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WILLBRANDT Planning, fitting and maintenance instructions for rubber compensators with rotatable flanges or solid flanges

WILLBRANDT rubber compensators are available in two ready-to-fit versions with standard connections (in accordance with DIN, ASA, BS, etc.):

- **Rotatable steel flanges**
  These flanges should fit precisely and burrfree in the fitting area of the rubber bellow, whereby the sealing surface can protrude about 1 - 10 mm depending on the nominal diametre. The mating flange sealing surfaces can be smooth (Form A) or with sealing (Form B) according to EN 1092 - 1:2001.
- **Pressure-resistant solid rubber flanges**
  Flange bellows up to DN 2400 are delivered with one-piece steel backing flanges (from DN 2500 divided). The mating flanges should have a smooth sealing surface in accordance with EN 1092 - 1:2001 (Form A).

Both types of compensator are self-sealing; additional seals are unnecessary.

1. Planning instructions

Compensators must be arranged in pipes in such a way that regular maintenance and any necessary replacement can take place easily.

Ensure that the compensators do not rub against adjacent components also when expanded to the maximum permissible limits. The compensators must also not be exposed to high externally radiated or accumulated heat.

Universal compensators (without tie rods) for absorbing axial, lateral and angular movements

For a compensator to absorb the axial or lateral movements (expansion or compression) of a pipe, it must be fitted between two fixed points. Plain bearings (PB) must also be included for pipe routing/support.

The reaction forces, adjusting forces and friction forces must be taken into account in the dimensioning of the fixed points and plain bearings.

Reaction force (N) = effective area (mm²) x operating pressure (N/mm²)

F = A x P

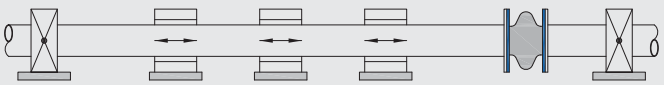
(Adjusting forces according to type data sheet)

Fitting example 1 (EB 1)

Compensation of axial expansion with compensators without tie rods

The reaction forces of the compensator are absorbed by the fixed bearings.

EB 1

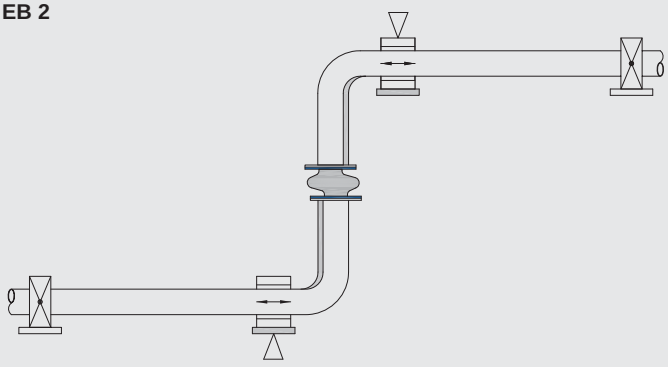


Fitting example 2 (EB 2)

Compensation of lateral and axial expansion with a compensator without tie rods

The reaction forces of the compensator are absorbed by the fixed bearings and plain bearings. The plain bearings must be appropriately supported! Adjusting forces must be absorbed by the fixed points.

EB 2



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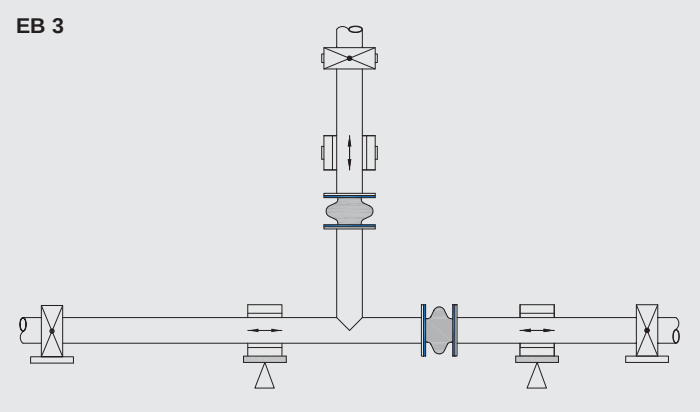
Fitting example 3 (EB 3)

Compensation of lateral and axial expansion with compensators without tie rods arranged in a pipe outlet

The reaction forces of the compensator are absorbed by the fixed bearings and plain bearings. The plain bearings must be appropriately supported!



Lateral compensators (with tie rods) for absorbing lateral movements

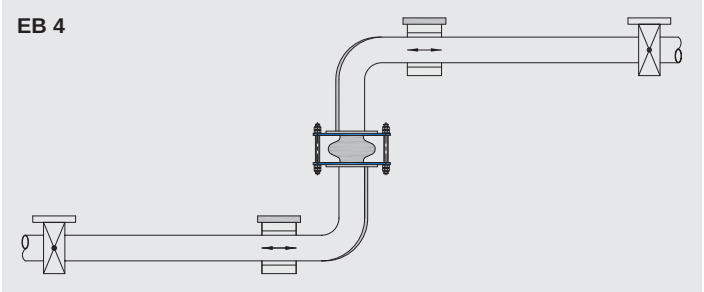
If a compensator for absorbing axial movements cannot be fitted between two fixed points, the axial movement must be converted into a lateral movement. This makes it possible to use an compensator with tie rods, which neutralises the occurring reaction forces (inside area of the compensator x operating pressure). With this arrangement, only appropriate plain bearings may be used for correct initiation of expansion.

A wide range of rubber compensators with tie rods can be found in our catalogue.

Fitting example 4 (EB 4)

Compensation of axial expansion by deflection into a lateral movement with compensators with tie rods

The adjusting forces of the compensator are absorbed by the fixed bearings. The plain bearings serve only for correct initiation of movement in the compensator! In contrast to EB 2, axial movement of the vertical pipe arm is disregarded.



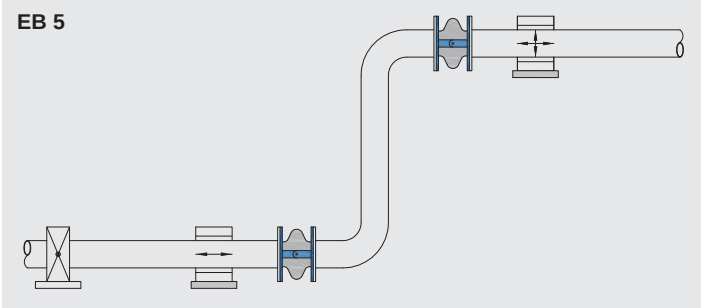
Angular compensators (with joint tie rods) for absorbing angular movements

In order to absorb significant axial movements with low adjusting forces, a combination of angular compensators with tie rods can be used.

Fitting example 5 (EB 5)

Compensation of axial expansion by deflection to angular movement using compensators with tie rods

Advantage: significant axial expansion can be absorbed by only two compensators. The reaction forces of a compensator are absorbed by the joint tie rods. The plain bearings serve only for correct initiation of movement in the compensator!



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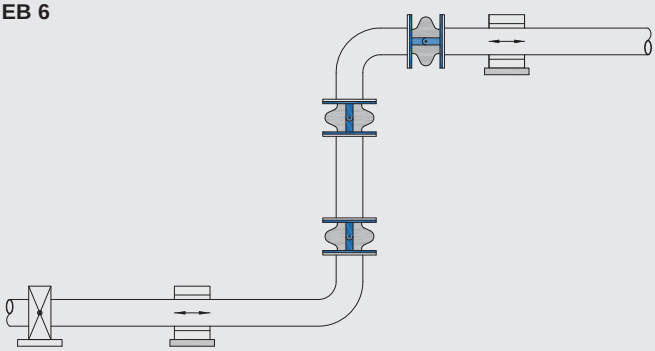
Fitting example 6 (EB 6)

Arrangement of pipe joint compensators in three joint systems for compensating expansion in two directions

Advantage: high expansion compensation, low adjusting forces, soft corner. The reaction forces of the compensator are absorbed by the joint tie rods. The plain bearings serve only for correct initiation of movement in the compensator!

