STENFLEX®

Rubber expansion joints

General description of rubber expansion joints

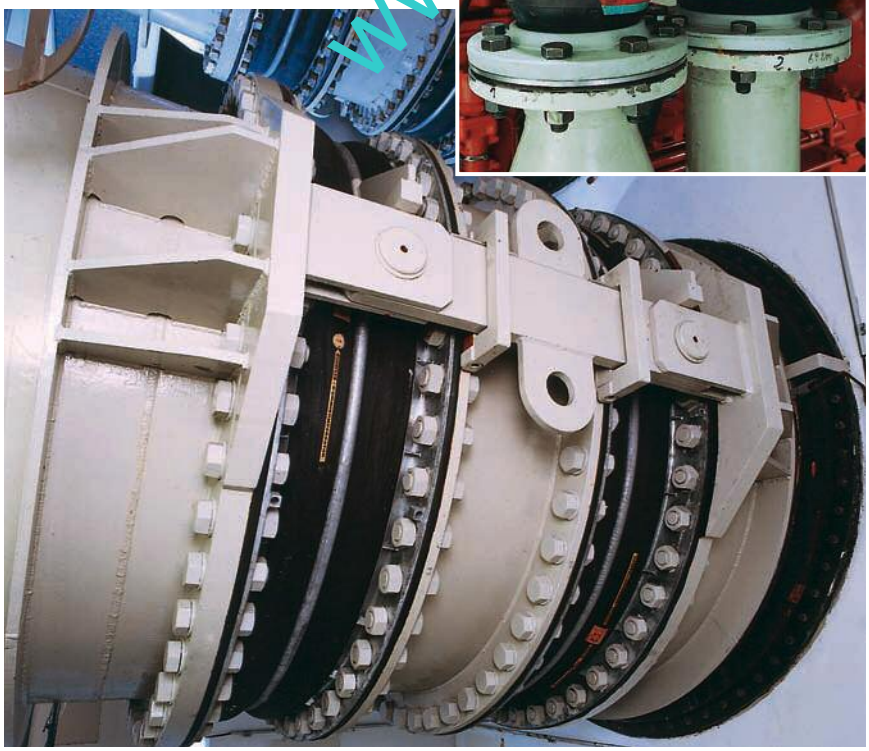
STENFLEX® rubber expansion joints have served with distinction for more than 45 years. They are the preferred flexible pipe connection elements of choice in manufactured appliances, machinery, apparatus and piping engineering.

Constant further development and innovations update our product range to meet the needs of current and changing markets. Numerous patent applications and on-going optimization of the formulae for our rubber grades ensure that our customers always receive state-of-the-art products; highly reliable and of superior durability.

The large-scale industrial manufacture of the rubber bellows, constant control of compliance with all manufacturing, business and quality processes in line with EN ISO 9001:2008 and decades of experience in the development and manufacture of rubber expansion joints: all this guarantees a uniform product of the highest standard. It underlines the STENFLEX® Quality Claim.

Nearly all nuclear plants throughout Europe are equipped with STENFLEX® expansion joints. Many of our rubber expansion joints have been used in a large variety of applications. They have served on site in trouble-free operation for decades. STENFLEX® rubber expansion joints have passed national and international type approvals and suitability tests and are certified by numerous classification societies.

Our engineers in the fields of mechanical-, and processing-plant engineering work hand-in-hand with our modern R & D department. They are always available for technical consultation and ready to help in solving specific application problems at any time.



Purpose

Expansion joints are used in appliances, machinery, apparatus and pipe systems where space is limited:

- to compensate for movement
- to compensate for expansion caused by differences in temperature
- to reduce tension
- to absorb noise and vibration transmission
- to compensate for ground, and foundation settlement
- to compensate for pipeline movement aboard ships
- as adapters to compensate for installation inaccuracies
- as dismantling pieces for fittings
- as elastic sealing elements, where pipelines pass through walls

Rubber expansion joints are used in a variety of industrial applications:

- Machine engineering
- Domestic industry
- Processing plant engineering
- Power station technology
- Shipbuilding

Rubber expansion joints

General description of rubber expansion joints

Rubber bellows

Structure

STENFLEX® rubber bellows have been optimized by calculation and verified by experimentation to produce highly elastic pressure-resistant bellows with flow contours to meet demanding absorption tasks.

Rubber bellows have a three-ply wall structure:

- inner ply (core) of medium-resistant rubber compound
- intermediate ply of rubber compound with tensile elements for reinforcement
- outer ply (cover layer) of weather-proof rubber compound

The arrangement of the tensile reinforcing elements is ascertained by calculation and experimentation to ensure that the force of pressure within the bellows can be absorbed. A permanent bond exists between the embedded tensile reinforcing elements and the rubber material.

The rubber grades used for the inner- and outer ply are empirically defined rubber compounds rated to certain properties (media resistance, ozone resistance, UV resistance, elasticity, wear-proof characteristics, etc.)

Material qualities

STENFLEX® rubber bellows are made of elastic synthetic elastomers. Their wide range of industrial applications are covered with combinations of the four standard elastomer qualities EPDM, CIIR, NBR and CR together with tensile reinforcing elements.

Elastomers are basic materials that are processed by adding sulphur, fillers, plasticizers and aging protection agents to produce rubber compounds suitable for vulcanization. Under the influence of temperature and pressure the vulcanization process (cross linkage) converts the rubber compounds into rubber grades – with their typical elastic properties.

Material properties such as hardness, elasticity, tensile strength, temperature resistance, etc., are rated to the corresponding application. Documents detailing media resistance of the rubber grades are available on request.

