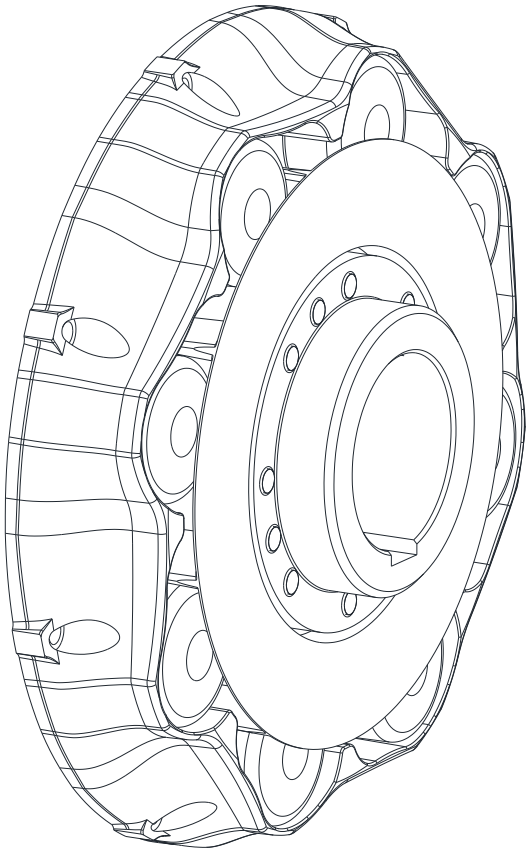
VAROLASTIC®

Type F

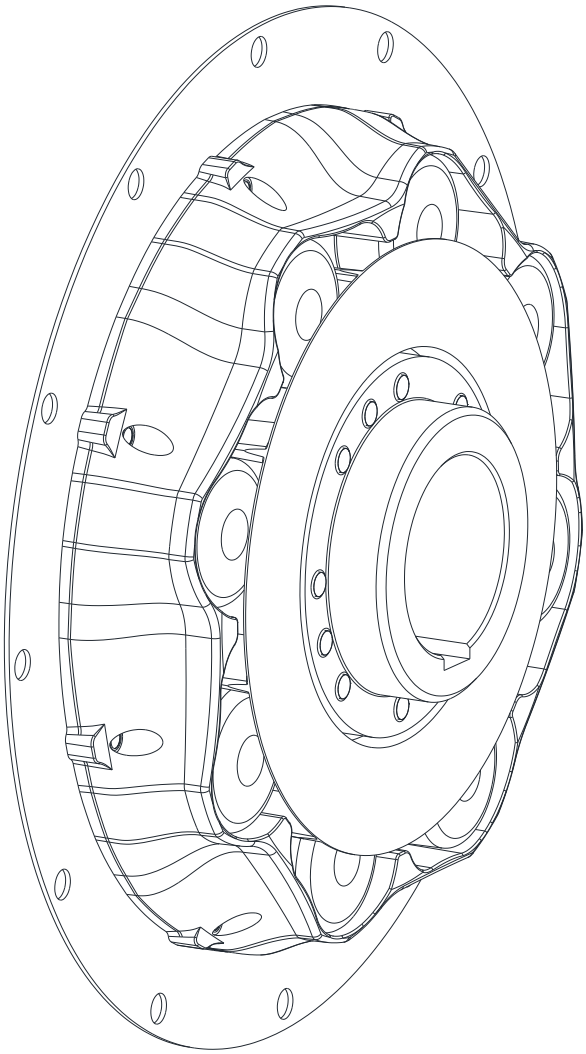
Axially pluggable, variable highly flexible roller coupling type F

Type F - standard type

for direct flywheel connection



Type F - adapted type



VAROLASTIC® type F is a highly flexible, direction of rotation bound, axially pluggable flange coupling with progressive torsional stiffness characteristic curve. The torsional irregularity is reduced or damped as a result of an initially very low torsional elasticity that increases with the load.

- Direction of rotation bound ("Counterclockwise" - "CCW")

