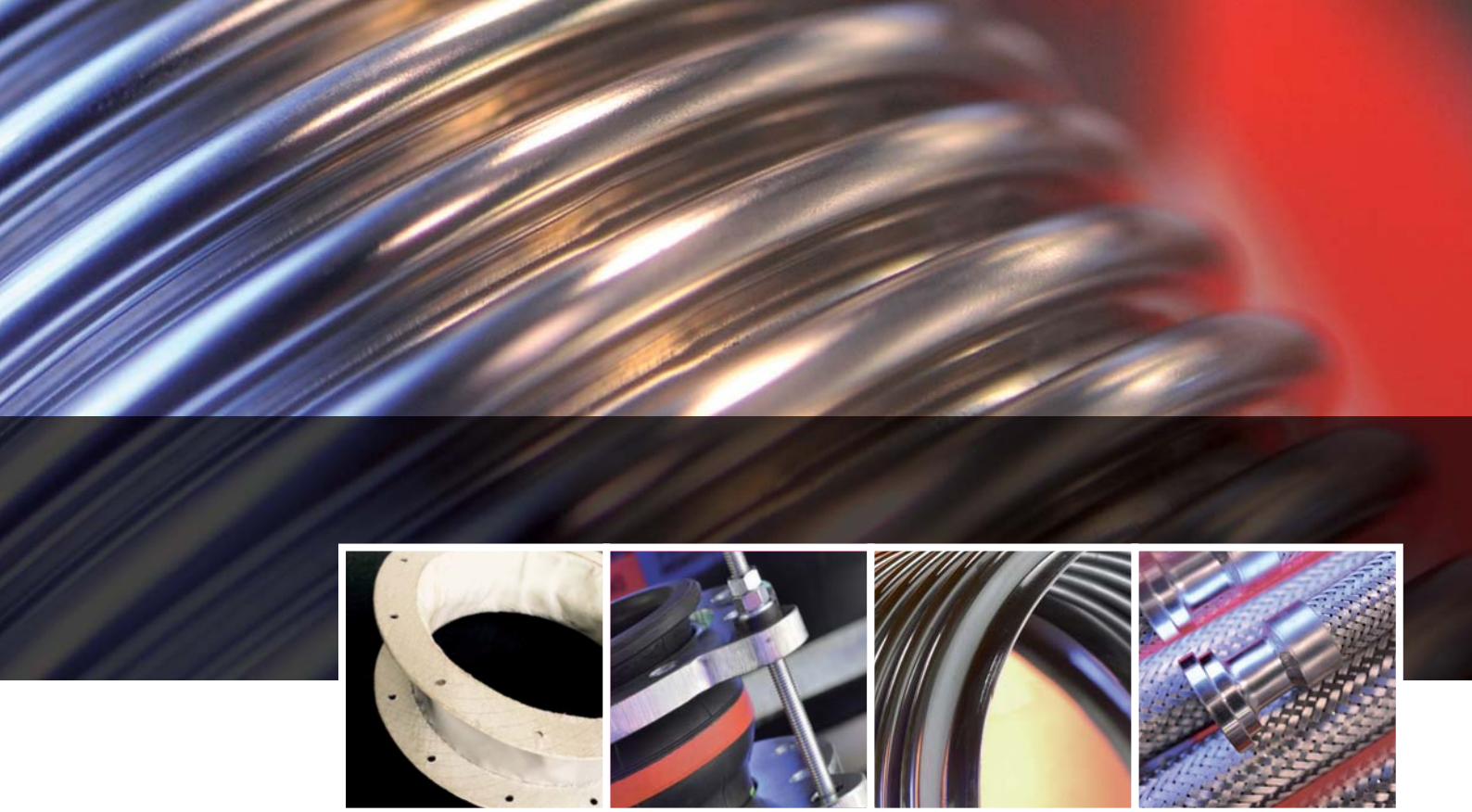


Expansion Joints

Corrugated Hoses

www.roth-kompensatoren.de

About us

For us, the basis of our business is a strong connection with our customers. Individual planning over short periods of time, high-quality products at fair prices. Feel safe in the knowledge that we look back on 50 years of experience in the field of quality flexible piping elements. The large number of satisfied customers from all over the world attests to the quality of our services, as do the various standards and many certifications we have been awarded. The core elements in our extensive range of products are the product lines stainless-steel expansion joints, composite and fabric expansion joints and stainless-steel corrugated hoses.