EB 6



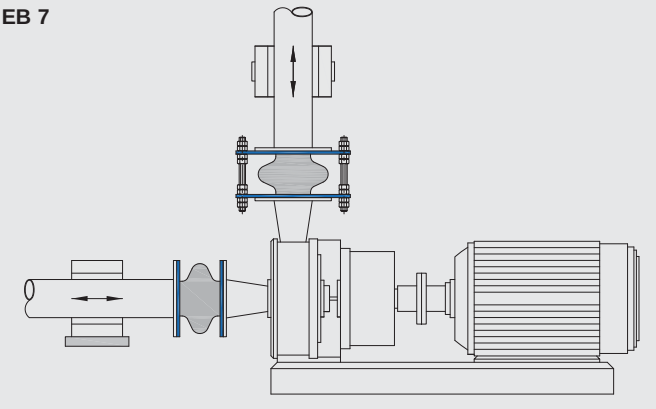
Fitting example 7 (EB 7)

Compensators for pump connection (with/without tie rods) for absorbing vibrations

The purpose of using rubber compensators on pumps is to prevent the transmission of forces, stresses and vibrations in order to decouple the pipe system from the pump.

Compensators with tie rods should always be used for arrangement in pressure pipes to prevent the pump support from being overloaded due to the reaction forces. A vacuum support ring should be used on the suction side if possible (see type data sheet).

EB 7

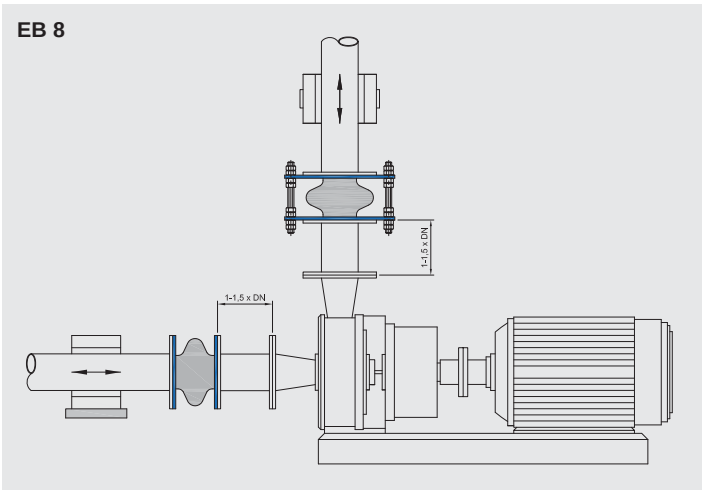


Fitting example 8 (EB 8)

For the transport of abrasive media (liquids containing solids such as water/sand), the compensators must not be arranged directly on the pump support (suction/pressure side) as there is a risk of the compensators being damaged due to relatively high velocities from turbulence and vortex formation on the pump support. This applies similarly to elbows and outlets.

The fitting distance from the pump support to the compensator/elbow must be 1 to 1.5 times greater than the nominal diameter. Pump operation against a fully or partly closed gate or flap valve must be avoided. Cavitation must also be avoided as this can quickly damage the compensator.

EB 8



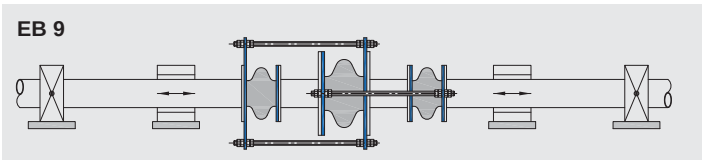
Fitting example 9 (EB 9)

Compensators with pressure relief for absorbing axial and lateral movement

Pressure-relieved compensators can be used to prevent the transmission of reaction forces resulting from excess or low pressure to adjacent fixed bearings, apparatus or machines.

Compensators for absorbing axial expansion without the transmission of reaction forces resulting from excess or low pressure to adjacent fixed bearings, apparatus or machines (observe adjusting forces).

EB 9



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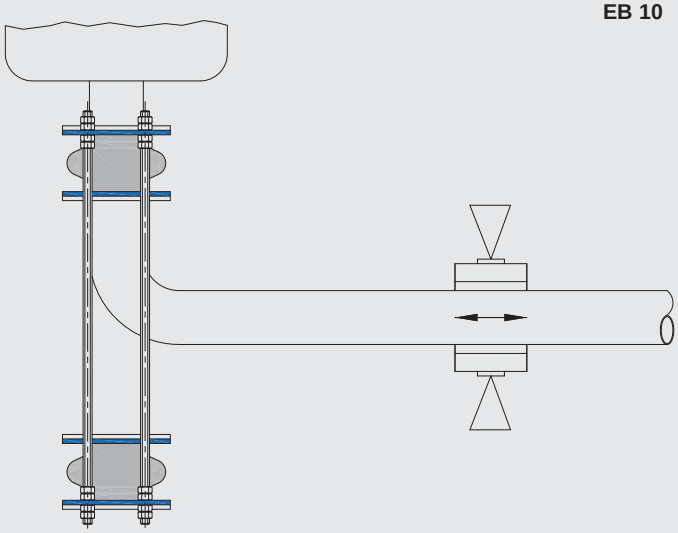
Fitting example 10 (EB 10)

Compensators for absorbing axial and lateral expansion on an elbow without the transmission of reaction forces resulting from excess or low pressure to adjacent fixed bearings (adjusting forces).

EB 10



Compensators (with tie rods) for fitting/removal

To compensate for fitting inaccuracies or for easy fitting or removal, a compensator with tie rods can also be mounted directly on a valve.

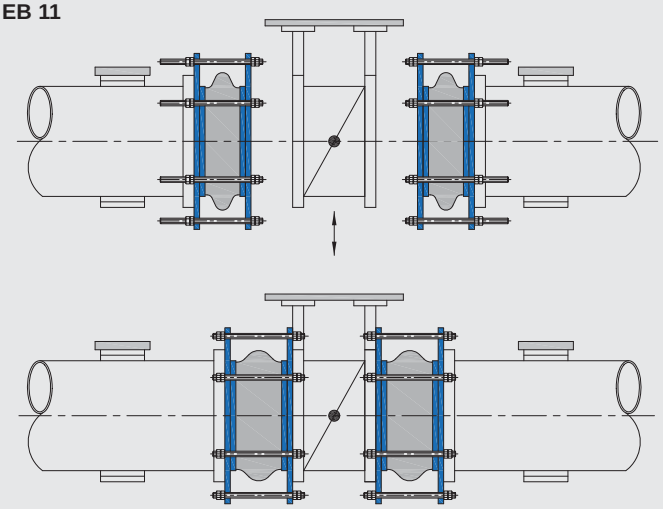
Fitting example 11 (EB 11)

Compensator with tie rods for fitting/removal

Tie rods prevent the transmission of reaction forces to a connected valve and by loosening the flange connection with the aid of the tie rod flange, the rubber bellow can be compressed to its maximum axial limits to enable removal of the valve.

Warning:
This is valid only for compensators with pressure-resistant solid rubber flanges. In case of compensators with rotatable flanges there is a danger that the bellow sealing bead could spring out of the flange groove. This could lead to lead to the sealing surfaces being crushed during re-fitting (see EB 16F).

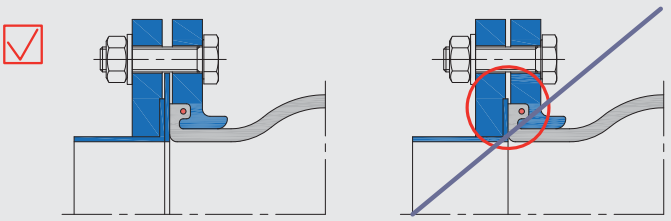
EB 11



Fitting example 12 (EB 12)

For rubberised pipes or valves, a blank gasket must be used to prevent a rubber-on-rubber seal.

EB 12



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WILLBRANDT Planning, fitting and maintenance instructions for rubber compensators with rotatable flanges or solid flanges

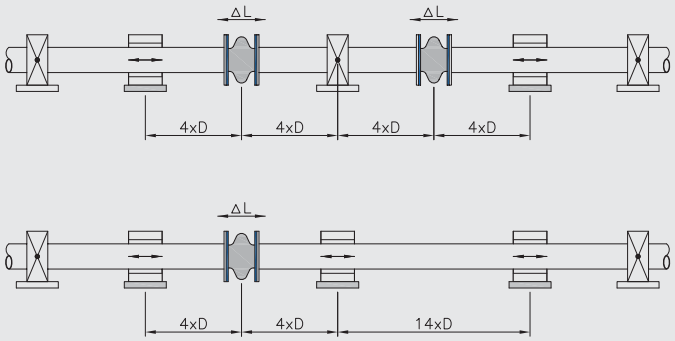
2. Pipe planning

Arrangement of guide bearings

The fixed points and guide bearings must be arranged so that:

- the compensator is not subject to loading from the weight of the pipe.
- bending caused by the arrangement of the fixed and floating bearings is avoided.
- suspension in self-aligning bearings is avoided. Plain or roller bearings should be used as a guide bearings.