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1 Technical data

1.1 Coupling dimensions and technical data

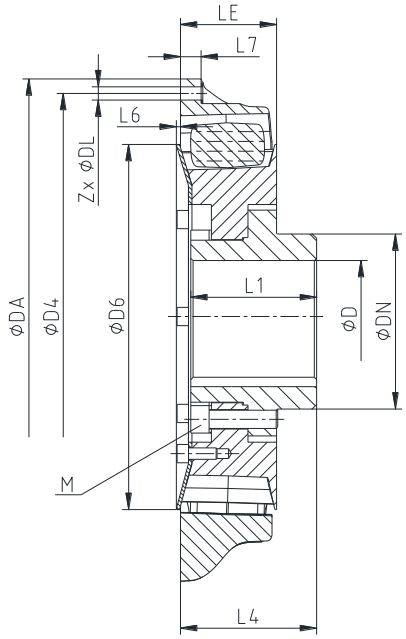


Illustration 1: VAROLASTIC® F standard type

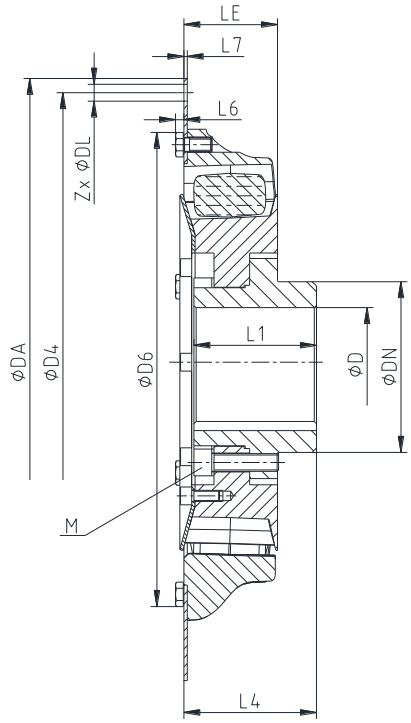


Illustration 2: VAROLASTIC® F adapted type

Table 1: Dimensions

Size	Type	Max. finish bore D in mm	Flange connection acc. to SAE - J620 / diameter [1]	Dimensions in mm							Cap screws DIN EN ISO 4762	
				DN	D6	LE	L1	L4	L6	L7	M	T_A in Nm
80	Standard	50	8“	70	175	49	50	57	6.5	21	M8	32
	adapted		10“		264				6.5	1.8		
160	Standard	70	10“	100	234	51	70	75	6.5	22	M12	100
	adapted		11 ½“		315				6.5	3		
240	Standard	60	11 ½“	85	227	66	65	82	2	22	M12	100
	adapted		14“		353				6.5	3		
300	Standard	80	11 ½“	112	263	65	75	83	6	26	M12	100
	adapted		14“		353				6.5	3		
450	Standard	90	14“	124	300	84	90	99	3.8	23	M16	240
600	Standard	110	14“	162	338	85	110	119	3.7	19.5	M16	240
	adapted		18“		460				7.5	3		

1) For dimensions of flange connection see table 2.

When tightening the cap screws (component 5), the ratchet washer (component 6) presses visibly into the inner component (component 2).
The specified tightening torques must be observed.

1 Technical data

1.2 General dimensions and torques

Table 2: Flange dimensions according to SAE - J620

Nominal size	Flange dimensions				
	8“	10“	11 ½“	14“	18“
Dimension DA in mm	215.90	314.32	352.42	466.72	571.50
Dimension D4 in mm	200.00	295.30	333.40	438.15	542.90
Number Z	6	8	8	8	6
Dimension DL in mm	11	11	11	13	17

Table 3: Torques

Size	Shore hardness	Torque in Nm				Operating speed in rpm	
		Synthetical rubber (EPDM)					
		T_{KN}	$T_{K\,max.}$ 1)	$T_{K\,max1}$ 2)	T_{KW}	n	$n_{max.}$
80	80	800	1600	2400	400	3600	4500
160	80	1600	3200	4800	800	3200	4000
240	80	2400	4800	7200	1200	2500	3200
300	80	3000	6000	9000	1500	2400	3000
450	80	4500	9000	13500	2250	2250	2800
600	80	6000	12000	18000	3000	2100	2600

1) Maximum torque of coupling $T_{K\,max.}$ = rated torque of coupling T_{KN} x 2.
The maximum torque TK max signifies short-term torque peaks (e.g. when passing through the resonance). $T_{K\,max}$ may arise at the maximum 100,000 times as pulsating torque.
2) $T_{K\,max1}$ indicates rare overload situations, e.g. impact loads, min. 1000 load cycles

2 Advice

2.1 General advice

Please read carefully through these operating/assembly instructions before you start up the coupling.
Pay special attention to the safety instructions!
The operating/assembly instructions are part of your product. Please store them carefully and close to the coupling. The copyright for these operating/assembly instructions remains with KTR.

2.2 Safety and advice symbols

	**Warning of personal injury**	This symbol indicates notes which may contribute to preventing bodily injuries or serious bodily injuries that may result in death.
	**Warning of product damages**	This symbol indicates notes which may contribute to preventing material or machine damage.
	**General advice**	This symbol indicates notes which may contribute to preventing adverse results or conditions.
	**Warning of hot surfaces**	This symbol indicates notes which may contribute to preventing burns with hot surfaces resulting in light to serious bodily injuries.

2.3 General hazard warnings

With assembly, operation and maintenance of the coupling it has to be made sure that the entire drive train is secured against accidental switch-on. You may be seriously hurt by rotating parts. Please make absolutely sure to read through and observe the following safety indications.

- All operations on and with the coupling have to be performed taking into account "safety first".
- Make sure to switch off the power pack before you perform your work on the coupling.
- Secure the power pack against accidental switch-on, e. g. by providing warning signs at the place of switch-on or removing the fuse for current supply.
- Do not reach into the operating area of the coupling as long as it is in operation.
- Secure the coupling against accidental contact. Please provide for the necessary protection devices and covers.

2 Advice

2.4 Intended use

You may only assemble, operate and maintain the coupling if you

- have carefully read through the operating/assembly instructions and understood them
- are technically qualified and specifically trained (e. g. safety, environment, logistics)
- are authorized by your company

The coupling may only be used in accordance with the technical data (see chapter 1). Unauthorized modifications on the coupling design are not admissible. We will not assume liability for any damage that may arise. In the interest of further development we reserve the right for technical modifications.
The **VAROLASTIC®** described in here corresponds to the state of the art at the time of printing of these operating/assembly instructions.

2.5 Coupling selection

For a permanent and failure-free operation of the coupling it must be selected according to the selection instructions (according to DIN 740 part 2) for the particular application (see catalogue drive technology "VAROLASTIC®").
If the operating conditions (performance, speed, modifications on engine and machine) change, the coupling selection must be reviewed.
Make sure that the technical data regarding torque refer to the coupling and elastomer elements only. The transmittable torque of the shaft-hub-connection must be reviewed by the customer and is subject to his responsibility.

For drives subjected to torsional vibrations (drives with cyclic stress due to torsional vibrations) it is necessary to perform a torsional vibration calculation to ensure a reliable selection. Typical drives subjected to torsional vibrations are e. g. drives with diesel engines, piston pumps, piston compressors etc. If requested, KTR will perform the coupling selection and the torsional vibration calculation.

