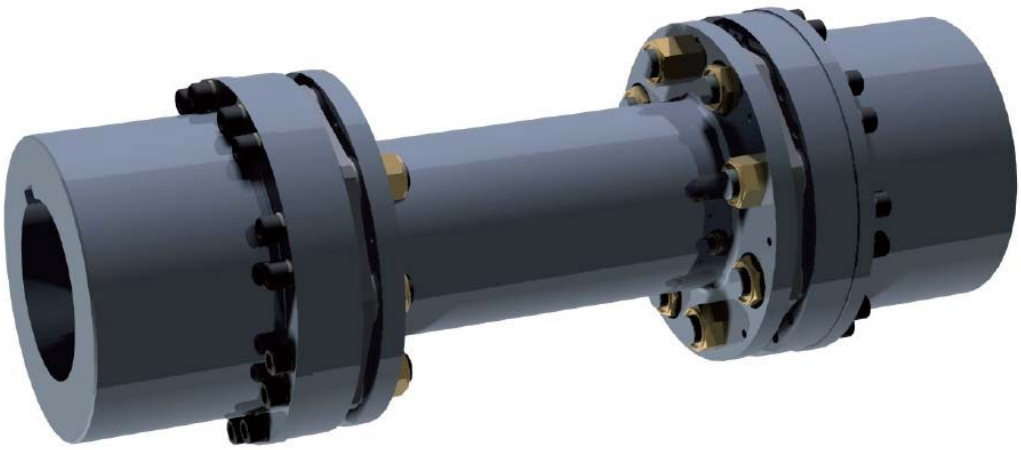
Unit 16, Victoria Spring Business Park, Liversedge
West Yorkshire England, WF15 6RA
Tel: +44 (0) 1924 460 801

TF

ORIGINAL INSTRUCTIONS

INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTIONS FOR BIBBY TURBOFLEX

TORSIFLEX COUPLINGS DESIGNED FOR GENERAL PURPOSE APPLICATIONS



Author IA; Issue G 04 March 2021

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1. General Notes

It is essential that a competent person carry out all the instructions contained in the following documents. Should any problems be anticipated or encountered then **Bibby Turboflex** personnel are available for site visits or, alternatively, repairs and overhauls can be undertaken in our works.

Prior to performing any maintenance works (including inspections) it is essential that the power supply is isolated and that no accidental movement of rotating machinery is possible.

This product is designed for a specific purpose. It is vital that it is not used for any purpose other than that for which it is designed and supplied, and that the limits of it's capacities, as detailed here or in any other document, are not exceeded.

No liability will be accepted and any warranty, either expressed or implied, will be null and void should any component of whatever kind, including nuts, bolts and washers, be used in the assembly, or modifications be made to all or part of the product which are not supplied, specified or agreed by **Bibby Turboflex**.

1.1 Do's

The following instructions should be read and understood prior to starting any assembly or maintenance work on the Torsiflex disc coupling.

Prior to fitting any component, care should be taken to ensure that it is clean and free from any dirt. When tightening any bolts or screws, this should be done evenly, cylinder head fashion, to 50% torque then to 100% torque in the same sequence. Where specified it is essential that torque-tightening figures are not exceeded nor should it be allowed for them to be below specification.

Whilst installing and removing the transmission unit*, the unit should be supported to ensure that the weight is not imposed on one side only.

Record the **Bibby Turboflex** order number, coupling type and size and any relevant information for future use.

Contact **Bibby Turboflex** for refurbishment works and spare components.

1.2 Don'ts

Do not use any component that is not supplied or approved by **Bibby Turboflex** in the assembly of this product.

Do not attempt, where the weight of the unit is excessive, to lift the coupling without the use of lifting equipment.

The inherent balance of these couplings could be disturbed if they are allowed to be knocked either by striking or rolling. Care should be taken when transporting and fitting to avoid such knocks. This is particularly when a coupling is specifically balanced.

* refer to section 8, figure 3 for definition of Transmissions Unit

1.3 Description of Coupling

The Torsiflex coupling is of the dry disc type. Flexibility is obtained by the deformation of the disc packs, within defined limits, which are separated by a tubular spacer.

Individual laminations are of regular polygonal profiles, which are assembled into a stack of previously designated thickness, supported by washers on each side. Flexibility is accomplished by connecting through the holes, on a common pitch circle diameter, by means of bolts, alternately, to driving and driven components.