Quality Assurance

EN ISO 9001:2009 Certified Quality Management System.

CE marking and declaration of conformity acc. to PED 97/23/CE.

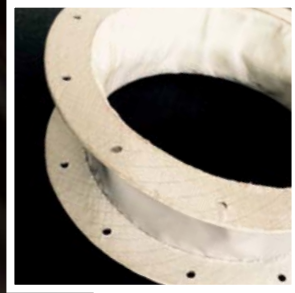
AD 2000-Merkblatt HP 0 / DIN EN ISO 3834-3 / HP 100 R / TRD 201
Proof to dispose of the prerequisites fort he manufacture of pressure equipment as defined in Pressure Equipment Directive 97/23/CE.

DIN EN 15085-2.
Railway applications – Welding of railway vehicles and components.

Certificate for the internal production and quality control (module A1) according to PED 97/23/EG. Identification no. CE 0036.

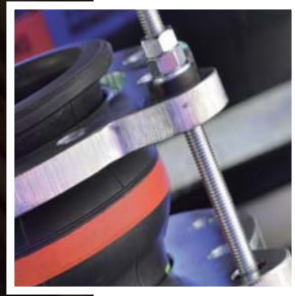
DIN-DVGW Approvals.
DIN30681 for metal bellows and DIN3384 for flexible hoses.

Zertifikat Nr. 60 204 – 09 HH. Approval for manufacturing of metallic hose assemblies according to GL standard VI-3-9 Regulations for the recognition of manufacturers of hose assemblies and compensators, 1998.



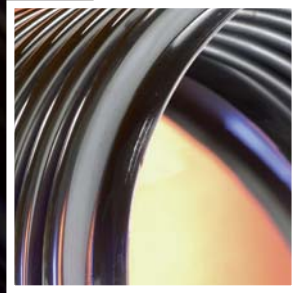
Fabric
expansion joints

1.1



Rubber
expansion joints

2.1



Stainless steel
expansion joints

3.1

Stainless steel
corrugated hoses

4.1

Appendix
materials and standards

5.1

Fabric
expansion joints

Introduction

Fabric expansion joints are flexible elements capable to compensate largely without any stresses axial, lateral and angular movements in various piping systems. These types of expansion can occur concurrently. Appropriate designs are available to withstand vibration and torsion as well.

When installing, note that fabric expansion joints are not load-bearing elements of the pipeline. It is therefore important to ensure that the fixed points and support points are properly located. For more information regarding installation and maintenance procedures please check “Installation and Servicing Instructions” on page 1.12.

Although fabric expansion have joints various applications, ROTH fabric expansion joints are mainly used with gaseous media and bulk media in areas such as:

- Coal, oil and gas-fired steam power plants;
- Flue-gas desulphurization systems (DeSOx);
- Nitrogen oxide removal systems (DeNOx);
- Waste incineration plants;
- Chemical plants;
- Refineries;
- Cement industry;
- Lime works;
- Metallurgical plants;
- Painting and drying systems;
- Industrial furnaces;
- Ventilation systems ;
- De-dusting and filter installations;
- Fire protection systems etc.

Designing and manufacturing fabric expansion joints is a complex process which requires detailed information about the application, the working environment and the dimensions of the equipments or pipings. ROTH fabric expansion joints can be made from one single layer of fabric or they can have several layers glued of sewed together according to each application requirements.

The structural design of fabric expansion joints and their layers are largely determined by the following:

- Duct shape;
- Location;
- Installation conditions;
- Leak-proof requirements;
- Medium;
- External influences;
- Overpressure or vacuum;
- Temperature;
- Degree of movement;
- Fluid velocity;
- Moisture occurrence;
- Solid components of medium.

With timely planning, suitable and efficient designs can be elaborated for practically all variables.

Backed by many years of practical experience and comprehensive test procedures, we are able to offer the very best in consultation. The high quality of our fabric expansion joints is ensured by the choice of high-grade materials and their appropriate processing. Correct installation is another factor that determines the operational effectiveness of fabric expansion joints. We will be pleased to advise you or to provide expert assembly engineers on request.