2.6 Reference to EC Machinery Directive 2006/42/EC

The couplings supplied by KTR should be considered as components, not machines or partly completed machines according to EC Machinery Directive 2006/42/EC. Consequently KTR does not have to issue a declaration of incorporation. For details about safe assembly, start-up and safe operation refer to the present operating/assembly instructions considering the warnings.

3 Storage, transport and packaging

3.1 Storage

The coupling hubs are supplied in preserved condition and can be stored in a dry and roofed place for 6 - 9 months.
The features of the elastomer rollers remain unchanged for up to 5 years with favourable storage conditions.

The storage rooms must not include any ozone-generating devices like e. g. fluorescent light sources, mercury-vapour lamps or electrical high-voltage appliances.
Humid storage rooms are not suitable.
Make sure that condensation is not generated. The best relative air humidity is less than 65 %.

3.2 Transport and packaging

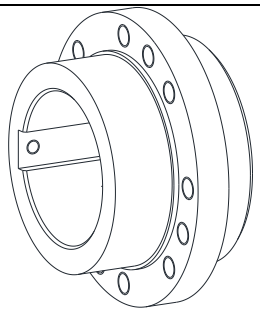
In order to avoid any injuries and any kind of damage always make use of proper transport and lifting equipment.

The couplings are packed differently each depending on size, number and kind of transport. Unless otherwise contractually agreed, packaging will follow the in-house packaging specifications of KTR.

4 Assembly

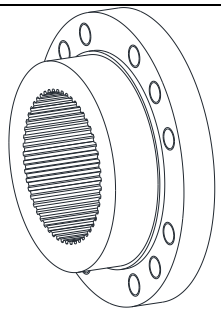
The coupling is supplied in the following subassemblies and single parts. Before assembly the coupling must be inspected for completeness.

4.1 Types of hubs

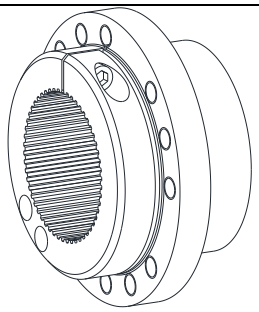


Type 1.0
Hub with feather keyway and setscrew

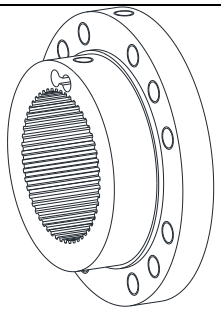
Type 1.4
Hub with feather keyway



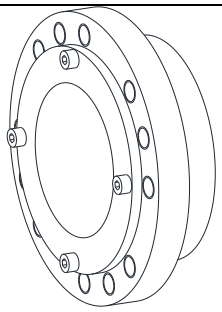
Type 1.3
Hub with spline bore



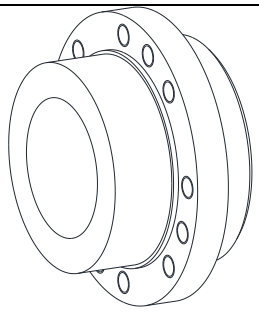
Type 2.7
Clamping hub with spline bore



Type 3.1
Clamping hub N with spline bore



Type 6.0
Clamping ring hub



Type 8.0
Hub with taper interference fit

Type 8.1
Hub with transverse interference fit

Illustration 3: Types of hubs

4 Assembly

4.2 Components of the coupling

Components of VAROLASTIC® type F

Component	Quantity	Description
1	1	Connection flange
2	1	Inner component
3	see table 4	Elastomer rollers
4	1	Hub
5	see table 4	Cap screws DIN EN ISO 4762
6	see table 4	Ratchet washer
7 [1)]	see table 4	Ratchet washer
8	1	Cable ties (mounting aid)