Rubber grade	Trade name	STENFLEX® colour code	Properties	Applications
EPDM Ethylene propylene diene rubber	Buna AP Keltan Vistaton	orange	Heat- and weather-proof rubber grade with special resistance to highly oxidizing media and very many chemicals (not oil-resistant). Temperature resistance in continuous operation* from –40 °C to +100 °C. Resistant to hot water up to +100 °C.	Water, hot water, cooling water, sea water, steam, acids, lyes, pickling lyes, hypochlorite solutions etc. Special type AS in heating systems (as per DIN 4809 up to +110 °C)
CIIR Chloro isobutylene isoprene rubber	Butyl	white	Rubber grade complying with the latest hygiene directives for drinking water systems as per KTW recommendation by the German Health Department (KTW = Plastics for drinking water). Impermeable to gas. Temperature resistance in continuous operation* –40 °C to +90 °C. Resistant to hot water up to +90 °C.	Recommended for drinking water supply systems
NBR Nitril-butadiene rubber	Perbunan	red	Quality with excellent oil resistance, very resistant to swelling, e.g. even in contact with petrol/benzole mixture, impermeable to gas for hydrocarbons. Temperature resistance in continuous operation* –30 °C to +100 °C, resistant to hot water up to +70 °C.	Municipal gas, fuel oil, mineral oil, blast furnace waste gas, compressed air systems, cooling water with antifreezing compound
CR Polychloroprene rubber	Neoprene Baypren	--	Multi-purpose rubber grade with good oil, weather and flame resistance, very good resistance to ageing. Resistant to various organic and inorganic chemicals. Impermeable to gas for hydrocarbons. Temperature resistance in continuous operation* from –30 °C to +100 °C, resistant to hot water up to +70 °C.	weather-proof outer ply (cover layer)

*The given temperature for continuous operation refers solely to the rubber grade. When reinforcements or other filling material is embedded, the temperature resistance in continuous operation increases.

Development/Design

STENFLEX® rubber expansion joints are rated by state-of-the-art computing techniques (which include the Finite Element Method). They are optimized under experimental conditions.

Our development engineers use the most up-to-date development tools throughout the development stage to validate the construction process in terms of form, function and installation. This means we offer our customers the following advantages:

- Design and development in line with the specific requirements, resulting in safe and extremely durable expansion joints
- Efficient products by incorporating superior product functionality
- Structures that are easy to install
- Reduced lead times for special designs

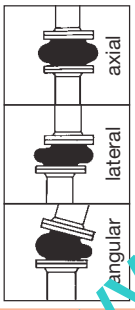
The excellent features of STENFLEX® rubber expansion joints include outstanding absorption of movement and good vibration damping properties. Depending on the particular expansion joint type, a maximum of the forces produced by the pipe internal pressure is absorbed by the specific design of the expansion joint itself, and not passed on to neighbouring system components.

Versions

Rubber expansion joints differ according to the following criteria:

- type (universal/lateral/angular expansion joints)
- pipe connection type (flange, thread)
- rubber quality of the bellows (rated to the media transported in the pipes)
- bellows structure (rated to the pressure and temperature load)

Our expansion joints are delivered ready to install. Together with the standard versions featured in the catalogue, special versions can also be developed and produced on request for special operating conditions. Connection parts (that deviate from DIN) such as ISO, ANSI, BS, VG and SAE standards etc. are also possible.

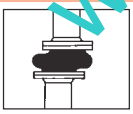


Universal rubber expansion joints

Structure:
Rubber bellows with connection parts (flange or thread)

Movement absorption:
Axial, lateral, angular and simultaneous movement absorption is possible. Universal expansion joints with two bellows and a connecting pipe are used to absorb large movement.

Fixed points:
To absorb axial force a pipe's fixed points must be robust. Pipe routing must be correct.

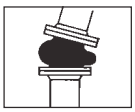


Lateral rubber expansion joints:

Structure:
Rubber bellows with flanges and laterally movable restraints.

Movement absorption:
Lateral shift of the expansion joints is possible. The restraint absorbs axial reaction force and relieves the pressure on the pipe's fixed points. In double joints the type of restraint allows for movement on one plane; in ball joints it allows for all-around movement. Lateral expansion joints with two bellows and a connecting pipe are used to absorb large movement.

Fixed points:
Only light fixed points are required to absorb force from lateral movement and friction force.



Angular rubber expansion joints:

Structure:
Rubber bellows with flanges and hinge restraint. The rotating axis of the hinge restraint is in the middle of the bellows.

Movement absorption:
Angular movement of the expansion joint is possible. The angular joints regulate a defined angular movement, absorb axial reaction force and relieve the pressure on the pipe's fixed points.
We differentiate between angular expansion joints with a hinge (bellows' angular movement guided on one plane) and angular expansion joints with a cardan hinge restraint (bellows movement guided on two planes). Angular expansion joints with connecting pipe are used to compensate large movements.

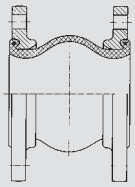
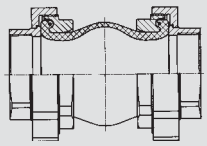
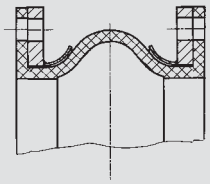
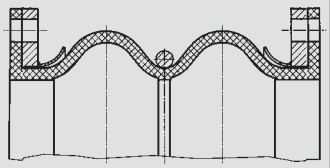
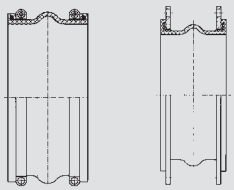
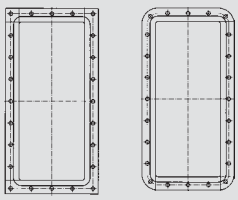
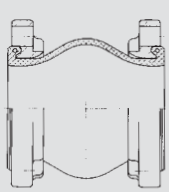
Fixed points:
Only light fixed points are required to absorb angular movement force and friction force.