Welded or flanged internal baffles are recommended depending on the operating conditions. Similarly, the mounting configuration for fabric expansion joints depends on diameter, structural design, layer structure and leak-proof requirements, see also page 1.10 -1.11.

Overview of Materials

ROTH fabric expansion joints are manufactured without any asbestos as a matter of principle. Insulation is provided nowadays by glass and silicate materials, which also serve as a substrate for various coating. Sealing foils and fully vulcanized elastomers are also used.

The suitability and durability of an expansion joint are determined less by structure of an individual layer than by correct composition of materials and appropriate processing. Both, practical experience and the Know-How of the expansion joint manufacturer are essential in this context.

The following table contains information regarding the compatibility of the most common materials used in the construction of fabric expansion joints against the most common chemical substances: acids and lyes. Also, the maximal temperature resistance (in operation) for each of these materials is showed in the second column.

Material overview	Temperature resistance max. [°C]	Chemical resistance		Description
		Acids	Lye	
Insulating material				
Ceramic fiber	1250 °C	+	+	For loose filling or quilted in fabric, also available incorporated in expansion joint.
Mineral wool	750 °C	O	O	For loose filling or quilted in fabric, also available incorporated in expansion joint.
Insulating glass	500 °C	+	+	Glass mat, also for use in some types of shaped fabric expansion joints.

Material overview	Temperature resistance max. [°C]	Chemical resistance		Description
		Acids	Lye	
Uncoated fabric				
INCONEL	1250°C	+	+	Woven ceramic fiber with INCONEL reinforcement.
Thermosil 650H	1100°C	+	+	Silicate fabric, extremely resistant to acids and temperature.
Thermotex 1100 HT	700 °C	+	+	Special fabric with high-temperature finish.
Thermotex 1100 NIRO	600 °C	+	+	Woven mineral fiber with stainless steel wire reinforcement ≈ 1100 g/m².
Glastex 1000	550 °C	+	+	Special glass fabric with high temperature resistance and good insulating effect, ≈ 1000 g/m²
Glastex 800	500 °C	+	+	Glass fiber fabric, high tensile strength, ≈ 800 g/m².
Glastex 440	500 °C	+	+	Glass fiber fabric, high tensile strength, ≈ 440 g/m².
Aramid	200 °C	+	+	High-strength fabric for extreme mechanical loads.
Stainless steel 1.4301 1.4828	600-1000 °C	+	+	Fine wire-netting, choice of material depends on requirements.
Coated fabric				
VITON-Glastex 1 VITON-Glastex 2	180 °C	+	+	Glass fiber fabric with VITON-coating, excellent chemical resistance.
PTFE Glastex 20/600	280 °C	+	+	Glass fiber fabric, one side with PTFE-Foil 0,2 mm, compound material.
PTFE Glastex 20/10/600	280 °C	+	+	Glass fiber fabric, one side 0,2 mm, other side 0,1 mm PTFE-foil, compound material.
TFM-Glastex	280 °C	+	+	Glass fiber fabric, one side with TFM-Foil 0,4 mm, compound material.
PTFE-Glas 15	280 °C	+	+	PTFE-covered glass fabric, 0,15 mm thickness
Silglas 1 Silglas 2	180 °C	–	O	Glass fabric, one side/both sides with silicone-coating grey or white.
Silaramid 1 Silaramid 2	150 °C	–	O	Aramid fabric, one side/both sides with silicone-coating grey or white.

Material overview	Temperature resistance max. [°C]	Chemical resistance		Description
		Acids	Lye	
Coated fabric				
Alufix 1 Alufix 2	150 °C	–	–	Glass fabric, one side/both sides with PU-coating, grey hardly inflammable, oil resistant.
Aluglas 430	200 °C	–	–	Glass fabric, one side with aluminum-coating.
Glastex 4435	400 °C	+	+	Glass fabric, one side with stainless steel coating.
Hypatex	120 °C	+	+	Polyester fabric, both sides with hypalon-coating.
Polytex	70 °C	+	+	Polyester fabric, both sides with PVC-coating.
Foils				
PTFE 25	260 °C	+	+	PTFE-foil 0,25 mm thick, virginal
Silicone	180 °C	–	O	Silicone-foil 1,5 mm or 2,5 mm thick, for high tightness requirements.
FPM (z.B. / pl. Viton)	180 °C	+	+	FPM-foil with high chemical resistance.
Stainless steel, INCONEL	600 °C	+	+	Stainless steel foil, good chemical and thermal resistance, choice of materials depends on requirements.
Soft-PVC	90 °C	+	+	High chemical resistance.
EPDM Neoprene Perbunan Butyl Mipolam	80 °C	+	+	With different layer thickness, also with inner fabric layer.
Hypalon	120 °C	+	+	Hypalon-foil, 2,0 mm thick, high chemical resistance.