1) For standard type only

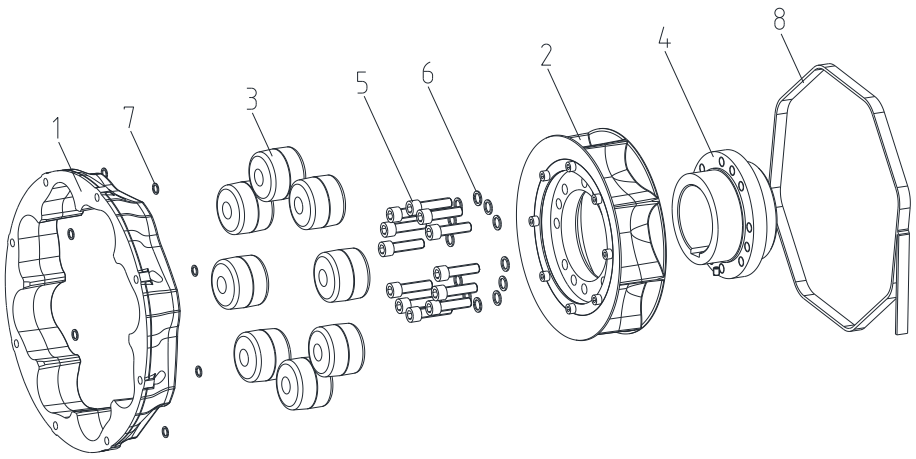


Illustration 4: VAROLASTIC® F standard type

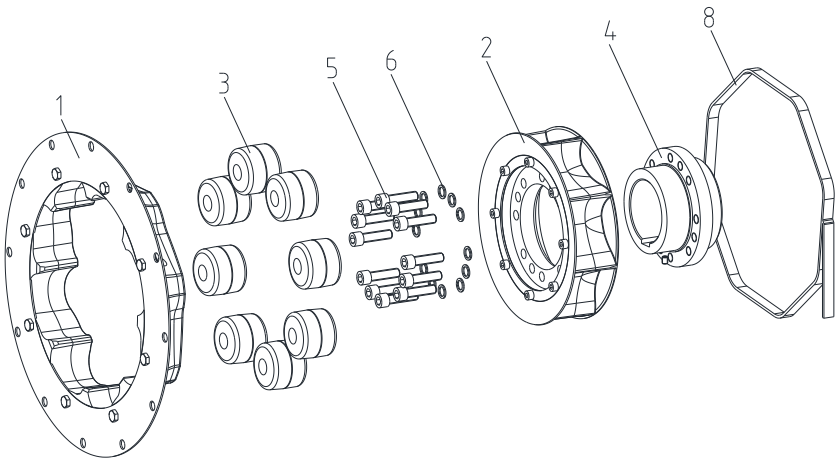


Illustration 5: VAROLASTIC® F adapted type

Table 4: Quantity

Size	80	160	240	300	450	600
Quantity of elastomer rollers (component 3)	6	8	7	8	7	8
Quantity of cap screws (component 5)	12	8	14	14	10	12
Quantity of cap screws (component 6)	12	8	14	14	10	12
Quantity of ratchet washers (component 7)	6	8	8	8	8	8

4 Assembly

4.3 Advice for finish bore

The maximum permissible bore diameters D (see chapter 1 - technical data) must not be exceeded. If these figures are disregarded, the coupling may tear. Rotating particles may cause danger to life.

- Hub bores machined by the customer have to observe concentricity resp. axial runout (see illustration 6).
- Please make absolutely sure to observe the figures for $ØD_{max}$.
- Carefully align the hubs when the finish bores are drilled.
- Provide for a setscrew according to DIN EN ISO 4029 with a cup point or an end plate to fasten the hubs axially.

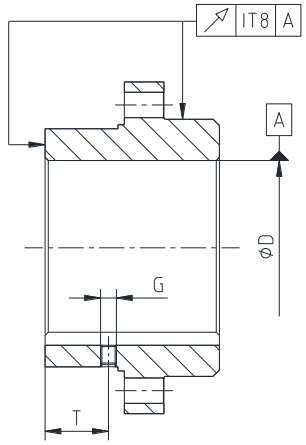


Illustration 6: Concentricity and axial runout

The customer bears the sole responsibility for all machining processes performed subsequently on unbored or pilot bored as well as finish machined coupling components and spare parts. KTR does not assume any warranty claims resulting from insufficient remachining.

Table 5: Setscrews DIN EN ISO 4029

Size	80	160	240	300	450	600
Dimension G in mm	M8	M10	M10	M12	M12	M12
Dimension T in mm	20	20	20	35	35	40
Tightening torque T_A in Nm	10	17	17	40	40	40

4.4 General advice for assembly

The VAROLASTIC® coupling may only be assembled in the order described below.

In case if a dimensional drawing was prepared for the coupling, the dimensions specified have to be primarily observed.

We recommend to inspect bores, shaft, keyway and feather key for dimensional accuracy before assembly.

Heating the hubs lightly (approx. 80 °C) allows for an easier mounting on the shaft.

Touching the heated hubs causes burns.
Please wear safety gloves.

We recommend to secure all screw connections against working loose additionally, e. g. applying Loctite screw adhesive (average strength), while the elastomer rollers must <u>not</u> come into contact with any type of adhesive.

4 Assembly

4.5 Assembly of inner component

- Mount the hub on the shaft of the driven machine.
- Fasten the hub by tightening the setscrew DIN EN ISO 4029 with a cup point (tightening torque T_A see table 5) or an end plate.

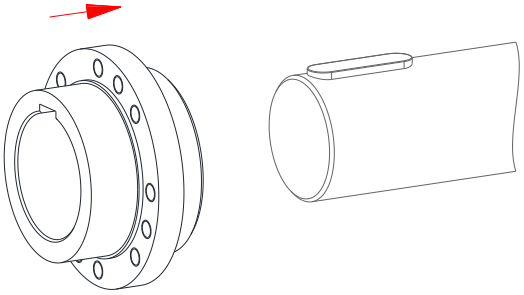


Illustration 7

- Shift the pre-assembled inner component (component 2) onto the centering of the hub (component 4). The through holes of the inner component must be aligned with the threaded holes of the hub.

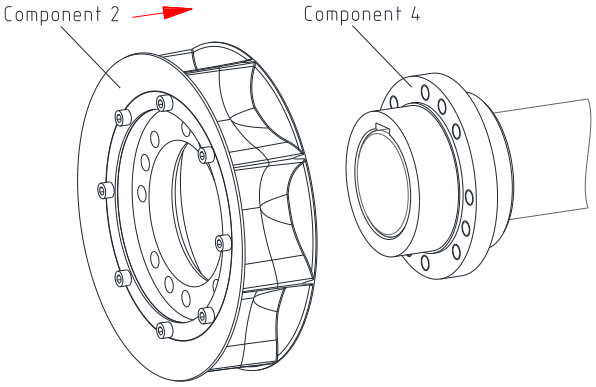


Illustration 8

- Screw the inner component (component 2) to the hub (component 4) using the cap screws (component 5) and the ratchet washers (component 6).

☞ **Make sure that the ratchet washer (component 6) is inserted with the convex side to the screw head of the cap screw (component 5) (see illustration 10).**

- Tighten the cap screws (component 5) by a suitable torque key to the tightening torques T_A specified in table 1.