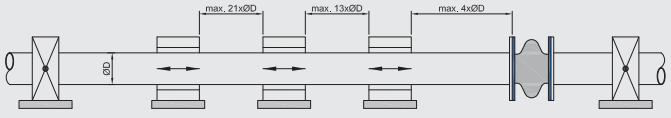
EB 13 A



Spacing of the guide bearings

- The distance between the compensator and the first bearing can be max. 4 x the pipe diameter.
- The distance between the first and the second bearing can be max. 14 x the pipe diameter.
- The distance between the remaining pipe bearings can be max. 21 x the pipe diameter. This distance must be reduced if necessary due to the inherent stability of the pipe.

EB 13 B



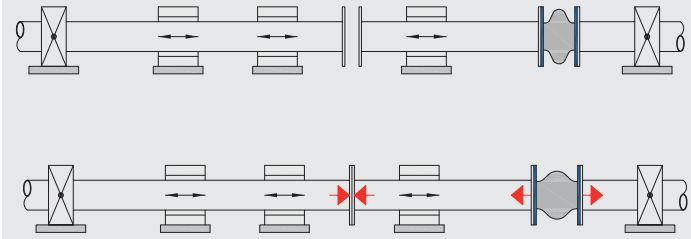
Initial tension of compensators

If a compensator is fitted with an initial tension greater than 10 mm axially or 5 mm laterally, the compensator must be fitted first and then the appropriate initial tension must be generated with the permanently fitted compensator at an open point in the pipe. **(Fitting example EB 14 + 15)**

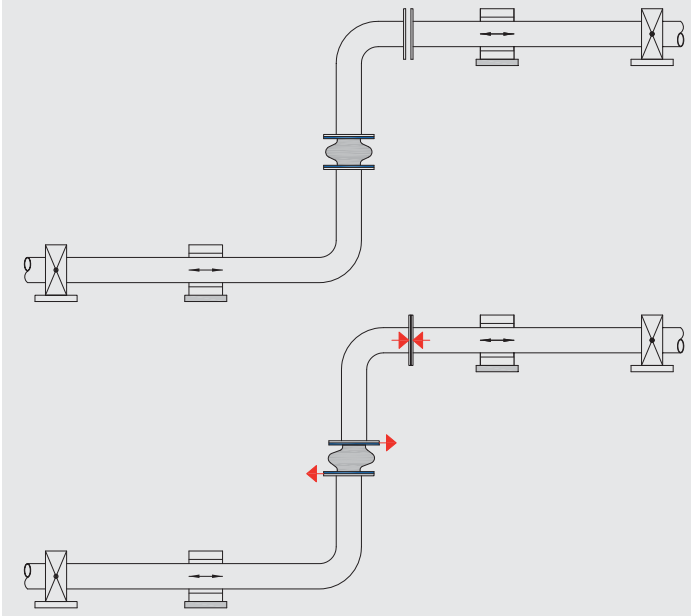
Reason: An as yet unfitted compensator with a higher initial tension will cause the sealing bead to spring out of the groove of the steel flange. This could damage the sealing bead or cause a leak.

For planning purposes, ensure that the pipe can be opened!

EB 14



EB 15



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WILLBRANDT Planning, fitting and maintenance instructions for rubber compensators with rotatable flanges or solid flanges

3. Safety measures

Excess pressure, temperature rise, vacuum
Protect pipes against impermissible excess pressure, excessive temperature rise and uncontrolled vacuum. The limiting values are shown in the data sheets of our catalogue.

Water hammer and vacuum drop
Draining and venting options are provided to prevent water hammer and vacuum drop.

Resistance
The inner material of the bellow that comes into contact with the medium must be suitable for the medium transported in the pipe (see our resistance list). If the list does not contain a specific medium, we should be provided with appropriate data from the safety data sheet for chemical substances and preparations in accordance with DIN 52900, Clauses 1 to 2.13 in order to allow us to determine whether the inner liner of the compensator is suitable.

Flow rate
For high flow rates, it must be clarified whether the compensators must be used with or without a guide sleeve in order to prevent wear due to excessive vortex formation.

Vacuum support spiral/ring
If the expected vacuum is higher than 0.8 bar absolute, a vacuum support spiral or vacuum support ring must be provided.
These prevent the bellow from collapsing. For use directly downstream of a pump, flap valve or elbow, a check must be made to ensure correct positioning after fitting – see Fitting instructions + **Fitting example 17 (EB 17 G)**!

External influences
Extreme external influences make it necessary to protect the compensators via special measures:

- **Ground protection cover:** protects against damage to bellows, fouling and earth pressure on buried pipes.
- **UV protection cover:** protects against UV radiation and influences of weather in regions exposed to extreme sunlight.
- **Flame-retardant protective cover:** protects against fire up to 800 °C for 30 minutes.

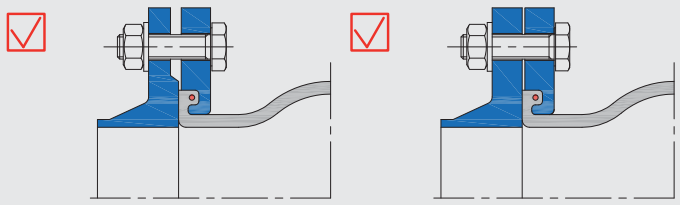
Dangerous media
The compensators must be provided with suitable splash protection for pipes used for transporting dangerous or environmentally harmful media.

Mating flanges / Flange connection
Mating flanges and flange connections must be as described in **Fitting example 16 (EB 16)** (below) to ensure a reliable sealing and to prevent damage to the rubber compensators.

Fitting example 16 (A - E)

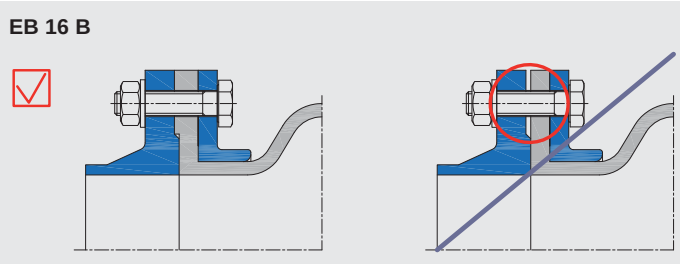
Mating flanges with and without projection according to EN 1092-1:2001 Form A or B must be used for compensators with rotatable flanges (EB 16 A). Only smooth mating flanges should be used for compensators with solid flanges. Other types are available on request.

EB 16 A



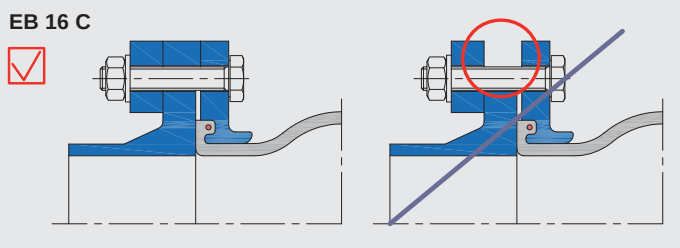
If a smooth flange cannot be used for compensators with solid rubber flanges, the recess of the mating flange must be compensated with a sealing with an appropriately thick ring or taken into account in rubber flange fabrication.

EB 16 B



When using loose flanges with thick bead, the gap above the bolts between both flanges must be filled with an appropriate ring. This stops the loose flange from tilting and thus prevents incorrect contact with the sealing surface!

EB 16 C



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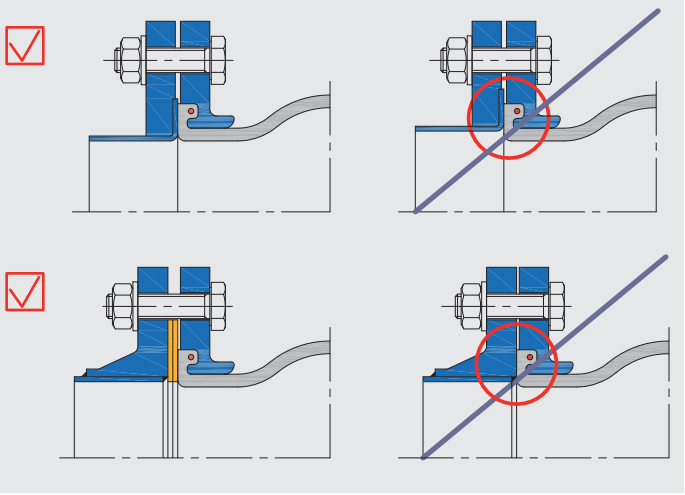
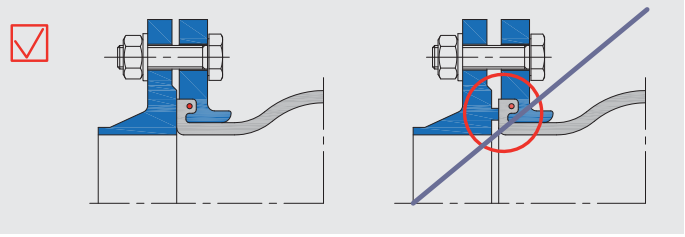
When using flare flanges and slip-on flanges, ensure that the internal diameter of the sealing surface of the mating flange corresponds to the internal diameter of the bellow. If this is not the case and the internal diameter of the mating flange is larger, a blank metal gasket and an additional sealing must be used!