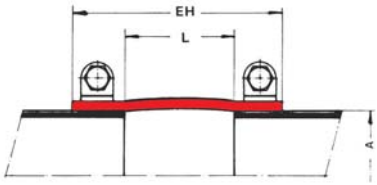
+ = Resistant; O = Conditionally Resistant; – = Not resistant.

Insulation Notes

Normally fabric expansion joints must not be included in external piping insulation to allow the calculated and necessary heat transfer. If you would like to install an insulation, please contact us, such that we may choose a special design for your expansion joints.

The piping insulation must not contact the expansion joint flanges under all circumstances. Generally a distance of at least 80 mm has to be kept between piping insulation and expansion joint. The duct insulation at ROTH fabric expansion joints has to be approved by our technical department. The installation of outer protection shields at the expansion joints has to be approved too.

Constructive Types

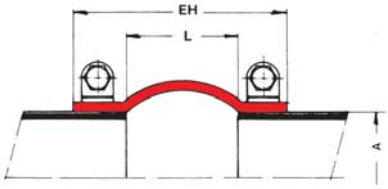


Type 11

Tube expansion joint, for mounting with clamps directly on the pipeline, standard model.

Capable movement:

axial:	0,10 L – 0,30 L
lateral:	0,05 L – 0,20 L

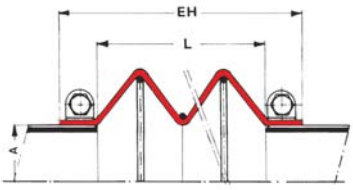


Type 12

Tube expansion joint with preformed convolution, greater expansion compensation than Type 11.

Capable movement:

axial:	0,20 L – 0,50 L
lateral:	0,10 L – 0,20 L

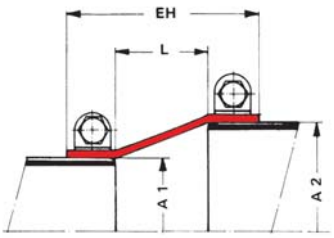


Type 14

Bellows expansion joint for mounting with clamps, with stainless steel support rings, for large expansion with internal or external pressure.

Capable movement:

axial:	0,30 L – 0,50 L
lateral:	0,15 L – 0,25 L



Type 15

Conical tube expansion joint for mounting with clamps, for bridging differed pipe or conduit diameters, usual configuration for fire-protection expansion joints.

Capable movement:

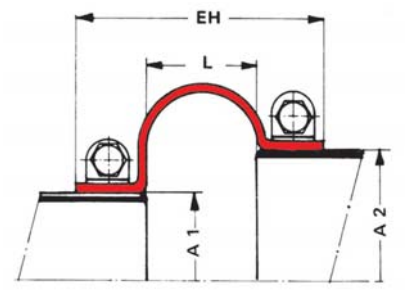
axial:	0,30 L – 0,50 L
lateral:	0,10 L – 0,15 L

Type 16

Tube expansion joint with external convolution for large movements, mounting with clamps, for different connecting cross-sections.

Capable movement:

axial:	0,30 L – 0,60 L
lateral:	0,15 L – 0,30 L

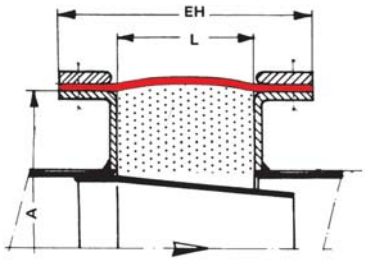


Type 21

Flat tube expansion joint, mounted on extended angle flange, for high temperature applications, baffle recommended, insulation can be installed locally or incorporated in the expansion joint.