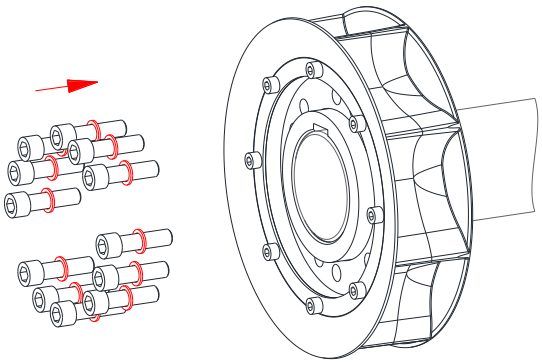


Illustration 9

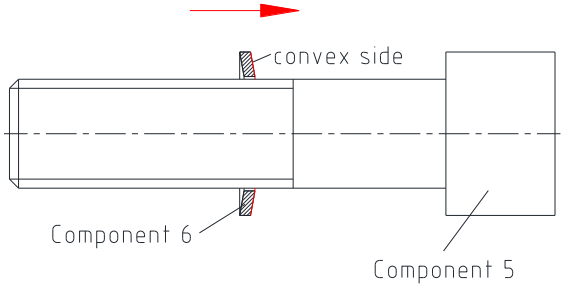


Illustration 10:
Assembly of ratchet washer

4 Assembly

4.6 Assembly of connection flange

- Insert the connection flange (component 1) into the centering of the flywheel.
- Align the through holes of the connection flange to the threaded holes of the flywheel.

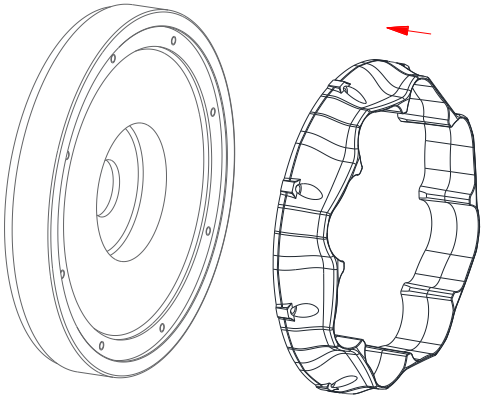


Illustration 11

- **<u>Applying for standard type only:</u>**
  Hand-tighten the components via suitable screws (not part of the scope of delivery) and ratchet washers (component 7) first.

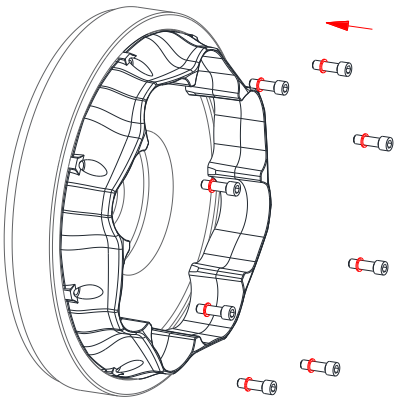


Illustration 12

☞ **Make sure that the ratchet washer (component 7) is inserted with the convex side to the screw head of the cap screw (not part of the scope of delivery) (see illustration 10).**

- **<u>Applying for adapted type only:</u>**
  Hand-tighten the components via suitable screws (not part of the scope of delivery) first.

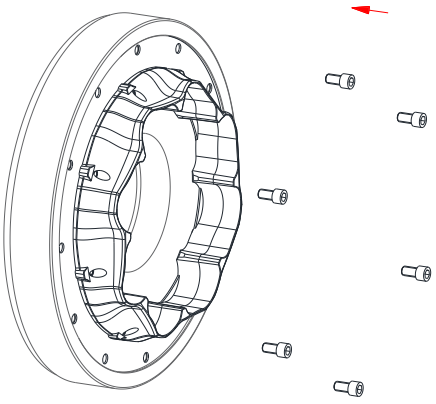


Illustration 13

- Tighten the screws at the tightening torques T_A specified in table 6 by means of a suitable torque key.

⚠ **We recommend to secure all screw connections against working loose additionally, e. g. applying Loctite screw adhesive (average strength), while the elastomer rollers must <u>not</u> come into contact with any type of adhesive.**

4 Assembly

4.6 Assembly of connection flange

Table 6: Screw tightening torques for screwing the external flange to the engine flywheel

Size	Size of flywheel acc. to SAE - J620 [1)]	Screw - property class	Number	Pitch circle in mm	Tightening torque T_A in Nm
80	8“	M10 - 8.8	6	244.5	48
	10“	M10 - 8.8	8	295.3	48
160	10“	M10 - 8.8	8	295.3	48
	11 ½“	M10 - 8.8	8	333.4	48
240	11 ½“	M10 - 10.9	8	333.4	71
	14“	M12 - 8.8	8	438.2	84
300	11 ½“	M10 - 10.9	8	333.4	71
	14“	M12 - 8.8	8	438.2	84
450	14“	M12 - 10.9	8	438.2	123
	18“	M16 - 10.9	6	542.9	206
600	14“	M12 - 10.9	8	438.2	123
	18“	M16 - 10.9	6	542.9	206

1) For dimensions of flange connection see table 2.

4.7 Insertion of elastomer rollers

- Insert the elastomer rollers into the pockets of the inner component so that they are in contact with the cast wall of the inner component and the lowest position of the inner component (see illustration 15).

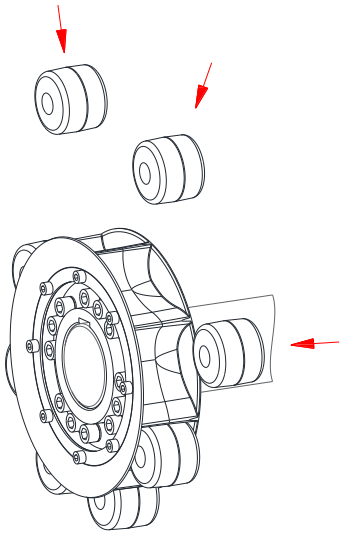


Illustration 14

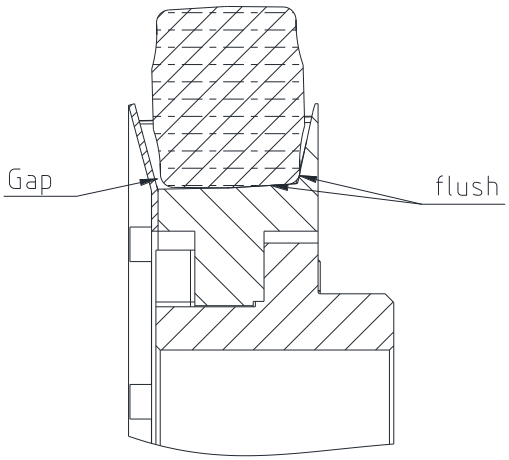


Illustration 15

- The elastomer rollers used must be secured against falling out, e.g. using a tensioning strap or a cable tie (component 8) (see illustration 16).