EB 16 D



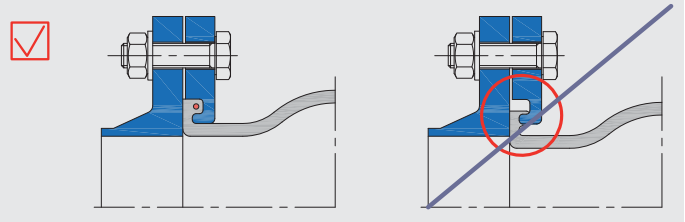
Mating flanges with a groove or tongue must not be used.

EB 16 E



Ensure during fitting that the rubber bead is located correctly in the groove of the compensator flange, otherwise the sealing surface may be damaged and leaks can occur!

EB 16 F



4. Packaging

- Check the packaging for external damage.
- Check the contents against the delivery note or packing list.
- If possible, do not unpack the compensators before fitting.
- Only open the packaging with a blunt object.
- Ensure that nails or staples in wooden crates do not come into contact with the rubber bellow.

5. Storage

See DIN 7716 - Guidelines for the storage of rubber parts:

- Rubber compensators must be stored without being subject to stress, deformation or kinking.
- Rubber compensators with steel flanges must be stored upright on the flanges (otherwise there is a risk of crushing).
- Store in a cool, dry, dust-free and moderately ventilated room.
- Protect rubber parts against draughts and cover if necessary. Ozone-generating equipment such as electric motors, fluorescent light sources, etc., must not be used at the place of storage.
- Do not store any solvents, fuels, chemicals or similar together with the compensators.

6. Transport

- Leave the parts packed.
- Note “TOP” at the top and “cable or lifting hook”.
- Steel backing rings (with bracing) and rubber compensator flanges must remain fastened until final fitting to avoid excessive loads on the rubber part!
- Do not use any sharp-edged tools, wire ropes, chains or lifting hooks (risk of damage to rubber).
- Always lift both steel flanges simultaneously. Shackle at both sides or place padded tie-bars through the compensator.
- For ground level transportation without means of transport, roll the compensator on the flanges.

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7. Fitting

Rubber compensators are intended for absorbing movements under certain pressure and temperature conditions to be determined in advance. To ensure that the maximum service life is reached, the following must be observed for fitting:

Prior to fitting

- Check the packaging of the rubber compensators and after unpacking check the compensator itself for damage. Damaged compensators must not be fitted.
- Check the pipe run to ensure that it is straight in the area in which the compensator is to be fitted and that the pipe is limited by appropriate fixed points. Only one compensator or several compensators coupled to form a unit may be fitted between two fixed points.
- Check the size of the fitting gap. The mating flanges should be fitted in alignment with each other. The maximum deviation between the fitting gap and compensator can be +/- 10 mm axially and +/- 5 mm laterally.
- **Note:** If the aforementioned tolerances cannot be maintained, the procedure is as described in the section “Initial tension of compensators” **Fitting example 14 - 15 (EB 14 - 15)**.
- The pipe flanges must not be twisted towards each other when fitting a compensator with solid rubber flanges, as the compensator will be subject to torsion – this must be avoided as torsion can damage the compensator.
- The pipe flanges must be clean, grease-free, smooth, flat and burr-free.
- Ensure that the flange connections are as described in the section “Mating flanges/flange connections” **(EB 16 A - F)** under “Safety”.
- If a compensator is to be provided with a guide sleeve, it must be inserted into the compensator prior to fitting into the pipe (do not forget the sealing between guide sleeve and mating flange).
- If the use of a vacuum support spiral or vacuum support ring is necessary due to low pressure, these must be fitted in advance. In the case of vacuum support rings, the section “Vacuum support ring” (below) must be observed **(EB 17 G)**!

IMPORTANT!

Welding in the vicinity of compensators must be avoided. If this cannot be avoided, the compensator must be covered with a fireproof and heat-resistant material to protect it against welding heat and flying sparks.

When welding the complete pipe system, steel-wire compensators can be damaged by stray currents or electrical earth conduction. The anode and cathode of the electric welding connection must always be located on the same line section (and not be separated by the rubber compensator!).
The rubber bellow must not be painted after fitting in the pipe.

It is also important to note that the compensator must not be insulated at temperatures above 50°C, as this will cause the rubber bellow to heat up and harden as a result of the accumulated heat.

Fitting a compensator with flange connection

- Centring mandrels, a rubber hammer and a torque wrench are required for fitting. Do not use any sharp-edged tools!
- Carefully insert the compensator into the fitting gap. Take care not to damage the sealing surfaces.
- No additional seals are required. The rubber sealing bead or rubber flange seals directly against the pipe flange.

  Warning: Exceptions for rubberised pipe flanges, valves or blank gaskets – see corresponding section above!
- Fix the compensator at both flanges using at least two bolts or threaded rods. If necessary, the lifting device can be detached/removed.
- When fitting compensators with tie rods, ensure that the tie rods are loosened so that the compensator is able to adjust to the fitting gap when tightened. Readjustment of the tie rods takes place after fitting the compensator - see the description “Fitting the tie rods” (below).
- The remaining fixing bolts can now be inserted and tightened hand-tight.
- For the bolted flange connection, bolts with the strength class 8.8 should be used.
- Do not use a U-washer on the compensator flange.

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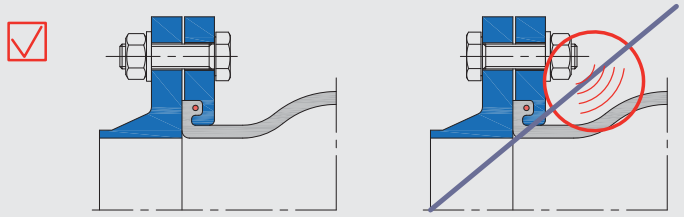
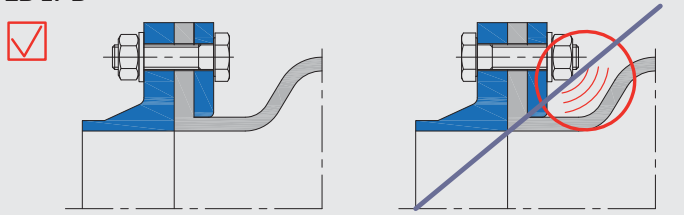
The following must be noted when inserting the bolts:

- Refer to tightening torque (Tables 1, 2 and 3)
- For compensators with through holes, all bolts must be inserted with the bolt head towards the bellow to prevent damage to the bellow under pressure.

EB 17 A

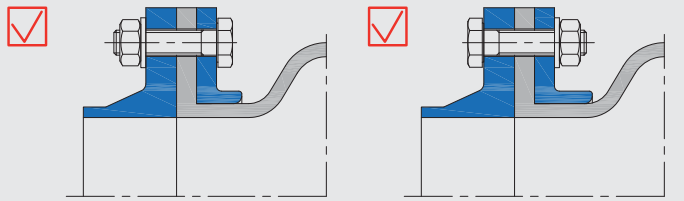


EB 17 B



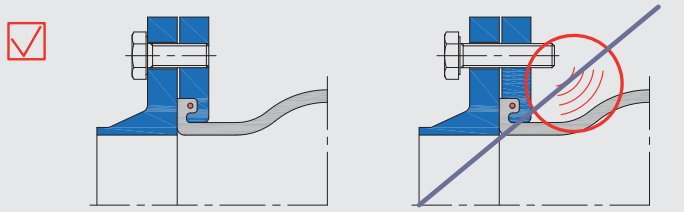
Exception: If the compensator has a long collar (supporting shoulder), the bolt can also be inserted the other way round - however the bolt must not be longer than the collar!