The bolts, washers and associated holes are machined to close limits associated with “fitted bolts”. Due to the need for reasonable ease of assembly, interference fits are undesirable and, consequently, tolerances are such as to allow for a close slide or slight transition fit. To compensate for these clearances and to ensure the best possible concentricity between components, the pitch circle diameter of the bolt holes in the flexible element is made smaller than that of the mating holes in the adjacent components. On assembly, all inherent clearances are, therefore, eliminated.

Coupling bolts are sized such that they are capable of inducing a load equivalent to 4 times the tensile load in the flexible element laminations, between driving and driven bolt, when transmitting the full rated continuous torque of the coupling. This assumes a coefficient of friction between the various components of 0.25 but experience has shown that, due to the high loads induced, minute compressive deformation is sufficient to raise this to about 0.3.

The reason for adopting this principle of using large, highly loaded, bolts is two-fold a) to prevent interface slip, as already mentioned, and b) to eliminate any chance of bolt bending due to the overhung radial loading imposed by the flexible element. Avoiding either slip or bending helps to avoid fretting which occurs when bolts are designed only to drive in shear.

Pairs of coupling washers are used to “sandwich the element packs”, one thin, the element washer, and one thick, the overload washer. The overload washers locate in close clearance holes in the coupling adaptor plates. In the unlikely event of a severe overload the overload washers will contact the side of the clearance hole, thus preventing rupture of the elements and ensuring drive is maintained.

In general, the design is identical to a large number of units supplied and fitted for many years by **Bibby Turboflex**.

1.4 Torsiflex Coupling data

- Specifically designed for the process
- pump and general industrial markets.
- Plug-in design allows installation and removal without disturbing the hul
- Standard couplings fully compliant
- with the requirements of API 610/ ISO
- Incorporates anti-flail feature
- API 610/ ISO 14691
- Large hubs available on first two sizes

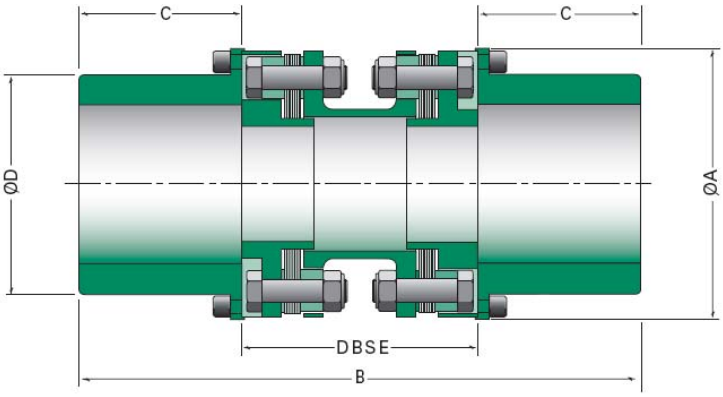


Table 1

COUPLING SIZE TF	kW RPM	Rating kNm	MAX SPEED RPM	COUPLING DIMENSIONS					MAX BORE		Mass Transmissions Unit (Kg)		Mass Unbored (Solid) Hubs (Kg)	
				A mm	B mm	C mm	D mm	Min DBSE mm **	Std Hub mm	Large Hub mm	At min. length	Extra per 10 mm	Std.	Large
27	0.028	0.27	20,000	84	150	40	84 *	70	40	51	1.34	0.03	0.9	1.69
38	0.040	0.38	16,500	103	160	45	103 *	70	51	70	1.95	0.04	1.6	2.84
140	0.147	1.4	12,000	127	250	75	101	100	73	-	4.5	0.07	4.9	-
260	0.272	2.6	10,000	149	290	85	117	120	85	-	7.8	0.10	7.5	-
400	0.419	4.0	8,500	176	350	105	144	140	105	-	12.9	0.14	13.8	-
750	0.785	7.5	7,500	203	410	120	166	170	120	-	21	0.23	21	-
1310	1.37	13.1	6,500	241	490	145	199	200	145	-	37	0.27	37	-
1900	1.99	19.0	5,600	279	500	150	233	200	170	-	46	0.33	52	-
2500	2.62	25.0	5,200	296	548	164	240	220	175	-	60	0.40	61	-
3300	3.46	33.0	4,900	326	604	182	270	240	190	-	81	0.49	84	-
6000	6.28	60.0	4,000	395	720	230	322	260	230	-	124	0.73	151	-
8500	8.90	85.0	3,600	443	844	262	365	320	260	-	199	0.96	220	-
12000	12.57	120.0	3,000	493	924	292	410	340	290	-	258	1.19	311	-

* Large Hub Boss Diameter

** The Inclusion of additional features such as packing rings, shims, and/or electrical insulation etc, will increase the minimum dimensions by the appropriate amount.