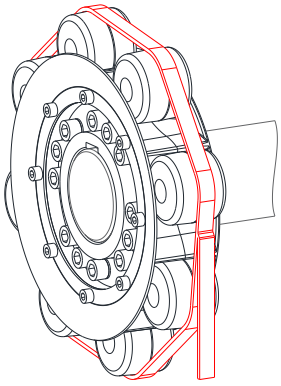


Illustration 16

4 Assembly

4.8 Assembly of the coupling

- Before final assembly, we recommend spraying the pockets of the connecting flange or the rollers with soapy water or a silicone spray (see illustration 17).

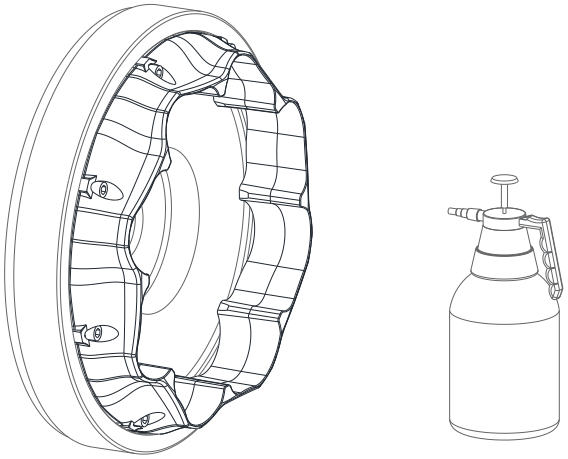


Illustration 17

- Before merging the coupling halves, align the fixed rollers and check that they are correctly seated.
- Feed the power pack with assembled inner component axially and insert with approx. 50 % coverage (see illustration 18). Avoid tilting the rollers.
- Check the position and alignment of the elastomer rollers, then remove the tensioning strap or cable tie.

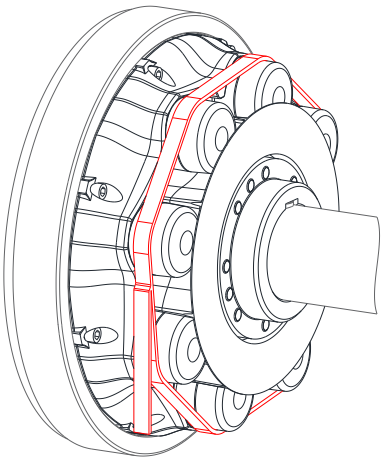


Illustration 18

- Now insert both power packs quickly into each other until the mounting dimension L4 (see illustration 20) is reached.

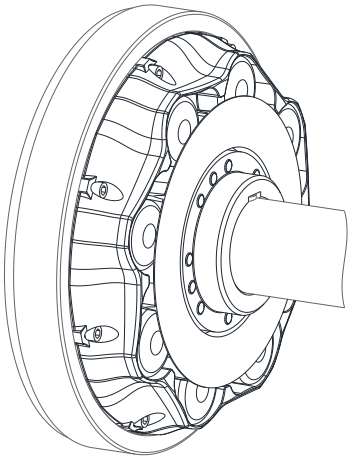


Illustration 19

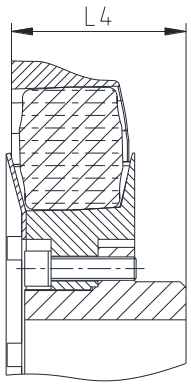


Illustration 20

4 Assembly

4.9 Displacements - alignment of the coupling

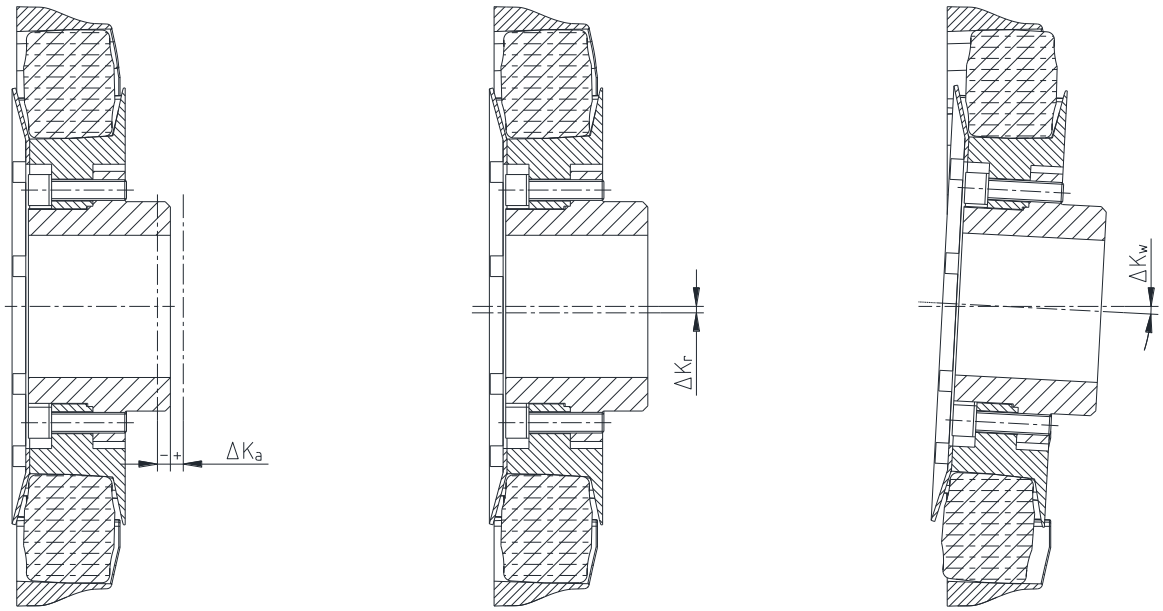
During operation, the **VAROLASTIC®** flange couplings compensate for position deviations of the machine components to be connected up to the data specified in table 7.
During assembly, the coupling must be aligned in accordance with the specifications in table 8.
The sum of the adjustment displacement and operating displacement must not exceed the maximum displacement according to Table 8.