Capable movement:

axial:	0,10 L – 0,30 L
lateral:	0,05 L – 0,20 L

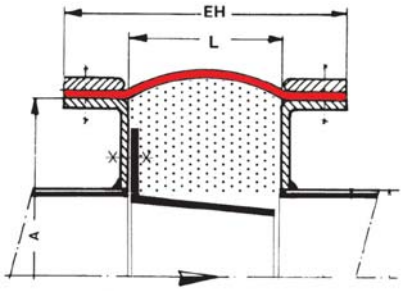


Type 22

Tube expansion joint with preformed convolution, greater expansion compensation than type 21.

Capable movement:

axial:	0,20 L – 0,50 L
lateral:	0,10 L – 0,20 L

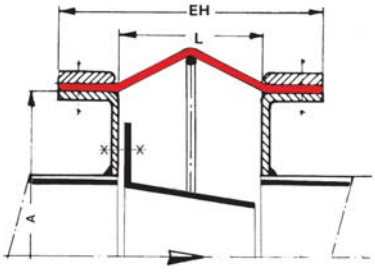


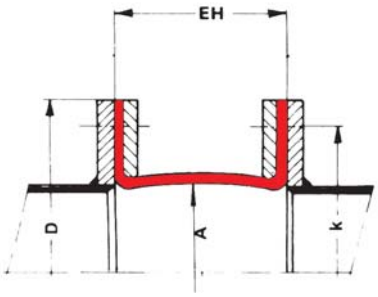
Type 23

Bellows expansion joint for extreme expansion compensation, also with integral stainless steel support rings, for internal and external pressure.

Capable movement:

axial:	0,40 L – 0,70 L
lateral:	0,15 L – 0,25 L



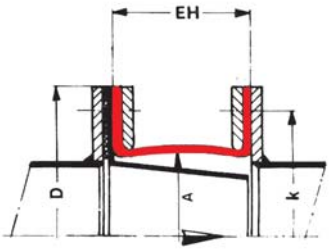


Type 31
(without baffle)

Flange expansion joint, U-design conventional standard model.

Capable movement:

axial:	0,10 L – 0,30 L
lateral:	0,05 L – 0,20 L

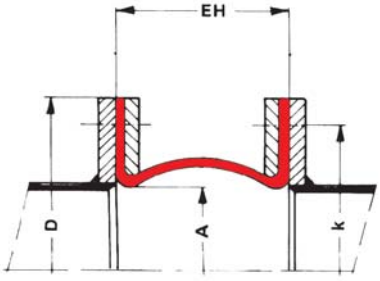


Type 31
(with baffle)

Flange expansion joint, U-design conventional standard model, flanged baffle.

Capable movement:

axial:	0,10 L – 0,30 L
lateral:	0,05 L – 0,20 L

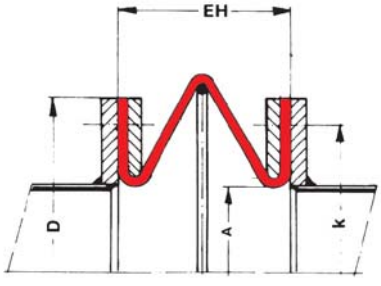


Type 32

Flange expansion joint with convex bellows, for greater expansion compensation and internal pressure.

Capable movement:

axial:	0,20 L – 0,50 L
lateral:	0,10 L – 0,20 L



Type 33

Bellows expansion joint, flange model for extreme expansion compensation, also with integral stainless steel supporting for internal and external pressure.

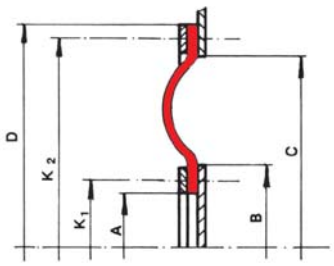
Capable movement:

axial:	0,40 L – 0,70 L
lateral:	0,15 L – 0,25 L

Type 35

Membrane expansion joint, for shaft and tubular bushings.

Capable movement:
* compensation depending of detailed design.

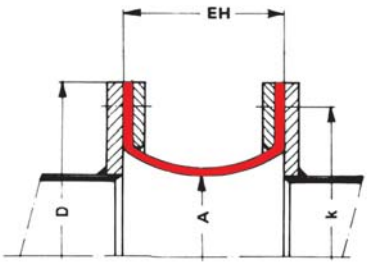


Type 42

Flange expansion joint with concave bellows for greater expansion compensation and external pressure.