2.0 Operating conditions

In operation the flexible elements are subjected to both tensile and bending stresses, each having an influence on the allowable magnitude of the other. It is important, therefore, that the operating limits of the various deflections for which the coupling is designed to accommodate, are kept, as far as practicable, within those indicated on the "Allowable Misalignment Curve"

In practice, the initial alignment of the coupling should be as close as possible and within the alignment limits given in the section 8.0 "Installation Instructions". This will allow for changes during operation to remain within allowable limits.

As the **Bibby Turboflex** units are designed to transmit the torque in friction between the driving and driven bolts and the flexible elements, it is essential that, should the need arise, these bolts should be correctly tightened to the torque indicated on the assembly drawing or in the "Installation and Maintenance Instructions".

Torque and speed should remain within the originally specified conditions.

3.0 Product identification/marking for non-electrical equipment.

Scope: Torsiflex Disc Coupling Assemblies, excluding component spares.

Equipment manufactured or supplied by **Bibby Turboflex** is marked legibly and indelibly, in a variety of ways, with the following (subject to contractual obligations permitting): -

- Name and telephone number of manufacturer
- Designation of the series or type and size (Part Number)
- Contract/Order Number and if applicable the unique serial number

3.1 Atex Compliance

If this coupling is marked with the ATEX symbol,  then it is supplied in accordance with Directive 2014/34/EU (ATEX) & BS EN ISO 80079-36:2016 as non-electrical equipment for use in explosive atmospheres by providing protection through constructional safety "c" and control of ignition sources "b" in compliance with BS EN ISO 80079-37:2016.
For this coupling to meet ATEX requirements, these installation and maintenance instructions must be followed. If these instructions are not adhered to, the coupling will be immediately considered non-conforming to ATEX.

IF IN DOUBT – CONTACT THE SUPPLIER

3.1.1 Product Identification / Marking

Applies to disc coupling assemblies. Excludes component spare parts.

3.1.2 Marking

The equipment shall be legibly and indelibly marked, in a variety of ways, on the main part on the exterior of the equipment and shall be visible prior to the installation of the equipment. (subject to contractual obligations permitting),

- Name and telephone number of manufacturers.
- Designation of the series or type and size (Part Number)
- Contract/ Order Number and/or Batch or serial number, if any

If applicable and in addition to the above, for equipment intended for use in potentially explosive atmospheres, the following will be marked on the equipment in accordance with Directive 2014/34/EU (ATEX) and BS EN ISO 80079-36:2016.

- Year of construction
- Identification number of the notified body
- CE Symbol.
- The specific symbol of explosion protection  followed by the equipment group and category.
- For equipment group II,
    - the letter 'G' (concerning explosive atmospheres caused by gas, vapours or mist), and/or
    - The Letter 'D' (Concerning explosive atmospheres caused by dust)

- Symbol “Ex” indicating explosion prevention and protection
- Letter “h” indicating non-electrical equipment.
- Where appropriate Equipment Group including the subdivision
- For group II the symbol indicating temperature class or maximum surface temperature in °C. (e.g.T4 or T4… T2)(see notes below)
- For group III the letter “T” followed by the maximum surface temperature in degrees Celsius followed by the units “°C” (e.g. T135 °C… T300°C) (see notes below)
- The EPL (Equipment Protective Level).
- The ambient temperature range when different to Standard.

Note:

Where a temperature class or surface temperature range is specified (e.g. “T4… T2”), then further assessment must be performed to ascertain an accurate surface temperature based on application. (see “Adjustments for Temperature Classification” below)

Standard ambient temperature (Ta) is between -20°C to 40°C.

3.1.3 Adjustments for Temperature Classification

If a Temperature Class Range is stated as part of the product marking, the coupling must be reviewed to account for influencing factors on the surface temperature of the coupling. It is the responsibility of the purchaser / installer to ensure the correct temperature class is applied.