The **VAROLASTIC®** flange coupling has to be aligned from the coupling hub on the shaft side to one of the machined surfaces of the flywheel or machine.

In order to ensure a long service life of the coupling, the shaft ends must be accurately aligned. Please absolutely observe the displacement figures specified (see table 7). If the figures are exceeded, the coupling will be damaged.
The more accurate the alignment of the coupling, the longer is its service life.

Please note:

- The displacement figures specified in table 7 are maximum figures which must not arise in parallel. If radial and angular displacements arise simultaneously, the permissible displacement figures may only be used proportionally (see illustration 22).
- The figures of maximum displacements refer to the mounting process; in addition they are permissible for a short time respectively rarely at standstill or with start-up operation as well as with exceptional loading conditions.
- Inspect with a dial gauge, ruler or feeler gauge whether the permissible displacement figures specified in table 7 can be observed.
- The displacement results in no or only low reaction forces during operation.



Axial displacement | Radial displacement | Angular displacement

Illustration 21: Displacements

4 Assembly

4.9 Displacements - alignment of the coupling

Examples of the displacement combinations specified in illustration 22:

Example 1:
ΔK_r = 30 %
ΔK_w = 70 %

Example 2:
ΔK_r = 60 %
ΔK_w = 40 %

$$\Delta K_{total} = \Delta K_r + \Delta K_w \leq 100\ \%$$

Illustration 22:
Combinations of displacement

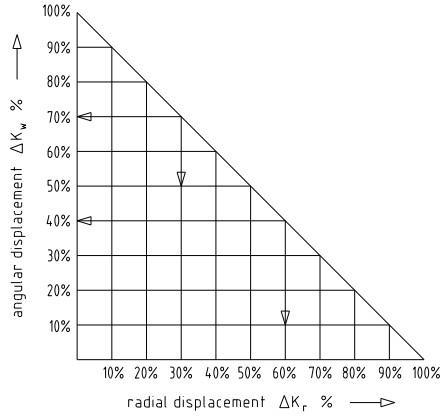


Table 7: Displacement figures(operating displacement)

Size	80	160	240	300	450	600
Perm. axial displacement ΔK_a in mm	0.2	0.25	0.3	0.3	0.5	0.5
Perm. radial displacement ΔK_r in mm	0.2	0.2	0.2	0.2	0.3	0.3
Perm. angular displacement ΔK_w in degree	0.15	0.15	0.2	0.2	0.25	0.25

Table 8: Maximum displacement and adjustment displacement

Max. axial displacement [1] ΔK_a in mm	Max. radial displacement ΔK_r in mm	Max. angular displacement ΔK_w in degree
± 1.5	0.3	0.25

1) Based on dimension L4

5 Start-up

Before start-up of the coupling, inspect the alignment and the distance dimension L4 and adjust, if necessary, and also inspect all screw connections for the tightening torques specified.

Finally the coupling protection against accidental contact must be fitted. It is required in accordance with DIN EN ISO 12100 (Safety of Machinery) and must protect against

- access with a little finger
- falling down of solid foreign objects.

The coupling protection is not part of KTR's scope of delivery and is the customer's responsibility. It must have sufficient distance to the rotating components to safely avoid contact. We recommend a distance of 15 mm from the outside diameter DA of the coupling.

Please check if a proper enclosure (ignition protection, coupling protection, contact protection) has been mounted and the operation of the coupling is not affected by the enclosure. The same applies for test runs and rotational direction inspections.

The cover may provide for openings intended for necessary heat dissipation. These openings have to comply with DIN EN ISO 13857.

During operation of the coupling, please pay attention to

- different operating noise
- vibrations occurring.

If you note any irregularities with the coupling during operation, the drive unit must be switched off immediately. The cause of the breakdown must be specified by means of the table „Breakdowns“ and, if possible, be eliminated according to the proposals. The potential breakdowns specified can be hints only. To find out the cause all operating factors and machine components must be considered.

6 Breakdowns, causes and elimination

The below-mentioned failures can result in an improper use of the **VAROLASTIC®** coupling. In addition to the specifications given in these operating/assembly instructions make sure to avoid such failures.
The errors listed can only be clues to search for the failures. When searching for the failure the adjacent components must generally be considered.

General failures with improper use:

- Important data for the coupling selection are not forwarded.
- The calculation of the shaft-hub-connection is not considered.
- Coupling components with damage occurred during transport are assembled.
- If the heated hub is assembled, the permissible temperature is exceeded.
- The clearance of the components to be assembled is not coordinated with one another.
- Tightening torques are fallen below/exceeded.
- Components are mixed up by mistake/assembled incorrectly.
- No original **KTR** components (purchased parts) are used.
- Old/already worn out elastomer rollers or elastomer rollers stored for too long are used.
- Maintenance intervals are not observed.