STENFLEX®

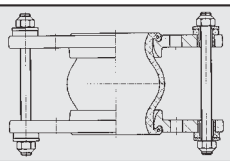
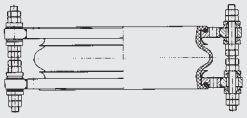
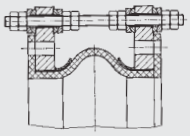
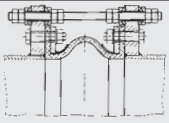
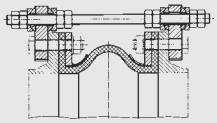
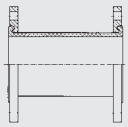
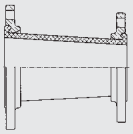
Rubber Expansion joints

Program summary

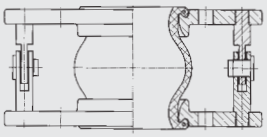
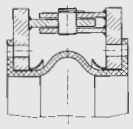
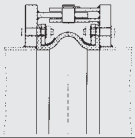
Universal rubber expansion joints

	Type	DN	Pressure rate bar	Max. operating temperature	Rubber grades	Connection parts	Page
	**A-1** **AR-1** **AS-1** **B-1** **R-1** **RS-1** **VS-1**	DN 20-1000 DN 20- 400 DN 25- 400 DN 32- 400 DN 25- 300 DN 25- 300 DN 40- 150	PN 16 PN 25 PN 16 PN 16 PN 16 PN 16 VG 85356	+90 °C +110 °C +110 °C +90 °C +90 °C +90 °C +90 ° C	EPDM, NBR, CIIR EPDM, NBR EPDM, NBR EPDM, NBR EPDM, NBR, CIIR EPDM, NBR EPDM, NBR	rotating flanges	**1.13** **1.15** **1.17** **1.21** **1.33** 1.35
	**AG-5** **AS-5**	DN 20-50 DN 32-40	**PN 16** **PN 16**	+100 °C +110 °C	EPDM, NBR, CIIR EPDM, NBR	female and/or male thread	1.19 1.20
	**C-1**	DN 300-2400 DN 300-2800 DN 300-3600	PN 16 PN 10 PN 4	+90 °C +90 °C +90 °C	EPDM, NBR, CIIR EPDM, NBR, CIIR EPDM, NBR, CIIR	press-on retaining flange	1.23
	**C-2**	DN 300-2000 DN 300-2000	PN 10 PN 4	+90 °C +90 °C	EPDM, NBR, CIIR EPDM, NBR, CIIR	press-on retaining flange	1.25
	**D-11** **D-30**	DN 300-7500 DN 300-7500	PN 0,7 PN 0,7	+90 °C +90 °C	EPDM, NBR EPDM, NBR	rotating press-on retaining flange or tightening straps	1.27
	**D-21** **D-22** **D-41** **D-42**	DN 150-7500 DN 150-7500 DN 150-7500 DN 150-7500	PN 0,7 PN 0,7 PN 0,7 PN 0,7	+90 °C +90 °C +90 °C +90 °C	EPDM, NBR EPDM, NBR EPDM, NBR EPDM, NBR	press-on retaining frame	1.29
	**GR-SAE**	DN 40-125	PN 16	+110 °C	NBR	rotating SAE flange	1.31

Lateral rubber expansion joints

	Type	DN	Pressure rate bar	Max. operating temperature	Rubber grades	Connection parts	Page
	**A-2** **AR-2** **AS-2** **B-2** **R-2** **RS-2**	DN 20-1000 DN 20- 400 DN 25- 400 DN 32- 400 DN 25- 300 DN 25- 300	PN 16 PN 25 PN 16 PN 16 PN 16 PN 16	+90 °C +110 °C +110 °C +90 °C +90 °C +90 °C	EPDM, NBR, CIIR EPDM, NBR EPDM, NBR EPDM, NBR EPDM, NBR, CIIR EPDM, NBR	rotating flange with tie rod restraint	1.37 1.39 1.41 1.43 1.53 1.55
	**A-4** **AR-4** **AS-4** **B-4**	DN 20-1000 DN 20- 400 DN 25- 400 DN 32- 400	PN 16 PN 25 PN 16 PN 16	+90 °C +110 °C +110 °C +90 °C	EPDM, NBR, CIIR EPDM, NBR EPDM, NBR EPDM, NBR	rotating flange with tie rod restraint	1.37 1.39 1.41 1.43
	**C-31**	DN 300-1000 DN 300-1000 DN 300-2400 DN 2500-3600	PN 16 PN 10 PN 4 on request	+90 °C +90 °C +90 °C	EPDM, NBR, CIIR EPDM, NBR, CIIR EPDM, NBR, CIIR	press-on retaining flange with tie rod restraint	1.45
	**C-32**	DN 300-3600	on request	+90 °C	EPDM, NBR, CIIR	press-on retaining flange with tie rod restraint on counter flange	1.47
	**C-35**	DN 300-3600	on request	+90 °C	EPDM, NBR, CIIR	press-on retaining flange with tie rod restraint on segments	1.48
	**E**	DN 20-250	PN 10	+90 °C	EPDM, NBR	rotating flange	1.49
	**G**	DN 25-100 DN 125-250	PN 16 PN 10	+90 °C +90 °C	EPDM, NBR EPDM, NBR	rotating flange	1.51