The list below isn’t exhaustive but highlights some of the main factors to include when making this assessment. The temperature class can then be read from the following table taking account of EPL.

Temperature Class (1)	Maximum Surface Temperature °C (2)	The Highest Surface Temperature Measured / Calculated shall not exceed °C for specified EPL		
		EPL Ga (3)	EPL Gb & Gc (4)	EPL Da, Db & Dc (5)
T1	≤ 450	360	440	450
T2	≤ 300	240	290	300
T3	≤ 200	160	195	200
T4	≤ 135	108	130	135
T5	≤ 100	80	95	100
T6	≤ 85	68	80	85

Heat Generated by the Coupling

Heat generated by the coupling alone is considered negligible. There are no moving parts to generate friction and any heat generated by the flexing of the discs is very low when the coupling is installed correctly. The surface temperature of a coupling is due to heating from other sources in the environment and installation of the coupling as listed below.

If no other heat sources / sinks are expected on the application, then the expected temperature class will be T6 / T85°C

Ambient temperature greater than standard.

Once thermal equilibrium is achieved after installation, the surface temperature of the coupling will be equal to the ambient temperature of the environment. The maximum ambient temperature will also be the maximum surface temperature of the coupling.

Heat generated by windage power losses.

Couplings are generally guarded for health and safety reasons. These guards tend to be close fitting. When couplings rotate at high-speed, they shear the air within the guard and this shearing generates heat through friction.
A coupling installed in an open guard (i.e. ventilated or constructed from mesh) is not expected to generate heat. Couplings in closed guards with very little ventilation are expected to heat up significantly. Likewise, slow speed couplings will generate less heat than a high-speed coupling.
Please refer to the guard manufacture for further advice.

Heat transfer from nearby equipment and other sources.

Heat can be transfer to the coupling through,

Conduction via connected parts, i.e. Flanges, Hub/Shaft interface
Heat radiated from a nearby source such as a turbine or the Sun

Heat from connected equipment can be transferred to the coupling. For example, a shaft of a pump moving a hot liquid will transfer heat from the liquid to the coupling. Or a coupling outside can absorb heat from the Sun particularly when it is stationary

4. Maintenance instructions

General maintenance of the coupling consists of a check of the following during normal machinery maintenance schedules. API617 references this time period as 3 years for compressor applications.

Axial, Angular & Parallel misalignment to ensure that these are still within the acceptable limits and that no major movements have occurred.

All bolts to ensure that they are correctly tightened.

Inspect the flexible elements visually for signs of fatigue cracking local to the washer anchoring points or general signs of fretting corrosion. Slight bowing or “S” like distortion is not detrimental to the operation of the unit. Note that any cracking will begin at the outermost edge of the outside blade. This means that this inspection is still possible without disturbing the element bolting. The element packs should be replaced at the earliest opportunity should cracking / damage be detected.

Bibby Turboflex use self locking nuts. This gives a high level of performance over many reinstallations.

Note: Any requirement for spare parts should be made quoting the original purchasers original purchase order number and the coupling serial number. (This will be etched on the major coupling flanges) and will appear on all documentation.

5. Alignment Instructions

Torsiflex will accept substantial amounts of misalignment, the configuration of each individual unit defining the actual acceptable level. The allowable misalignment is shown graphically on a curve section

This curve shows the maximum permitted level of misalignment for operation and is NOT

intended to define set up limits.

6. Alignment Method.

Each company has its own method for aligning machinery all of which are well documented in both internal and freely available documents and books. Hence it is not our intention to describe methods for setting machines. Instead, the following gives guidelines for quick checks for alignment suitable after initial installation and for general maintenance checks.

6.1 Axial Alignment

The suggested limits for axial set up distance between the machinery shafts are as shown in table 2.

Sizes	No. of Bolts	Tolerance on DBSE
TF0027 to TF1310	6	± 0.3 mm
TF001900 to TF12500	8	± 0.25 mm

6.2 Parallel / Radial / Angular Alignment

Having basically aligned the machinery shafts using one of the established techniques, the coupling may be installed as per the instructions. It is then worth performing a check to establish that the overall alignment is correct for the particular coupling. This may be simply performed by one of the following two methods:

Attach a dial indicator securely to the back of one of the coupling flanges, with the needle in contact with the flange face the other side of the flexible element as near the outside periphery as possible. Rotate the machinery & coupling and locate the minimum reading position. At this position, set the dial reading to zero. Rotate the machinery again and record the maximum reading over 360 degrees. Divide this maximum value by the coupling flange diameter to gain a value in mm/mm, which should be no greater than that shown in the following list. (This should be repeated at both flexible elements in a spacer coupling).