Breakdowns	Causes	Elimination
Different operating noise and/or vibrations occuring	Micro friction by faulty alignment on the contact surfaces of the elastomer rollers	1) Set the unit out of operation 2) Eliminate the reason for the misalignment (e. g. loose foundation bolts, fracture of the engine mount, heat expansion of unit components, modification of the installation dimension L4 of the coupling) 3) For visual inspection/inspection of wear see chapter 8 "*Maintenance*"
	Axial fastening of hub working loose	1) Set the unit out of operation 2) Inspect alignment of coupling 3) For visual inspection/inspection of wear see chapter 8 "*Maintenance*" 4) Secure the hubs axially and against working loose
Fracture of elastomer rollers	Fracture of elastomer rollers/ high impact energy/ overload	1) Set the unit out of operation 2) Disassemble the coupling and remove remainders of the elastomer rollers 3) Inspect coupling components and replace coupling components that are damaged 4) Insert elastomer rollers, assemble coupling components 5) Find out the reason for overload
	Operating parameters do not meet with the performance of the coupling	1) Set the unit out of operation 2) Review the operating parameters and select a bigger coupling (consider mounting space) 3) Assemble new coupling size 4) Inspect alignment
	Operating error of the unit	1) Set the unit out of operation 2) Disassemble the coupling and remove remainders of the elastomer rollers 3) Inspect coupling components and replace coupling components that are damaged 4) Insert elastomer rollers, assemble coupling components 5) Instruct and train the service staff

6 Breakdowns, causes and elimination

Breakdowns	Causes	Elimination
Excessive wear of the elastomer rollers, fracture of elastomer rollers	Vibrations of drive	1) Set the unit out of operation 2) Disassemble the coupling and remove remainders of the elastomer rollers 3) Inspect coupling components and replace coupling components that are damaged 4) Insert elastomer rollers, assemble coupling components 5) Inspect alignment, adjust if necessary 6) Find out the reason for vibrations
	Ambient/contact temperatures which are too high for the elastomer rollers, max. permissible -30 °C / +120 °C	1) Set the unit out of operation 2) Disassemble the coupling and remove remainders of the elastomer rollers 3) Inspect coupling components and replace coupling components that are damaged 4) Insert elastomer rollers, assemble coupling components 5) Inspect alignment, adjust if necessary 6) Inspect and adjust ambient/contact temperature
	E. g. contact with aggressive liquids/oils, influence by ozone, too high ambient temperature etc. causing a physical change of the elastomer rollers	1) Set the unit out of operation 2) Disassemble the coupling and remove remainders of the elastomer rollers 3) Inspect coupling components and replace coupling components that are damaged 4) Insert elastomer rollers, assemble coupling components 5) Inspect alignment, adjust if necessary 6) Make sure that further physical modifications of the elastomer rollers are excluded

7 Disposal

In respect of environmental protection we would ask you to dispose of the packaging or products on termination of their service life in accordance with the legal regulations and standards that apply, respectively.

- **Metal**
  Any metal components have to be cleaned and disposed of by scrap metal.
- **Nylon materials**
  Nylon materials have to be collected and disposed of by a waste disposal company.

8 Maintenance and service

We recommend to perform a visual inspection on the coupling at least once or twice a year. Pay special attention to the condition of the elastomer rollers of the coupling. The elastomer rollers should always be checked and, if necessary, replaced during the maintenance intervals of the driving or driven side.

- Remove loose dirt from the coupling.
- Inspect the coupling for spalling or missing components, if necessary. Inspect the elastomer rollers in particular for cracks.
- Defective components must be replaced immediately resp. missing components must be replaced immediately.
- Inspect the tightening torques of all screw connections and correct, if necessary.
- Since the flexible machine bearings of the driving and driven side settle during the course of load, inspect the alignment of the coupling and re-align the coupling, if necessary.

Visual inspection:

- A simple visual check for abrasion/cracks in the elastomer rollers can be made during operation, e.g. with a stroboscopic lamp or high-speed camera.
- The elastomer rollers must be checked for externally visible cracks, abrasions and signs of crushing. Deposited rubber dust is normal and acceptable.

Maintenance check:

- Check the dimensional accuracy of the elastomer rollers (component 3) using suitable measuring tool
- Replacement if dimension X is fallen below or damage
- Replacement of the elastomer rollers after 15 - 20,000 operating hours, depending on the load profile

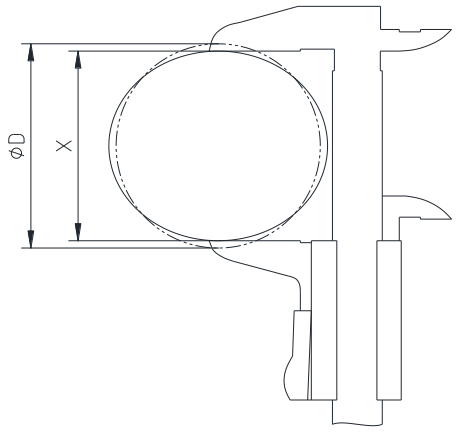


Illustration 23

$$X \approx 0{,}9 \cdot ØD_{component\ 3}$$

Table 8: Limit values of elastomer rollers

Size	$ØD_{component\ 3}$ in mm	X in mm
80 / 160	56	50
240 / 300	66	59
450 / 600	84	76

9 Spares inventory, customer service addresses

We recommend to store major spare parts on site to ensure the readiness for use of the machine in case if a coupling fails.

Contact addresses of the KTR partners for spare parts and orders can be obtained from the KTR homepage at www.ktr.com.

☞ **KTR does not assume any liability or warranty for the use of spare parts and accessories which are not provided by KTR and for the damages which may incur as a result.**

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