Angular rubber expansion joints

	**A-3** **AS-3**	DN 32-1000 DN 25- 400	PN 16 PN 16	+90 °C +110 °C	EPDM, NBR, CIIR EPDM, NBR	rotating flange with hinge restraint	1.57 1.59
	**C-41**	DN 300-3600	on request	+90 °C	EPDM, NBR, CIIR	press-on retaining flange with hinge restraint	1.61
	**C-42**	DN 300-3600	on request	+90 °C	EPDM, NBR, CIIR	press-on re-taining flange with hinge restraint on counter flange	1.62

Wall sealing expansion joints

	**W-1** **W-2**	DN 80-3400 DN 200- 800	PN 1 PN 2,5 PN 2,5	+90 °C +90 °C +90 °C	EPDM, NBR EPDM, NBR EPDM, NBR	press-on retaining flange	1.63

Connection parts

STENFLEX® rubber expansion joints are supplied ready for installation. They are connected to pipes, fittings, pumps, tanks etc., by flanges or screwed union. The connections are standardized to fit commercially available pipes, flanges and threads.

Flanges

Flanges for rubber expansion joints in the series A, AR, AS, B, E, G, GR-SAE R and RS have a specially turned groove designed to accommodate the rubber rim. They are fitted in a rotating position at the bellows to simplify mounting to the pipeline.

STENFLEX® rubber expansion joints in the series C, D, and W have press-on retaining flanges.

The flanges have a stabilizing collar on the side facing the bellows (moulded bead or welded rim). This stabilizes the rubber bellows and ensures compliance with safety spacing between the ends of the screws and the rubber bellows throughout the entire range of pressure and movement. The purpose is to eliminate the risk of damage to the rubber bellows caused by the screw ends. Special flanges are fitted with stabilizer rings.

Standard screws can be used because the flanges are drilled for through-bolts according to EN 1092 (DIN 2501). Other pitch circles and bores are possible e.g. to ANSI (ASA), BS, SAE and for ventilation systems.

Flanges vary according to expansion joint type (universal, lateral and angular expansion joints) and size as follows:

- Standard flanges
- Flanges with molded ears
- Flanges with welded ears
- Oval flanges
- Flanges with two pitch circles
- Flanges made to other standards

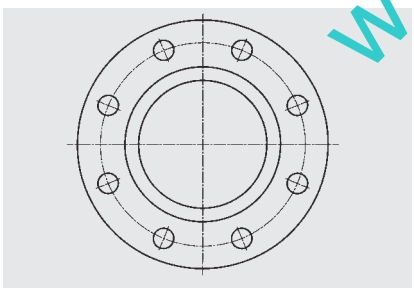
Standard flanges for rubber expansion joints are machined to produce a fit within the tolerances.

The following special versions are possible on request:

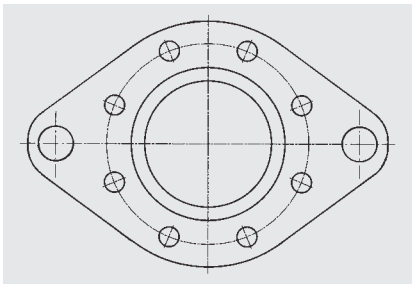
- All-round machined flanges
- Special materials deviating from the standard data sheet (stainless steels, aluminum, plastic, etc.)

Flanges made of unalloyed steels are galvanized and blue chromated or given an anti-corrosion prime coating. Stainless steel is used to meet tougher corrosion protection requirements. Other materials and forms of corrosion protection (hot-dip galvanizing, special varnish, coating etc.) can be supplied on request.

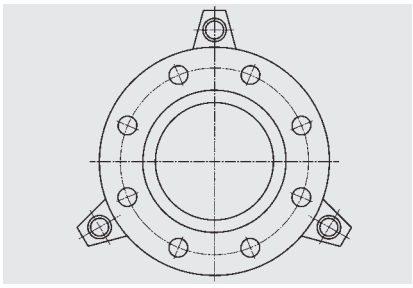
Flange material	Material No. as per DIN EN	Abbreviation as per DIN EN (DIN)
Unalloyed steel	**1.0038**	**S235JR**
	1.0577	**S355J2**
Stainless steel	**1.4541**	**X6CrNiTi18-10**
	1.4571	**X6CrNiMoTi17-12-2**
	1.4404	**X2CrNiMo17-12-2**



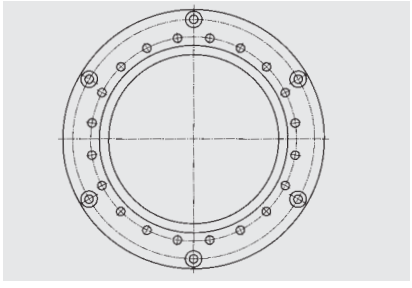
Standard flange with turned groove for rubber rim and stabilizing collar (universal expansion joint)



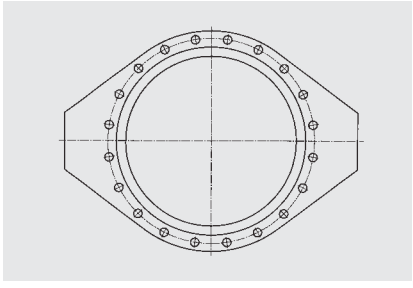
Flange with molded ears for the restraints (lateral expansion joints)