Capable movement:

axial:	0,20 L – 0,50 L
lateral:	0,10 L – 0,20 L

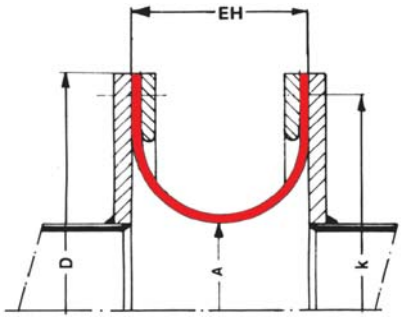


Type 43

Flange expansion joint with internal convolution, for extreme expansion compensation and external pressure.

Capable movement:

axial:	0,30 L – 0,80 L
lateral:	0,15 L – 0,30 L

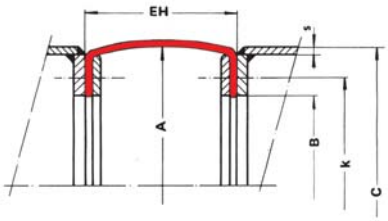


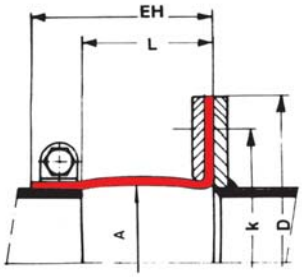
Type 45

Flange expansion joint, U-design external bellows, special design with internal bolts.

Capable movement:

axial:	0,10 L – 0,30 L
lateral:	0,05 L – 0,20 L



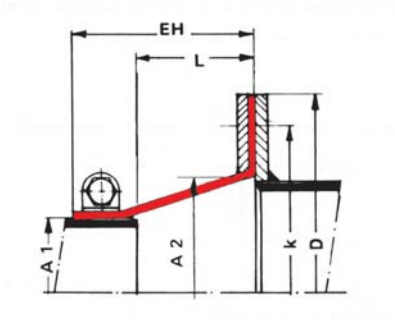


Type 51

Tube-flange expansion joint for identical connecting cross-sections.

Capable movement:

axial:	0,10 L – 0,30 L
lateral:	0,05 L – 0,20 L

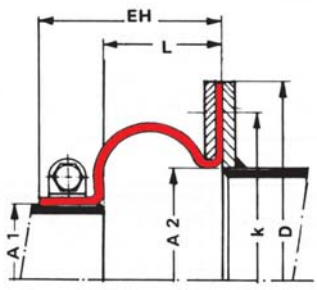


Type 52

Conical tube-flange expansion joint for different connecting cross-sections.

Capable movement:

axial:	0,30 L – 0,50 L
lateral:	0,10 L – 0,15 L

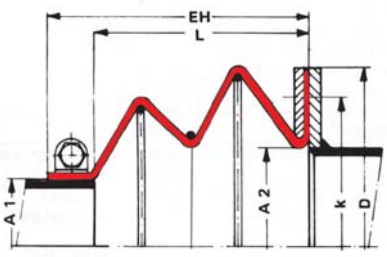


Type 53

Tube-flange expansion joint with external convolution, for extreme expansion compensation for identical or different connecting cross-sections.

Capable movement:

axial:	0,30 L – 0,60 L
lateral:	0,15 L – 0,25 L



Type 54

Bellows expansion joint, tube-flange model, for identical or different connecting cross-sections, with stainless steel support rings.

Capable movement:

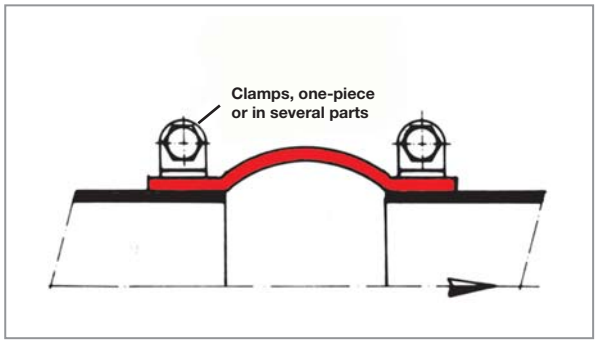
axial:	0,40 L – 0,70 L
lateral:	0,15 L – 0,25 L

Methods of Attachment

Fabric expansion joints are designed and manufactured according to the operating and leak-proof requirements imposed on them. The resistance to leaks is, however, only as good as permitted by the chosen method of attachment and the surface quality of the sealing surfaces. The correct method of attachment must therefore be selected in order to ensure the operational reliability of the expansion joint.

