP	80 N.m
STRAFLEX	100 N.m

All these couplings can be used at a speed of 3,000 rpm.

In this case, the PAULSTRA MPP 80 N.m coupling would be chosen as it is the only one which will fit the diameter (42 mm) of the end of the motor shaft.

2.3.2 - Electric motor – compressor

Driving machine :	Driven machine :
Standard 200 L electric motor	2 cylinder compressor with fly wheel
Power : 30 kW	End of shaft Ø : 60 mm - length : 110 mm
Speed : 1,500 rpm	Less than one start-up/hour
End of shaft Ø : 55 mm - length : 110 mm	8 hours operation per day

Nominal torque to be transmitted : chart indicates 190 N.m.
Safety coefficient : $K_1 = 1.7$ $K_2 = 1$ $K_3 = 1$ hence $K = 1.7$.
Nominal torque of coupling : NT = 190 x 1.7 = 320 N.m.

The characteristics of the driven machine mean that high torsional flexibility is essential to absorb the cyclic irregularities.

**The JUBOFLEX 350 N.m will therefore be selected, having checked that it can accommodate the shaft ends of the machines.
These examples are simple cases. In many instances, this method is adequate for selecting couplings. In more complex cases (cyclic vibrations, for example), it is advisable to consult our technical Department.**

COUPLING

In order to make it easier to select the coupling required, this selection chart indicates the behaviour of PAULSTRA couplings when under stress.

This rating takes account of the possibilities of misalignments, offset and the resultant forces on the shafts and supports. Each condition is shown :

TORSION	**	**	***	*
RADIAL	***	*	**	*
AXIAL	Push fit	Push fit	***	**
CONICAL	**	*	***	**

	MINIFLEX® P303				MPP® P307				JUBOFLEX® P311				STRAFLEX® P319			
Nominal Torque (N.m)	Coupling Ref.	Nominal Torque (N.m)	Speed Max (rpm)	Max shaft Ø (mm)	Coupling Ref.	Nominal Torque (N.m)	Speed Max (rpm)	Max shaft Ø (mm)	Coupling Ref.	Nominal Torque (N.m)	Speed Max (rpm)	Max shaft Ø (mm)	Coupling Ref.	Nominal Torque (N.m)	Speed Max (rpm)	Max shaft Ø (mm)
100 000																
50 000																
40 000																
30 000																
20 000																
10 000													635107	6 000	2 000	145
5 000																
4 000																
3 000													635106	3 200	2 400	110
2 000																
													635105	1 600	2 800	100
1 000																
													635304 *635308	800	3 500	700
									632025	700	2 400	80				
500					633055	650	3 000	75								
									632043	500	2 800	75	635303 *635307	400	4 500	50
400					633054	380	3 000	60	632031	350	3 000	70				
300																
									632017 *632217	250	3 500	60				
200																
					633051	200	4 000	55	632017 *632217	160	4 500	48	635302 *635306	200	5 000	42
100																
									632023 *632210	90	5 000	40	635301 *635305	100	5 500	32
					633053	80	7 000	42								
50	633047	60	4 000	55												
40																
	633044	40	4 000	55					632027 *632205	40	6 000	30	635100	50	6 000	30
30					633052	30	9 000	28								
20																
	633038	20	7 000	42												
10	633039	10	9 000	28												
2,5	633041	2,5	10 000	14												

*separate hubs

SELECTION CHART

Very flexible	* * *	Flexible	* *	Semi-flexible	*	Rigid	

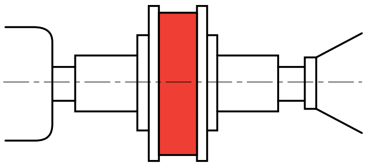
More precise information on the values for misalignment, offset and rigidity can be found in the individual data sheets.