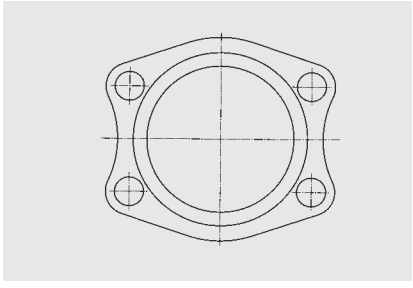
Flange with welded ears or molded ears for the restraints (lateral expansion joints)



Flange with second pitch circle for the restraints (lateral expansion joints)



Oval flange (angular expansion joints)



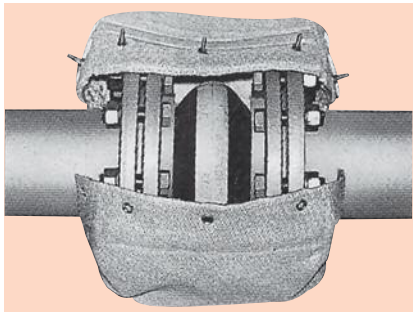
Flange as per SAE standard (type GR-SAE)

Rubber expansion joints

General description of rubber expansion joints

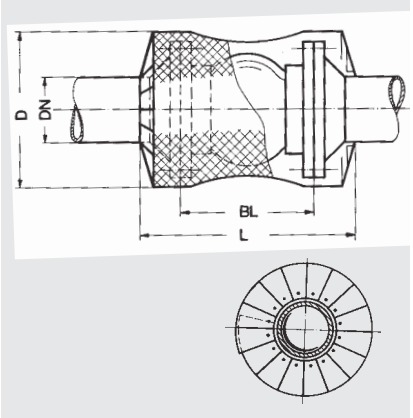
Protective covers

STENFLEX® protective covers for expansion joints are used where special operating conditions make it necessary to protect the expansion joint from external effects, or where adverse operating conditions and dangerous flow media make it necessary to protect the environment with a preventive splash-guard.



STENFLEX® flame protective cover K-1

Flame protective cover K-1



Application:
As protective cover to prevent flame penetration up to +800 °C for up to 30 minutes at a medium temperature of +80 °C, to maintain full operational ability of the expansion joint over this period.

When used aboard ships the protective cover together with STENFLEX® rubber expansion joints complies with the requirements of the classification agencies.

However, the best solution is to use our special type AS which is flame-proof.

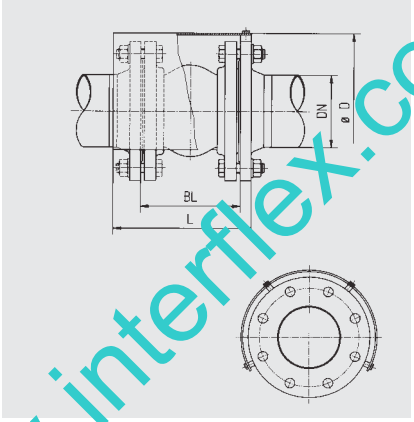
Properties
- Flame-proof
- Flexible material

Material
- Fabric

Structure
Flexible protective cover of special fabric with heat-proof insulation inlays; ready for installation with fastening screws to seal the cover.

Installation
The expansion joint is mounted according to the prescribed installation and mounting instructions. The protective cover also encompasses the pipe flanges.

Protective hood K-3



Application:
As protective hood under extremely adverse operating conditions or exposure to the elements (extreme sunshine), or risk of damage from external mechanical effects (sea, river, or road traffic).

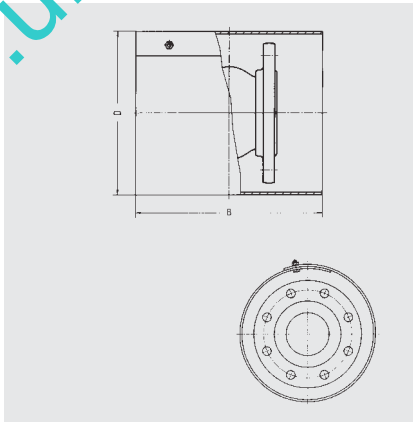
Properties
- Impact resistant
- Weather-proof
- Rigid

Material
- Stainless steel

Structure
Rigid protective stainless steel hood, mounted on one side (pre-mounted in the factory).

Installation
The expansion joint is mounted according to the prescribed installation and mounting instructions. The protective hood, open at the bottom, is placed over the expansion joint and counter flange and screwed on one side; the other side remains unfastened to give the expansion joint room to move.

Protective tube K-4



Application:
Primarily for underground pipelines to protect the expansion joint from soiling and possible earth pressure.

Properties
- Impact-proof
- Corrosion-resistant
- Rigid

Material
- Plastic
- Stainless steel

Structure
Rigid, cylindrical protective tube of impact-proof plastic or stainless steel, overlapping. With corrosion-proof screwed union.

Installation
Before fitting the expansion joint, the closed protective tube is pushed over one of the two connection pipes; after the expansion joint has been installed, the tube is pulled back over the expansion joint and fastened in position.

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Technical annex

Movement and force at compensators

Movement

Before opting for a compensator type, it is important to decide on how a change in length of a pipe system is to be compensated.

The choice of the compensator type depends essentially on the securring expansion, on the routing of the piping system and on the space available.

Pipe expansion can be absorbed by shift and deflection of a certain type of compensator.