An alternative method is, where possible, to accurately measure the distance across the flanges that sandwich the flexible element (element gap) to obtain a maximum and minimum value. The difference between these two values should be divided by the flange outside diameter to obtain a value in mm/mm, which should be no greater than that shown in the following list. (This should be repeated at both flexible elements in a spacer coupling).

Table 3

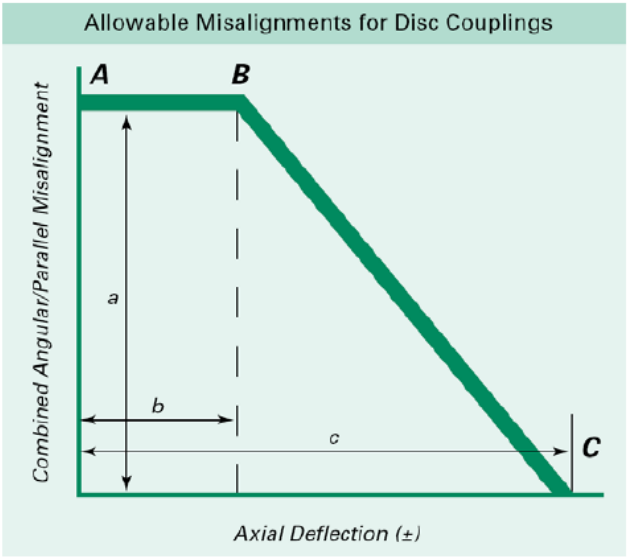
Sizes	No. of Bolts	Tolerance Element Gap
TF0027 to TF1310	6	± 0.003 mm/mm
TF001900 to TF12500	8	± 0.002 mm/mm

NOTE: These values are intended as guides only and, in certain cases, may be exceeded. IF IN DOUBT, CONTACT BIBBY TURBOFLEX.

6.3 Installation and Operating |Misalignment Limits.

The following curve shows the general allowable running misalignment limit

Figure 2

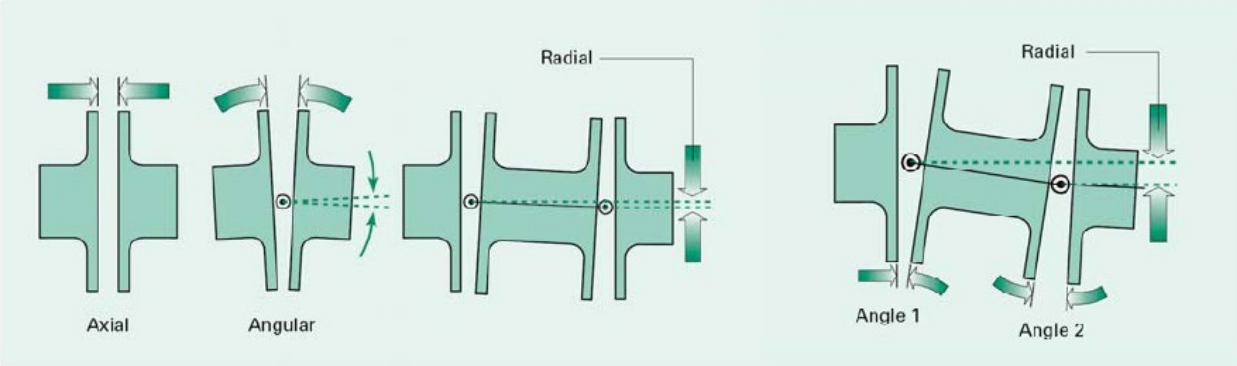


1. Combined angular/radial misalignment
2. 1 degree angle is equivalent to 0.017 mm/mm
3. At zero speed (Static)
4. At maximum speed and continuous rated torque

The coupling shall operate within this envelope (below the allowable misalignment curve) and providing these limits are not exceeded at any time, the coupling should enjoy a trouble free life.