EB 17 C

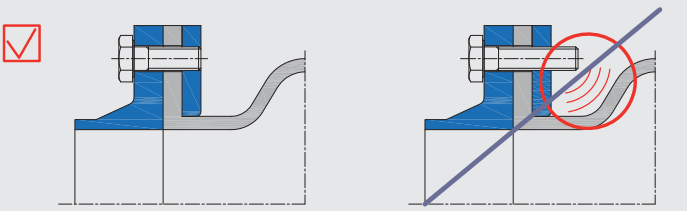


- **For compensators with tapped holes in the flange**, the bolts should be flush towards the bellow side with the flange, as protruding bolts are liable to damage the bellow under pressure.

EB 17 D



EB 17 E



- The bolted flange connections must be tightened as follows:

  Step 1:
  - Tighten all bolts by hand
  - Apply torque evenly according to Step 1 crosswise
  - Check gap width on outer edge of flange
  - Settling time ≥ 30 minutes

  Step 2:
  - Tighten all bolts crosswise in accordance with Step 2
  - Check gap width

  Step 3:
  - Apply final torque in accordance with Step 3 in two passes crosswise.

- The bolts do not require further tightening as this would ultimately damage the sealing surface.
- Throughout the entire fitting process, ensure that the sealing bead does not tilt. The protruding sealing surface should be compressed evenly on all sides.
- When fitting silicone rubber compensators, the specified tightening torques must be reduced by 30 %.
- If a leak should occur during the subsequent pressure test, the bolts must be tightened with the torque according to Step 3. If the bolted flange connection is still leaky, the tightening torque must be increased slightly. Before retightening the bolts, the pressure in the compensator must be reduced.
- Throughout the entire fitting process, ensure that the compensator is not over-expanded or crushed.

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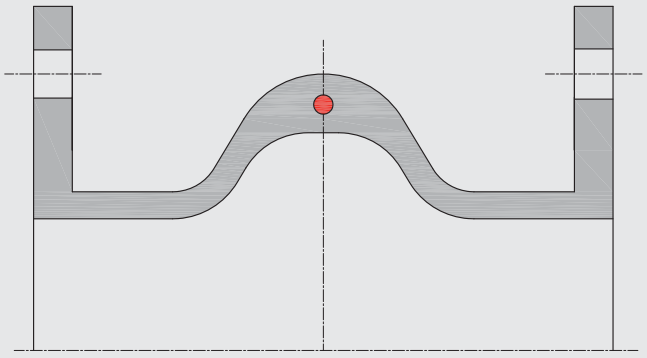
Vacuum support ring

When fitting vacuum support rings arranged directly downstream of a pump, flap valve or elbow the vacuum support rings must be checked for correct positioning after fitting as follows (**EB 17 G)**:

- Firm seating (max. 10 - 15 mm clearance between bellow and ring on one side)
- If necessary, adapter plates should be used to obtain the permissible seat clearance.
- The connection lock should always be in the lower flow area (6°°).
- At high flow rates, a check should be made to determine whether a compensator with vulcanised support ring should be used in order to avoid fatigue failures due to strong turbulence **(EB 17 F)**.
- After fitting, check that the hexagon bolts and nuts are securely locked to prevent loosening.

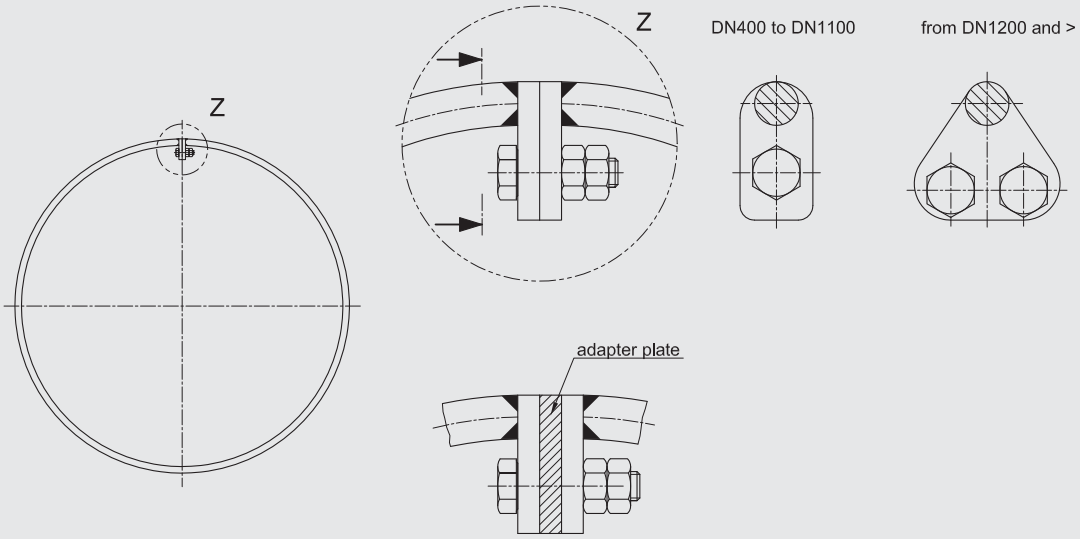
EB 17 F



8. Final fitting check

- Check the compensators on all sides for any visible damage and in particular clean the gap between the steel backing flange and rubber bellow (remove foreign bodies, sand, etc.).
- After being fitted, the compensators should be provided with suitable protection against damage; this protection must only be removed directly prior to commissioning.
- The rubber parts must not be painted. Solvents and chemicals affect the surface and damage the bellow.
- The compensators must not be insulated as this can cause the bellow to overheat and dry out and will ultimately lead to damage to the bellow.
- The best results are obtained when the compensator is able to function stress-free under operating conditions (initial tension must be taken into account when fitting).
- For compensators with tie rods, check the tie rods.
  It should be possible to tighten them hand-tight. The lock nuts must be tightened.
- If the installation situation allows, check that any support spirals/rings are correctly seated and locked.

EB 17 G



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9. Measures prior to pressure test and commissioning

- Remove the protective covers and clean the compensator.
- Check the compensator for damage.
- Check that all supports, fixed and plain bearings are fitted and functional.
- Check the tie rods for even loading and if necessary adjust them to the prevailing conditions.

10. Pressure test

The rubber compensator is not a proper pressure vessel, but it is classified according to the Pressure Equipment Directive as a “pipe accessory” (pipe component). When fitting the compensator in piping, the sealing does not take place via a separate seal, but directly on the sealing surface of the integrated rubber bellow.

A one hundred per cent pressure test of the rubber compensator at the manufacturer can adversely influence the integrated rubber sealing surface. Pressure testing of the rubber compensators at the manufacturer therefore takes place only at the special request of the customer and with the utmost care.

The pressure test normally takes place only after the rubber compensators have been fully installed in the pipe system. All of the instructions contained in these fitting instructions should be observed prior to the pressure test.

If leaks should occur in the area of the flange connection during the pressure test, the bolted flange connection must be retightened in accordance with the tightening table (Step 3).

11. Supplementary assembly and fittings instructions for Tye 46

Type 46 rubber compensators should be fitted stress-free. The bolted connections should always be made using two wrenches to avoid torsion on the compensator **(EB 18)**.

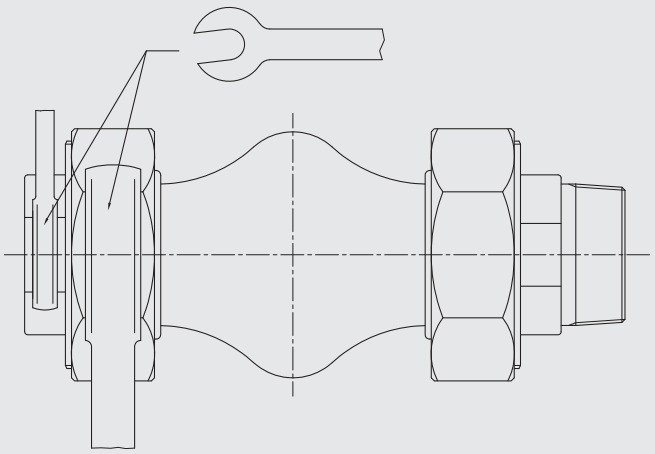
- Mount the bolting parts on the pipe and check the fitting gap! The fitting gap should be the same length as the compensator bellow (e.g. 130 mm +/- 5 mm).
- Insert the compensator and tighten using two wrenches as follows:

  DN 20/25
  The front threaded part must be used as a counter support and the sleeve nut must be tightened (to avoid torsion on the bellow).