When choosing a compensator the following types of movement must be considered:

- axial movement
- lateral movement
- angular movement

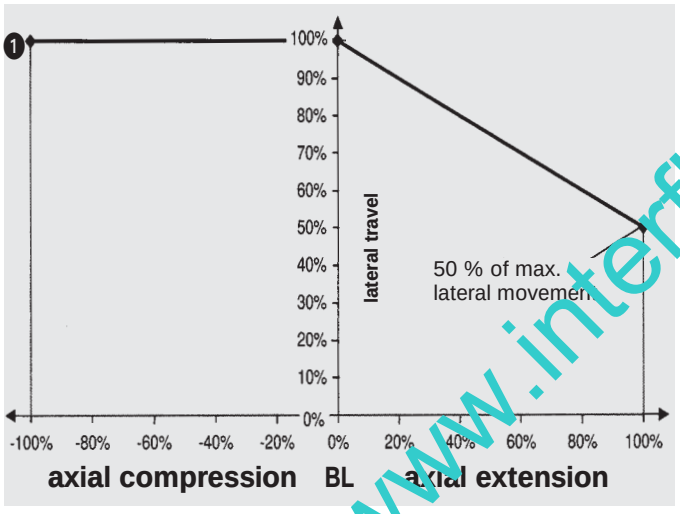
Rubber compensators

If both axial and lateral (superimposed) movement are simultaneously introduced into a rubber compensator, its maximum extension in the axial direction and its ability to absorb the highest rated movement are reduced (see diagram ❶).

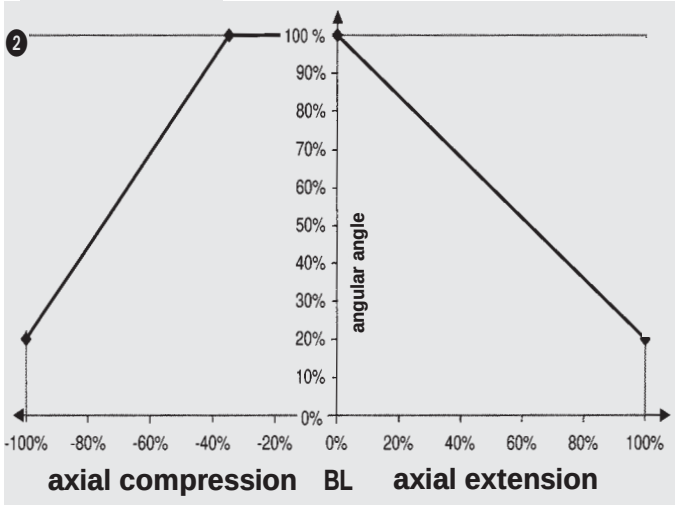
The interrelation of superimposed angular and axial movement is shown in diagram ❷.

Steel compensators

If axial and lateral movement are simultaneously introduced into a steel compensator (superimposed movement), the lateral share is converted by an equation into an equivalent axial path and must not exceed 100 % when added.
Please contact our Technical Consultation Service.



Restriction of the lateral movement with simultaneous axial movement (universal expansion joints)



Restriction of the angular deflection with simultaneous axial movement (universal expansion joints)

Rubber Expansion Joints: Influence of temperature on the permissible inner pressure

The maximum permissible operating pressure of rubber expansion joints stated in the data sheets refers to a temperature of 20 °C. The pressure must be reduced with rising temperature as the strength of bellows materials decreases with rising temperature (see table).

max. permissible operating pressure (bar)

Temperature °C	type series A, AG, B, R bar	AS, RS bar	AR bar	GR-SAE bar	E, G bar
20	16	16	25	16	10
30	16	16	25	16	10
40	16	16	25	16	10
50	16	16	25	16	10
60	15	16	24	16	9.5
70	14	15	22	15	9
80	11	14	20	14	7
90	6	12	16	12	4
100	6*	10	11	10	4*
110		6	6	6	
120		6*	6*	6*	
130		6*	6*	6*	

Temperature °C	type series C bar				F bar		H bar	W bar	
20	2.5	4	6	10	4	6	6	1	2.5
30	2.5	4	6	10	4	6	6	1	2.5
40	2.5	4	6	10	4	6	6	1	2.5
50	2.5	4	6	10	4	6	6	1	2.5
60	2.2	3.8	5.5	9.5	3.8	5.5	5.5	0.9	2.2
70	2	3.5	5	9	3.5	5	5	0.9	2
80	1.7	2.8	4	7	2.8	4	4	0.7	1.7
90	1	1.5	2.5	4	1.5	2.5	2.5	0.4	1
100	1*	1.5*	2.5*	4*	1.5*	2.5*	2.5*	0.4*	1*

*for brief periods (max. 100 hours)

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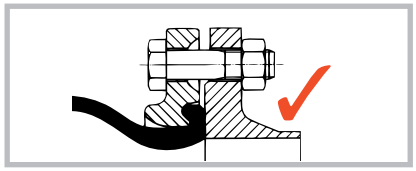
Installation and operating instructions for rubber compensators and pipe connectors

STENFLEX compensators and pipe connectors can only fulfil their function when installed and fitted correctly. The service life is affected not only by the operating conditions but above all by correct installation. Compensators and pipe connectors are not simple pipe elements but moving parts which require regular inspection.

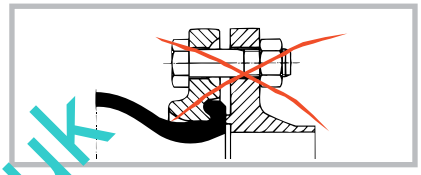
Compensators and pipe connectors are individual components of a pipeline system manufactured by STENFLEX. STENFLEX assumes no guarantee for imitation products or modifications to original products.