Table 4 - TF Misalignment Data

COUPLING SIZE TF	Max Angular Misalignment (Deg)	Bending Moment (Nm/deg)	Max Axial Deflection (Zero Angular Misalignment) (mm)	Max Axial Thrust (N)	Max Axial Deflection at fill Angular Misalignment (mm)	Max Axial Thrust (N)
	Point A (1) (2)	(4)	Point C (3)		Point B (4)	
	Per Element		Per Assembly			
27	0.5	31	1.7	560	0.5	65
38	0.5	27	2.2	500	0.5	40
140	0.5	27	2.7	1,278	0.5	90
260	0.5	40	3.3	2,410	0.6	125
400	0.5	89	4.3	4,080	1.4	500
750	0.5	146	5	6,140	1.8	900
1310	0.5	272	6	8,770	2.2	1300
1900	0.33	375	5	11,000	1.5	1500
2500	0.33	500	5.4	12,900	1.7	1500
3300	0.33	590	6	15,650	1.8	1800
6000	0.33	955	7.5	23,000	2.4	2700
8500	0.33	1390	8.1	33,500	2.8	5000
12000	0.33	1710	9	38,200	3	5000



7. Limited End Float Couplings

N.B. In the case of special limited end float (LEF) versions the amount of axial movement is physically restricted and therefore the values shown in the above table do not apply. In these cases please refer to the coupling drawing for reference to the amount of axial movement the coupling is capable of.

8. Installation Instructions.

No liability will be accepted, and any warranty, either expressed or implied, will be null and void

should any components of whatsoever kind, including nuts, bolts and washers, be used in the assembly or any modifications be made to all or part of the unit which are not supplied, specified or agreed by **Bibby Turboflex**.

For general Safety, Alignment and Maintenance Instructions see other sections of this manual. **IMPORTANT:** The main Coupling Bolts/Nuts at both ends are tightened by **Bibby Turboflex,** and should, under normal circumstances, **NOT BE TOUCHED** unless specified in the installation instructions.

When tightening any other bolt or screw, this should be done evenly, i.e. cylinder head fashion, to 50% torque then to 100% torque in the same sequence. Threads should be lubricated with Molybdenum Disulphide grease or equivalent. Reference table 6 for tightening torques.

Check that the parallel & and axial misalignments of the shafts are within the limits defined in the alignment curves, section 7.4, figure 2. **Bibby Turboflex** do not recommend any specific alignment method as this varies due to personnel preference; however the alignment should be within the operational envelope shown on the misalignment curve.

8.1 Reference any applicable drawings for sizes and dimensions. Ensure that all required tools and equipment are available.

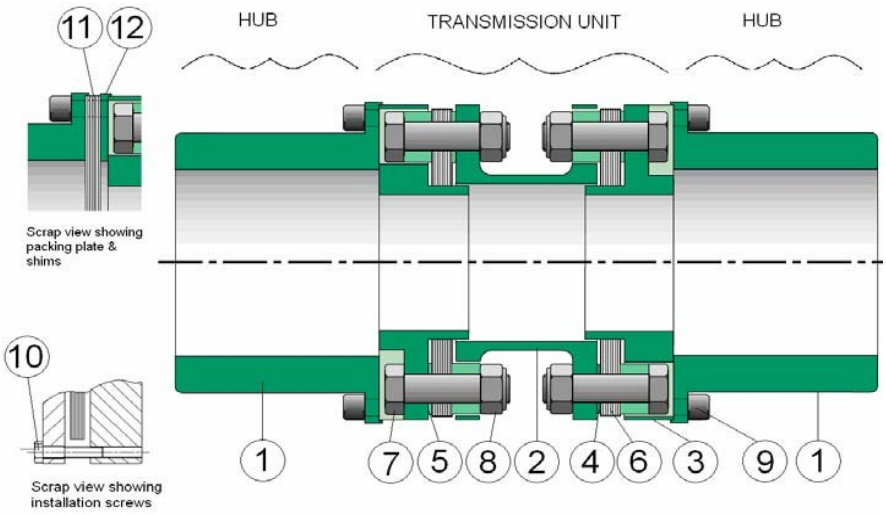
8.2 The coupling is supplied in an assembled state with its misalignment capabilities locked by installation screws near the element packs. The coupling is packed appropriately for transportation and storage. Inspect the coupling for:

- Indication of deviation from specification to ensure that it conforms to requirements.
- Potential damage due to transportation.