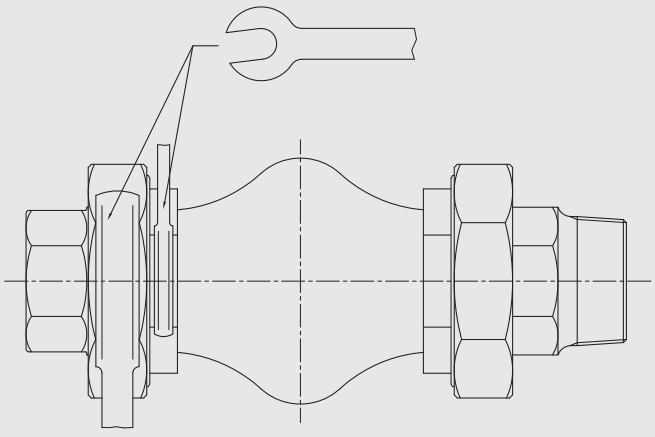
  DN 32 - 50
  The rear threaded part must be used as a counter support and the sleeve nut tightened (to avoid torsion on the bellow)

EB 18

DN 20/25



DN 32 - DN 50



All other fitting positions are as described in our main fitting instructions.

The tightening torque for all types is 100 Nm.

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12. Supplementary assembly and fittings instructions for Type 49

There are various **bolt packs (SU)** for connecting Type 49 compensators to the pipe so that the bolt length is flush with the compensator bellow when using DIN flanges.

When fitting, ensure that the surfaces that contact the rubber bellow are free of burrs. Use the U-washers to correct the length (place under the bolt head).

Corresponding bolt pack (DIN)

	PN 6	PN 10	PN 16
DN 32	SU 1	SU 2	SU 2
DN 40	SU 1	SU 2	SU 2
DN 50	SU 1	SU 3	SU 3
DN 65	SU 1	SU 5	SU 5
DN 80	SU 4	SU 7	SU 7
DN 100	SU 4	SU 7	SU 7
DN 125	SU 5	SU 6	SU 6
DN 150	SU 6	SU 10	SU 10
DN 175	SU 6	SU 10	SU 10
DN 200	SU 8	SU 10	SU 11
DN 250	SU 9	SU 13	SU 17
DN 300	SU 11	SU 14	SU 18
DN 350	SU 12	SU 15	SU 19
DN 400	SU 15	SU 19	SU 21
DN 500	SU 16	SU 20	SU 22

Contents

Bolt pack	kg	Qty	Bolts ISO 4017	Qty	U-washers Ø
SU 1	0,35	8	M 12X30	8	13
SU 2	0,62	8	M 16X30	8	17
SU 3	0,67	8	M 16X35	8	17
SU 4	0,68	8	M 16X35	16	17
SU 5	1,4	16	M 16X35	16	17
SU 6	1,5	16	M 16X40	16	17
SU 7	1,55	16	M 16X40	32	17
SU 8	2,6	16	M 16X45	16	17
SU 9	2,4	24	M 16X45	48	17
SU 10	2,7	16	M 20X45	16	21
SU 11	4,1	24	M 20X45	24	21
SU 12	4,2	24	M 20X45	48	21
SU 13	4,3	24	M 20X50	48	21
SU 14	4,2	24	M 20X50	24	21
SU 15	5,8	32	M 20X50	64	21
SU 16	7,3	40	M 20X50	80	21
SU 17	6,7	24	M 24X50	48	25
SU 18	6,6	24	M 24X50	24	25
SU 19	9,3	32	M 24X55	64	25
SU 20	11,7	40	M 24X55	80	25
SU 21	13,5	32	M 27X60	64	28
SU 22	22,0	40	M 30X60	80	31

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13. Supplementary assembly and fittings instructions for Type 60 - WRG

- The Type 60 WRG rubber-metal pipe connector must be fitted stress-free.
- The fitting gap must be 70 mm.
- The pipe connector must not be subject to tension, torsion or bending.
- No additional seals are required.
- Only hexagon head bolts in accordance with DIN 933 with a washer should be used (note bolt length - see table below).
- The bolt tightening torque is 30 Nm.

All other fitting positions are as described in our main fitting instructions.

Bolt size for	**Flange PN 6**	**Flange PN 10**
DN 20	4 x M10 x 25	4 x M12 x 30
DN 25	4 x M10 x 25	4 x M12 x 30
DN 32	4 x M12 x 30	4 x M16 x 30
DN 40	4 x M12 x 30	4 x M16 x 30
DN 50	4 x M12 x 30	4 x M16 x 30
DN 65	4 x M12 x 30	4 x M16 x 30
DN 80	4 x M16 x 35	8 x M16 x 35
DN 100	4 x M16 x 35	8 x M16 x 35
DN 125	8 x M16 x 35	8 x M16 x 40
DN 150	8 x M16 x 35	8 x M20 x 40
DN 200	-	8 x M20 x 45

14. Supplementary assembly and fittings instructions for Type 61

- Type 61 is fitted as part of the pipe installation. Installation in the fitting gap is difficult in the case of very large nominal diameters.
- The pipe ends must be long enough to reach the beginning of the shaft on both sides.
- Only use wide GBS-clamps for fixing the compensator (min. 20 x 1 mm).
- At an operating pressure of up to 2 bar, one clamp is adequate per side. Above 2 bar, two clamps should be used.

All other fitting positions are as described in our main fitting instructions.

15. Supplementary assembly and fittings instructions for Type 64

The compensator must not be fitted before comnpletion of all work on the pipes and flanges and mounting of all anchors and supports. This is intended to prevent the compensator from being damaged by welding sparks, sharp-edged objects, etc.

As Type 64 compensators are made from extremely flexible material, their durability is dependent on careful and correct fitting.

- Avoid sharp edges and folds.
- Ducting flanges, backing flanges or other steel parts included in the scope of delivery should be checked and correspond to the drawings. The bolt holes in each flange must be symmetrical.
- It is advisable to use a support plate or an inner frame when lifting the compensator. Preferably, the compensator should be pre-assembled with loose flanges and an internal sleeve (if included in the scope of delivery) on the ground before lifting.

All other fitting positions are as described in our main fitting instructions.

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WILLBRANDT Planning, fitting and maintenance instructions for rubber compensators with rotatable flanges or solid flanges

Tightening torque for Type 64

Material	Backing flanges / bolts			
	40x10/M10	50x10/M12	60x10/M12	60x12/M16
EPDM	60 Nm	80 Nm	80 Nm	80 Nm
FPM	80 Nm	80 Nm	80 Nm	

Warning: Refer to the tightening scheme!

16. Supplementary assembly and fittings instructions for Type 80

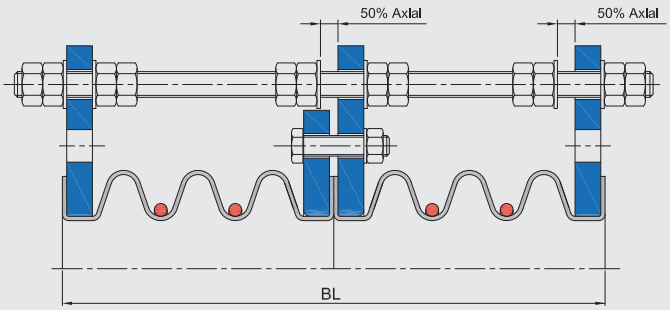
- The compensators are delivered with protective covers. These covers may only be removed directly prior to fitting. If these covers need to be removed in advance for the purpose of inspection, they must be screwed back into place.
- Welding, soldering and brazing on the PTFE bellow is not permitted as the bellow could be damaged and highly toxic gases could develop.
- It is not necessary to use seals between PTFE/PTFE sealing surfaces. It is advisable to use a 5-mm-thick PTFE sealing for connections to glass, enamel and other components.
- The flange connection bolts must be tightened according to the torque table below.
- The limiting bolts (tie rods) must be adjusted to the maximum permissible expansion after fitting the compensator. The limiting bolts must not be removed.
- In the course of commissioning, the flange connections should be retightened with the specified torque after reaching operating temperature.
- If leaks occur, the flange connections must be inspected to ensure that the flanges are parallel and for fouling or damage to the sealing surfaces.

  Minor indentations or damage can be removed with emery cloth.

When coupling Type 80 compensators, ensure that a corresponding blank gasket is used between the bellows that are being coupled in order to avoid a double PTFE effect.

When adjusting the continuous tie rods, ensure that the central flange is appropriately fixed with lock nuts on the right and left of the flange pair in order to avoid lateral buckling. The play between nuts and flange should be a maximum of 2 mm (in order to leave clearance for lateral movement). In the case of the outer flanges, the hexagon bolts should be arranged on the inside and outside so as to accommodate the desired axial expansion. During this process, ensure that the axial expansion is equally distributed between the two compensators. Please refer to EB 19.