Installation

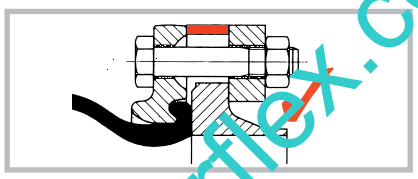
- The compensator or pipe connector must be kept clean and dry. When stored out in the open, it must be protected from intense sunshine and weather.
- Prior to installation, check the packaging and compensator or pipe connector for signs of damage. If any sign of damage whatsoever is detected the product must not be installed.
- Keep the compensator or pipe connector clear of any foreign matter e.g., dirt, insulation etc. on the inside and outside, and check again accordingly before and after installation.
- Do not remove transport safeguards and protective caps until immediately before installation.
- Compensators and pipe connectors must only be installed by authorized qualified personnel. Appropriate accident prevention regulations must be observed.
- Do not throw, or jolt, the compensator or pipe connector; protect from falling objects. Do not attach chains or cables directly to the bellows.
- Special seals are not required because the compensators and pipe connectors are self-sealing. The sealing faces of the flanges must be smooth and clean. Additional seals are not required; a seal only needs to be inserted when fitting internal guide sleeves.
- Insert rubber compensators with vacuum supporting rings for negative pressure operations.
- Compensators are to be mounted according to ❶. If this is not possible the screw length for ❷ must be selected so as not to damage the bellows. In the case of flanges with threaded holes, make sure that the screw length is flush with the flange as far as possible ❸.



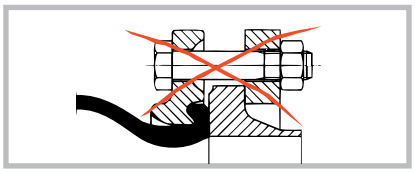
The sealing faces of the counter flange must be smooth and clean.



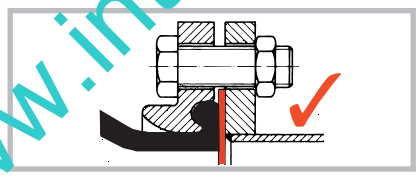
Flanges with groove and tongue are not allowed.



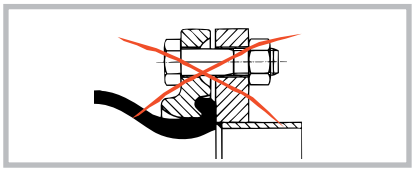
Spacer pieces must be used to level gaps.



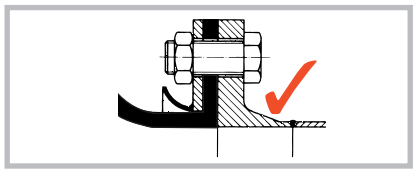
Rotating flanges with short stub end are unsuitable: no uniform full-circumference surface pressure.



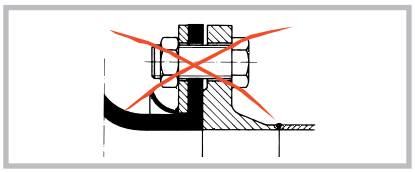
Additional flat seals protect the rubber sealing face from sharp-edged pipe ends.



Sharp-edged pipe ends cut into the rubber sealing face.



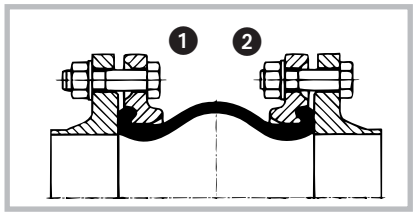
For full-faced rubber flanges, uniform full-circumference surface pressure is only possible with smooth mating flanges.

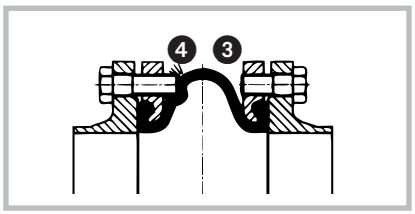


Mating flanges with raised shoulder will squash the rubber flange, the press-on retaining flange warps – insufficient surface pressure.

The risk of damage from screws that are too long increases when the rubber bellows expands when operating under pressure ❹.

- During installation ensure that the bores in the pipe flanges are aligned. If necessary, adjust rotating flanges at the compensator or pipe connector.





Installation

- Tighten the flange screws crosswise and evenly, hold the key in the middle and turn on the outside to avoid tool damage to the bellows. Tighten the screws again after initial commissioning.
- It is important to ensure that there is no torsion strain (twisting) on the compensator or pipe connector during assembly/dismantling and during operation. This applies in particular to types with threaded connection: hold these with a key at the hexagon.
- When electric welding is carried out on the pipe near the compensator or pipe connectors they must be bridged with earthing cables. Compensators and pipe connectors must always be protected from welding splashes and thermal load during welding work.
- Wherever possible install compensators or pipe connectors so that they can be visually checked at regular internals for possible damage.
- Cover compensators or pipe connectors to prevent damage of any kind.
- Note the direction of flow for compensators with internal guide sleeves (direction of the arrow = direction of flow).
- Do not paint the bellows, do not apply any insulation.
- Do not remove the pre-tensioning safeguards until after installation.
- The pipes must be equipped with adequately rated fixed points and pipe guides to absorb pipe force (see chapter: 'Movement, force, pipe fixed points'). The operator is responsible for correct rating.
- The fixed points of the pipe system must only be fastened after the compensator has been mounted (after flange screws have been tightened).
- In general the manufacturer does not conduct pressure tests according to Annex 1, section 3.22 of the pressure equipment directive PED 93/23/CE. This is the responsibility of the operator after installation in the pipe system (PT = 1.43 x PS).
- The operator must provide the necessary safety and monitoring devices for the pipe system (e.g., installation of temperature sensors, pressure reduction valves, measures to prevent pressure pulses and water hammers).