*				**			*			TORSION
*				*			*			RADIAL
**				**			see Data Sheet			AXIAL
*				**						CONICAL
AXOFLEX® P333				CARDAFLEX® P325			RADIAFLEX® RTP* P329			
Coupling Ref.	Nominal Torque (N.m)	Speed Max (rpm)	Max shaft Ø (mm)	Coupling Ref.	Nominal Torque (N.m)	Max shaft Ø (mm)	Coupling Ref.	Nominal Torque (N.m)	Max shaft Ø (mm)	Nominal Torque (N.m)
							612616	104 000		100 000
							612613	72 000		
							612612	60 000		50 000
										40 000
										30 000
615418	40 000	1 200	200				612608	34 000		
615444	24 000	1 400	200							20 000
615414			170				612606	17 500		
615442	17 500	1 500	170				612416			
615412			150							
										10 000
615440	12 000	1 500	150				612412	9 700		
615410			120							
615408	7 500	1 800	120				612410	6 900	1 500	5 000
615212	5 000	1 800	120				612408	4500	1 500	
615406		2 000	100				612212	4 100	2 000	4 000
										3 000
615210	3 600	2 500	100				612210	2 800	2 500	
							612406	2 500	1 500	2 000
615208	2 300	2 500	80							
							612208	1 800	2 500	
615206	1 300	3 000	80				612206	1 100	3 000	1 000
615204	800	3 000	60				612 204	630	3 000	500
				622406	520	4500				
615203	800	3 000	60				612203	470	3 000	400
										300
										200
				622405	160	5 500				
				622404	120	5 500				100
				622403	80	6 000				
				622402	50	6 500				50
										40
				622401	30	7 000				30
										20
										10
										2,5

* See current price list for items held in stock. Braking force proportional to the speed of displacment.

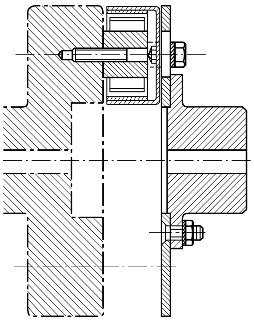
3 - EXAMPLES OF INSTALLATION

III.1 Flanged shaft mounting

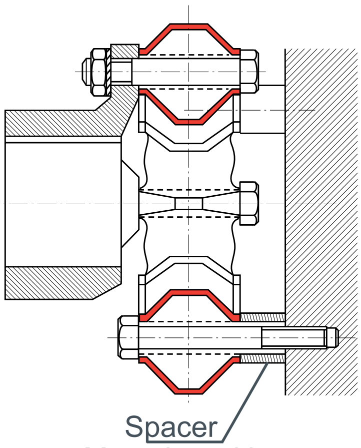


The most common mounting

III.2 Flywheel mounting

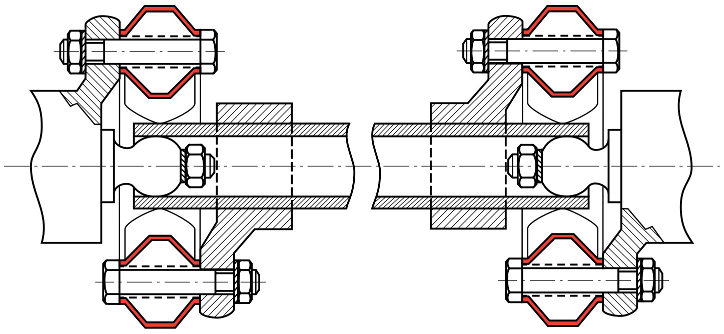


Mounted directly on flywheel
Ex. : AXOFLEX®



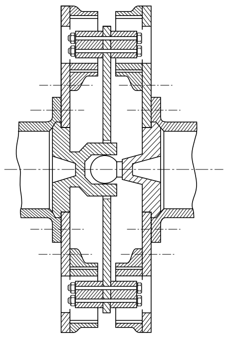
Mounting with spacer.
Ex. : JUBOFLEX®

III.3 Mounting on transmission shaft



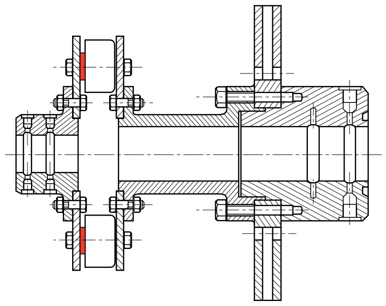
Assembly with centred transmission shaft. Ex. : JUBOFLEX®

III.4 Mounting in series

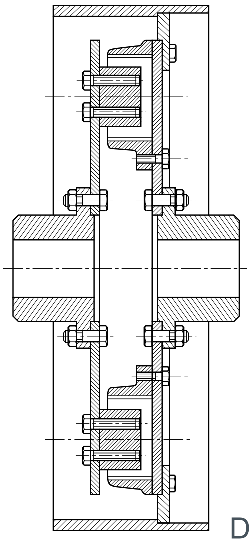


Increases the flexibility while keeping the torque constant.
Ex.: AXOFLEX coupling with two sets of studs linked by an "anti-centrifuge" disk.

III.5 Drum brake and disk brake mounting



Disk brake mounting



Drum brake for mounting our couplings with rings : AXOFLEX®, R.T.P®.