EB 19



17. Supplementary installation instructions for compensators with length limiters

In order to correctly install rubber compensators with length limiters, please note the following points:

- Check gap measurements for permissible installation tolerances and adjust, if necessary.
- Loosen tie rod bolts so that stress-free installation is possible.
- Insert the compensator and screw into place in accordance with the tightening torque plan. Note the tightening torque for the appropriate type.
- Fix tie rods to stop (without play) so that they can still be turned by hand. Then tighten the tie rods to the stipulated tightening torque using the relevant flange-side hexagon bolts.

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18. Maintenance and monitoring

- The flange connection tightening torque must be checked once prior to final commissioning.
- First inspection 1 week after commissioning.
  Further inspections after 1, 4 and 12 months; then annually.

  The following must be checked:

  - External damage to rubber bellow, flange and tie rods
  - Deformations of the rubber flange between the bolts (displacement of flange surfaces)
  - Changes to the rubber bellow (bubbles, brittleness, cracks, hairline cracks
  - Impermissible displacement and misalignment of the tie rods
  - Corrosion and wear on the entire component
- The compensators can be cleaned with a weak soap solution and clear water. Do not use sharp-edged objects, wire brushes or emery cloth.

19. Maintenance and inspection instructions

After installing the rubber compensators in accordance with our installation instructions, the following points should be included in the annual inspection:

- Check the installation position of the rubber compensator, i.e. the permissible combined axial and lateral expansion should not be exceeded.

  Reason: Pipe movement due to loose fixed points or plain bearings.
- Check for external damage to rubber and tie rods.
- Assess corrosion and wear on the entire component.
- Check rubber bellow for blistering.

  Reason: Minor damage to the inner bellow can lead to media reaching the cover via the reinforcement, which causes minor blistering.
- Check the bellow behind the backing flanges for circumferential cracks.

  Reason: Overexpansion can lead to cracks on the outer cover at the end of the continuous reinforcement. If these cracks are deeper than 2 mm, we recommend replacing the bellow.
- Check the surface of the bellow for hairline cracks.

  Reason: External influences and incorrect media cause the cover to harden.

  Assessment: If these surface cracks are only superficial, they must be recorded (surface photo).

  The cracks should be re-assessed during the next annual inspection. If there are only minor changes, maintenance can take place at the time of the next inspection. If the cracks are deeper than 1.5 mm, the cover must be replaced.
- Check the bellow for hardening. This can be achieved using an impression test, e.g. by pressing the edge of a coin into the rubber. If the rubber is elastic, the notch will disappear; if it is hard, the notch will remain.

  A conclusive assessment using a Shore hardness test must be made to determine whether a compensator must be quickly replaced. The hardness should not exceed 80 to 84 Shore.

Normally, rubber compensators are maintenance-free - in cooling water systems and water operation a service life of 15 to 20 years can be expected. In oil and fuel plants, compensators should be replaced after 5 years and in chemical plants they should be replaced after 10 years.

If in doubt, we recommend that you send us photos of the relevant compensators for better assessment. Our expert staff will make an assessment.

20. Electrical conductivity

In case of rubber compensators, ensure that the compensators are either insulated, conduct electricity or have surface conductivity.

The values mentioned in our catalogue for the different qualities of rubber compensator relate to the inner, i.e. the rubber surface in contact with media. The following should be observed:

- **Range I**
  Electrical conductor electrical resistance < 10^6 Ohm cm
- **Range II**
  Antistatic - electrical resistance value: 10^6 to 10^9 Ohm cm
- **Range III**
  Electrical insulator - electrical resistance: Ohm cm > 10^9

Generally speaking, the harder the mix, the greater the conductivity. The reason for this is that the increased amount of soot in the mix reduces the resistance.

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21. Flow rates

In case of rubber compensators and PTFE compensators, ensure that the maximum permissible flow velocities without guide sleeves are not exceeded. Permissible flow rate of many media not containing solids:

- for rubber compensators: 4.5 m/s
- for rubber compensators with PTFE coating: 3 m/s

If the rates are higher rates, we recommend using a guide sleeve. In case of media containing solids, we generally recommend a guide sleeve due to wear.

When using guide sleeves, it should be noted that standard guide sleeves are designed for ± 5 mm laterally. If higher lateral measurements are required, the size of the guide sleeves should be reduced in accordance with double the value of the lateral guidance.

22. Application of tightening torque

Fitting instructions

Tools — Centring mandrels, rubber hammer and torque wrench. All tools must be burr-free (danger of damage to rubber parts).

Use Strength Class 8.8 flange bolts
(Non-post-treated, lubricated bolts)

Step I
a) Insert all bolts and tighten evenly by hand.
b) Apply torque evenly according to Step 1 in three passes crosswise.

Check gap width on outer edge of flange.

c) Settling time ≥ 30 minutes

Step II
d) Tighten all bolts in three passes or to 2/3 of the final torque crosswise. Check gap width.
e) Settling time ≥ 60 minutes

Step III
f) Apply final torque in two passes crosswise.
NO FURTHER TIGHTENING!

Before testing pressure: Check torque in one pass crosswise using the final value (Step 3).

Subsequent inspections: Refer to maintenance instructions.
Only tighten flange bolts until final value (Step 3).

Flange tightening torque
The tightening torques for flange bolts provided in the table offer a specific surface pressure based on the entire sealing surface for solid flanges or the sealing bead in the case of rotating flanges.

In case of solid flanges, temporary settling process in the rubber flange area mean that under operating conditions the surface pressure falls to around 50% of the final value (Step III). The residual effective gripping and sealing force is completely sufficient and suitable for test pressures up to 1.5 times the operating pressure.

Tensile stresses from over-expansion of the compensator are not permissible.

Warning: The maximum tightening torques given must not be substantially exceeded, since excessive loading causes a constant increase in the flow in the elastomer and leads to destruction (crushing).

Tightening torque: Rough estimation of the final tightening torque for special flanges:

Rule of thumb: **MA = 0.2 x FVM x d2 (Nm)**

MA = Bolt tightening torque
d2 = Thread flank diameter

FVM = Initial tension at fitting = KA* x FKL
KA = Tightening factor ~ 1.4 lubricated,
against a firm support

K = Experimental value = 1.0 selected
flow process in rubber flange

FKL = Clamping force, contact pressure
7 N/mm² for total flange surface
for Type 40

$$FKL = \left(\frac{\text{Flange } D^2 - DN^2}{4} \right) \times \pi \; \frac{\text{Contact pressure}}{\text{Number of bolts}} \; (N)$$

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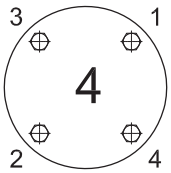
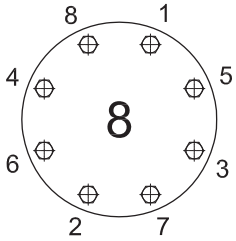
Note
The bolt tightening torques are valid only for steel flange connections and compensators with rubber-flange or profile seals. Separate tightening torques should be observed for GRP flange connections.

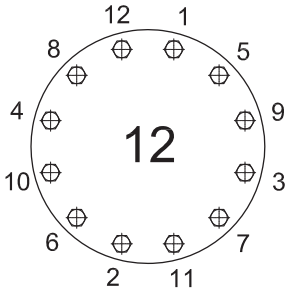
Important instructions for removing rubber compensators
When removing rubber compensators for revisions or conversion, ensure that the bolts are loosened crosswise, as during fitting.

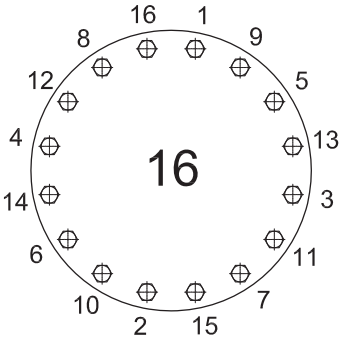
Reason
When rubber-flange or profile seals are bolted, a high level of spring force is stored in the rubber elements. When they are loosened, the rubber element acts like a spring. As soon as the bolts are loosened, the rubber-flange/profile sealing attempts to creep into the free space, which can cause damage to the sealing and render the compensator unusable.