Initial commissioning

- Compensators and pipe connectors with restraints have been adjusted to the structural length (BL) in the factory. The tie rods must be connected to the flanges with a positive connection after installation.
- Only proceed with pressure and leak tests after the fixed points and guide bearings have been installed correctly. Otherwise the compensator will extend in length and become useless.
- During operation at high temperatures the operator must take safety precautions to prevent injury to persons inadvertently touching hot surfaces.
- To guarantee safe operation the compensators and pipe connectors must only be operated within the permitted ranges of pressure, temperature and movement.
- The operator is responsible for precautions that will prevent incorrect use of compensators or pipe connectors by ensuring that the staff have been instructed accordingly and are supervised adequately, and by providing safety equipment and operating instructions.

Use

- Before using the compensators or pipe connectors check the media resistance (if in doubt, please inquire).
- Internal guide sleeves must be installed in the compensator or pipe connector where abrasive media flow through the system and where high flow speeds or turbulent flow are concerned.
- To avoid fire damage, compensators and pipe connectors can be provided with additional flameproof covers.
- The operating data as stated in the data sheets, design drawings and on the nameplate are the application limits for use. STENFLEX assumes no liability for damage caused by operation outside these limits. The operator is responsible for complying with these specifications (e.g. by using safety devices).

Detailed installation, and operating instructions which also stipulate screw torques are enclosed with every compensator and pipe connector.

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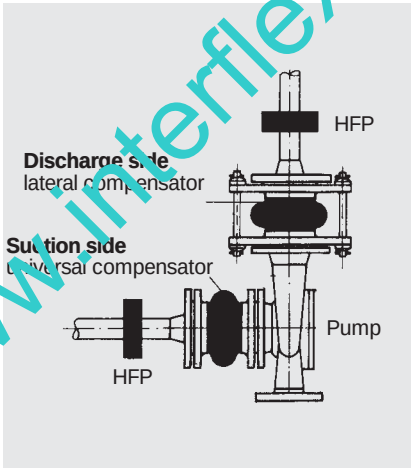
Installation and operating instructions for rubber compensators and pipe connectors

Inspection and maintenance

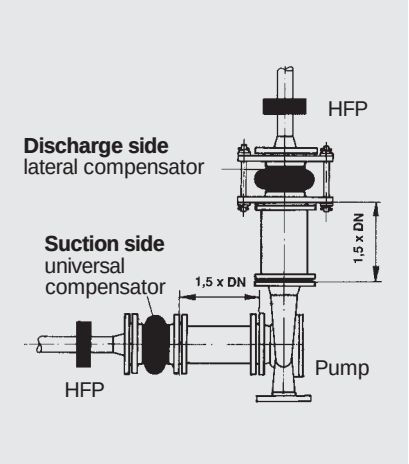
- The operator must ensure that the compensators and pipe connectors are freely accessible so that visual inspections can be carried out at regular intervals.
- Check the compensators and pipe connectors for flawless condition in accordance with valid standards. In the case of faults such as blistering, surface cracks or irregular deformation, please contact our Technical Consultation Service. Repairs are not permitted.
- The Shore hardness of the flexible rubber elements in compensators and pipe connectors must be checked at regular intervals. If the hardness exceeds 83 Shore A, the element must be replaced, for safety reasons.
- Avoid using chemically aggressive media to clean the pipe system.
- The compensators and pipe connectors can be cleaned with soap and warm water. Never use sharp or pointed objects such as wire brushes or sandpaper.

Instructions for rubber compensators at pumps

- Connect the compensators or pipe connectors as close to the pump flange as possible.
  Exception: a spacer pipe should be used where abrasive media are concerned.
- When using centrifugal pumps to pump abrasive media, the compensators or pipe connectors must not be positioned directly on the pump fitting (suction/discharge side).
  Otherwise there is a risk that the compensators could be damaged by the high relative speeds caused by swirling and eddying at the pump connection.
  The spacing between the pump connection and the compensator or pipe connector must be 1 to 1.5 x DN.
- In the case of negative pressure on the suction side, use a rubber compensator with vacuum supporting ring.
- Avoid operating pumps against completely or partially closed gate valves. Also avoid cavitation! This can destroy the compensator or pipe connector in a very short time.



Recommendation for arranging compensators at pumps (normal case)



Pumping media with abrasive solid particles (special case)

Special instructions for pipe connectors

- Rubber-metal pipe connectors are intended as decoupling elements to prevent sound transmission and to dampen vibration only. They are not to be used to absorb low frequency oscillation, expansion, tension or to compensate misalignment in the pipeline.
- During installation use only the screw lengths and washers as stated in the data sheets and attached installation instructions.
- The length of the gap in the pipe system must equal that of the pipe connector. No tensile force must be introduced into the rubber-metal pipe connector.
- Install the rubber-metal pipe connector free of tension, do not subject to tension, torsion or bending. Do not use as a compensator!

Declaration of conformity

STENFLEX rubber compensators of type series A, AR, AS, AG, B, C, E, F, G, GR-SAE, H, R, RS and W have undergone conformity appraisal procedure and conform with the PED directive 97/23/EG.

Attestation is done by notified body, identification number 0036 according to annex VII of PED 97/23/EG.

The expansion joints are marked with CE and identification number.