8.3 For balanced couplings, note any match markings, which must be aligned when the coupling is installed.

8.4 The Torsiflex coupling hubs must be removed from the transmissions unit – see figure 1. to allow installation. Remove the connecting nuts and bolts from the hub/adaptor flanges and using jacking screws force the flanges apart. Store the nuts and bolts along with the packing ring and shims (if supplied) for future stages of installation.

Figure 3: Coupling Construction



Component Parts

1. Hubs
2. Spacer
3. Adaptor
4. Element Washer
5. Element Washers
6. Element Blades
7. Coupling Bolt
8. Coupling Nuts
9. Attachment Screws
10. Installation Screws
11. Shims
12. Packing Plate

8.5 The hubs may now be fitted to the driver and driven shafts. The method of fitting will be dependant on the type of fit specified for the particular installation. In all cases the hub face should be in line with the shaft end.

Where hub/shaft connections require a standard interference fit the hubs may be heated in an oil bath or oven at 200-250 °Celsius and rapidly positioned on the shaft. It is essential that this heat is evenly applied over the whole hub and that spot heating is avoided. Ensure that one shaft rotates so that the coupling match marks can be aligned.

8.6 Check the shafts misalignments and DBSE (distance between shaft ends) are within allowable limits. (Reference Section 7.4).

8.7 The main bolts in the transmission unit are factory assembled and must not be disturbed. Undo the installation screws; the coupling should now be in a relaxed state.

If no packing ring or shims are supplied, go to step 8.12.

8.8 Measure the free length of the transmission unit. Add to this the thickness of the packing plate. Record this value as X.

8.9 Now measure the distance between the shaft ends (DBSE) of the machinery. Adjust this length by either subtracting pre-stretch or adding pre-compression. Record this value as Y

8.10 Calculate the required number of shims from the following equation

Number of shims = (Y-X) ÷ shim thickness

Round this value to a whole number of shims. Shim thickness is 0.381mm

8.11 Fit shims between packing ring and the transmission unit. Ensure match marks are aligned.

8.12 Install the attachment screws Ref 9, and tighten in cylinder head fashion, maintaining parallelism between the flange faces of the adaptor and spacer, until both elements packs are compressed by a minimum required amount to allow the transmission unit to be put into position.

Do not compress the elements beyond the value stated in "Maximum Element Compression" Values.

Table 5 These values express the maximum amount of compression allowed per element pack. However, it is recommended to use the minimum amount of compression required when installing couplings

Coupling Size TF	Maximum Compression (mm) per element pack
27	1.5
38	1.75
140	2.0
260	2.3
400	2.3
750	2.5
1310	3.0
1900	3.0
2500	3.0
3300	3.0
6000	3.5
8500	3.5
12000	4.0

8.13 Position the transmission unit between the shaft ends (hub faces), ensuring match marks are aligned.

8.14 Fit and tighten in cylinder head fashion the connecting bolts that pass through the packing ring and shims. Reference table 6 for tightening torques.

8.15 Release and remove the compression screws.

8.16 Fit and tighten in cylinder head fashion the connecting bolts that pass through the remaining flange. If a pre-stretch is present, it may be necessary to pull the flanges together using the connecting bolts. Reference table 6 for tightening torques.

8.17 Ensure all match marks are aligned, all tooling is removed and inspect the coupling before operation.

9. Removal Instructions

Coupling removal is a reverse of the above installation process ensuring that, upon re-installation, the above process is again followed in careful sequence.

Table 6: When tightening any other bolt or screw, this should be done evenly, i.e. cylinder head fashion, to 50% torque then to 100% torque in the same sequence. Threads should be lubricated with Molybdenum Disulphide grease or equivalent

IMPORTANT: The main Coupling Bolts/Nuts at both ends are tightened by **Bibby Turboflex,** and should, under normal circumstances, **NOT BE TOUCHED** unless specified in the installation instructions

Coupling Size TF	Coupling Bolt Nm	Attachment Screw Nm
27	9	12
38	9	30
140	45	12
260	75	30
400	113	30
750	225	55
1310	370	64
1900	370	64
2500	480	152
3300	750	152
6000	1100	287
8500	1900	380
12000	2500	481

10. Proposition 65 Compliance warning.

WARNING: Cancer – For more information, go to www.P65Warnings.ca.gov.