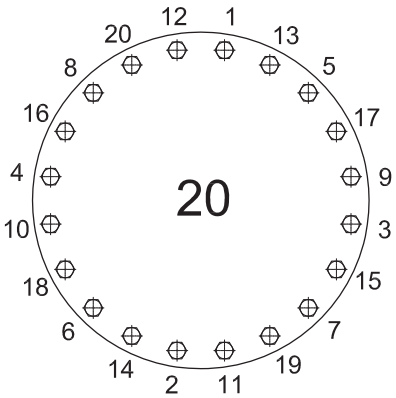
Tightening torque plan

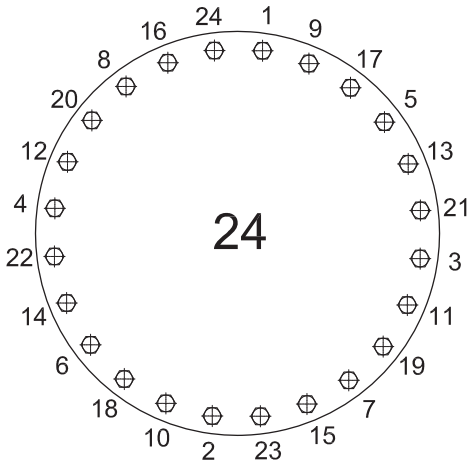












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WILLBRANDT Planning, fitting and maintenance instructions for rubber compensators with rotatable flanges or solid flanges

Table 1 Flange bolt tightening torques for Types 40, 42, 58 and 59

DN	Step 1				Step 2				Step 3			
	PN 6 Nm	PN 10 Nm	PN 16 Nm	ASA 150 Nm	PN 6 Nm	PN 10 Nm	PN 16 Nm	ASA 150 Nm	PN 6 Nm	PN 10 Nm	PN 16 Nm	ASA 150 Nm
200	34	54	37	57	67	107	74	114	100	160	110	170
250	30	44	57	50	61	87	114	101	90	130	170	150
300	47	50	70	74	94	101	141	147	140	150	210	220
350	57	47	64	97	114	94	127	194	170	140	190	290
400	47	67	87	87	94	134	174	174	140	200	260	260
450	54	60	84	100	107	121	167	201	160	180	250	300
500	47	67	117	94	94	134	234	187	140	200	350	280
550				114				227				340
600	70	97	174	134	141	194	347	267	210	290	520	400
650				124				247				370
700	67	104	134	117	134	207	267	234	200	310	400	350
750				134				267				400
800	97	144	180	200	194	287	361	401	290	430	540	600
850				190				381				570
900	110	137	170	204	221	274	341	407	330	410	510	610
950				240				481				720
1000	104	180	240	220	207	361	481	441	310	540	720	660
1050				244				487				730
1100	137	187	320	230	274	374	641	461	410	560	960	690
1150				244				487				730
1200	144	230	324	234	287	461	647	467	430	690	970	700
1250				284				567				850
1300	190	284	307	297	381	567	614	594	570	850	920	890
1350				324				647				970
1400	190	280	330	317	381	561	661	634	570	840	990	950
1450				350				701				1050
1500	204	384	450	320	407	767	901	641	610	1150	1350	960
1600	194	400	467		387	801	934		580	1200	1400	
1650				400				801				1200
1700	234	384	450		467	767	901		700	1150	1350	
1800	230	400	467	384	461	801	934	767	690	1200	1400	1150
1900	277	384	584		554	767	1167		830	1150	1750	
1950				467				934				1400
2000	280	417	567		561	834	1134		840	1250	1700	
2100	307	517	0	534	614	1034		1067	920	1550		1600
2200	297	517	600		594	1034	1201		890	1550	1800	
2250				517				1034				1550
2400	314	550	634	667	627	1101	1267	1334	940	1650	1900	2000
2500	384	567	600		767	1134	1201		1150	1700	1800	
2550				800				1601				2400
2600	400	550	634		801	1101	1267		1200	1650	1900	
2700				884				1767				2650
2800	417	600			834	1201			1250	1800		
2850				1034				2067				3100
3000	567	934		1367	1134	1867		2734	1700	2800		4100

Important note

The tightening torques for flange bolts provided in the table offer a specific surface pressure based on the entire sealing surface for solid rubber flanges or the sealing bead in the case of rotatable flanges. In the case of solid rubber flanges, temporary settling process in the rubber flange area mean that under operating conditions the surface pressure falls to around 50% of the final value (Step III).

The residual effective gripping and sealing force is completely sufficient and suitable for test pressures up to 1.5 times the operating pressure.

Warning: The stipulated max. tightening torque may not be substantially exceeded, as increased pressure loading on the flow in the elastomer progresses constantly and leads to destruction (crushing).

(Stand: 03/18)

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WILLBRANDT **Planning, fitting and maintenance instructions for rubber compensators with rotatable flanges or solid flanges**

Table 2: Bolt tightening torques for Types 48, 49, 50, 51, 53, 55, 56 and 65

DN	Step 1 for all Nm	Step 2 for all Nm	Step 3 PN 6 Nm	PN 10 Nm	PN 16 Nm	PN 25 Nm	ASA 150 Nm
25	by hand	50	60	80	80	80	80
32	by hand	50	60	80	80	80	80
40	by hand	50	60	80	80	80	80
50	by hand	50	60	80	80	80	80
65	by hand	50	60	80	80	80	80
80	by hand	50	60	80	80	80	80
100	by hand	50	80	100	100	100	100
125	by hand	50	80	100	100	100	100
150	by hand	50	80	100	100	100	100
175	by hand	50	90	100	100	100	100
200	by hand	50	90	100	100	100	100
250	by hand	50	90	100	100	110	100
300	by hand	50	100	110	110	110	100
350	by hand	50	120	130	135	165	110
400	by hand	50	120	140	155	200	140
450	by hand	50	140	145	165	200	145
500	by hand	50	120	145	170	200	145
600	by hand	100	185	210	255	280	210
700	by hand	100	200	225	300	300	230
800	by hand	100	235	300	360	410	300
900	by hand	100	235	300	360	415	300
1000	by hand	100	300	360	425	525	360

Warning: Refer to the tightening scheme!

Table 3: Bolt tightening torques for Type 80

DN	PN 10 Bolts Quantity	PN 10 Bolts Thread	PN 10 Torque Nm	PN 25 Bolts Quantity	PN 25 Bolts Thread	PN 25 Torque Nm
20	4	M12	10	4	M12	10
25	4	M12	20	4	M12	20
32	4	M16	30	4	M16	30
40	4	M16	40	4	M16	40
50	4	M16	50	4	M16	50
65	8	M16	70	8	M16	40
80	8	M16	40	8	M16	40
100	8	M16	40	8	M20	50
125	8	M16	50	8	M24	80
150	8	M20	60	8	M24	90
200	8	M20	90	12	M24	100
250	12	M20	60	12	M27	120
300	12	M20	70	-	-	-
350	16	M20	110	-	-	-
400	16	M24	160	-	-	-
500	20	M24	180	-	-	-
600	20	M27	240	-	-	-
700	24	M27	260	-	-	-

Warning: Refer to the tightening scheme!

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WILLBRANDT **Planning, fitting and maintenance instructions for rubber compensators with rotatable flanges or solid flanges**

Threaded bolts and hexagonal nuts for fastening mating flanges to welding neck flanges according to DIN 1092-1 Type 11 for Types 50, 51, 55 and 39 (with perforations)

DN	PN 6			PN 10			PN 16		
	Quantity	Size	Length mm	Quantity	Size	Length mm	Quantity	Size	Length mm
20	8	M10	45	8	M12	55	8	M12	55
25	8	M12	50	8	M12	55	8	M12	55
32	8	M12	50	8	M16	55	8	M16	60
40	8	M12	50	8	M16	55	8	M16	60
50	8	M12	50	8	M16	60	8	M16	60
65	8	M12	50	16	M16	60	16	M16	60
80	8	M16	60	16	M16	65	16	M16	65
100	8	M16	60	16	M16	65	16	M16	65
125	16	M16	60	16	M16	65	16	M16	70
150	16	M16	65	16	M20	75	16	M20	75
200	16	M16	70	16	M20	80	24	M20	75
250	24	M20	75	24	M20	80	24	M24	85
300	24	M20	75	24	M20	80	24	M24	90
350	24	M20	75	32	M20	80	32	M24	90
400	32	M32	80	32	M24	90	32	M27	100
450	32	M32	85	40	M24	100	40	M27	110
500	40	M40	90	40	M24	100	40	M30	110
600	40	M40	90	40	M27	100	40	M33	120
700	48	M10	100	48	M27	110	48	M33	120
800	48	M27	110	48	M30	120	48	M36	130
900	48	M27	110	56	M30	120	56	M36	130
1000	56	M27	110	56	M33	120	56	M39	140

1 set = ISO 4017 hexagonal bolts + ISO 4032 hexagonal nuts + ISO 7089 U-washers

Warning: Refer to the tightening scheme!