Clamps

Clamps are a simple and low-cost form of attachment that does not require the drilling of the expansion joint. They are subject to the following operational limitations:

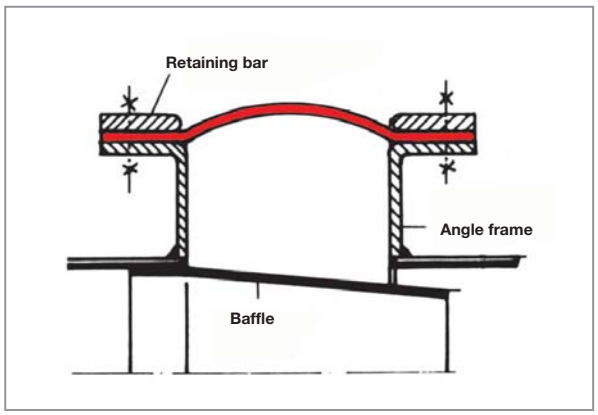


- For conventional clamp types, the attainable surface pressures are approx. 3 N/mm² up to DN 500 and approx. 1 N/mm² up to DN 1000;
- The pressure of the medium in the pipe must not exceed 100 mbar;
- The temperature of the medium should not exceed 300 °C, because the significant differences in the thermal expansion of the pipe and clamps can lead to over-stretching and leaks when exposed to.

Please note that clamps are only suitable for circular cross-sections. Also, composite clamps must be installed with max. part lengths of 1000 – 2000 mm in order to achieve uniform radial forces at the circumference. Surface pressure of 5 N/mm², as usually required at the sealing surfaces of fabric expansion joints, cannot be achieved owing to the limited tensile strength with clamps.

Retaining Bars

With equivalent technical properties to those offered by flange connections, retaining bars are used to secure the simple tube expansion joints. Normally made out of carbon steel profiles with primer or galvanizations finish, retaining bars are a cheap solution for assembly.



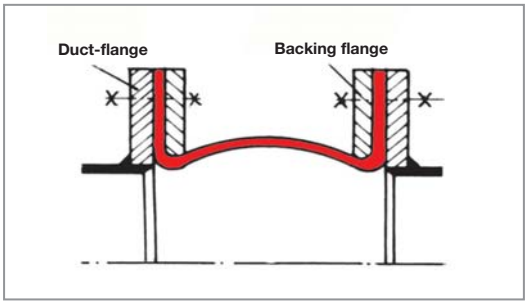
They are applied in cases where it is not possible to achieve with clamps assembly the radial forces needed/required for sealing purposes.

A common application for retaining bars is the case of rectangular and oval cross-sections expansion joints.

For information on the layout of the screw connections and appropriate strip dimensions see table, in the next section “Flange connection”.

Flange Connection

Flange connections are regularly used for large round and rectangular cross-sections. It is the most favorable design for installation purposes. As with retaining strips, the required surface pressure at the static sealing area can be achieved by the appropriate choice of flange width and thickness, hole spacing and bolt size.



The following table contains empirically tested flange connection dimensions for reference purposes:

Flange width [mm]	Flange thickness [mm]	Hole spacing [mm]	Bolt size	Tightening torque [Nm]	Bolt force [N]
30	8	80	M10	20	11800
40	10	90	M12	35	17300
60	12	130	M16	85	31000

Compression of the expansion joint flange owing to the force exerted by the bolts can lead to permanent depressions in the area of the flange and slacking the bolts. Either take up the slack at the flange bolts with a torque wrench after commissioning or use appropriately dimensioned cup spring assembly at each bolt to allow self-adjustment.

▶ Pre-assembled Kits

ROTH fabric expansion joints can be supplied as a complete pre-assembled unit which can be welded or flanged to the duct. This will guarantee a perfect mounting of the expansion joint in factory, whilst the effort for installation on job site will be reduced to a minimum.

Pre-assembled kits are suitable for nearly all applications and temperatures. Nevertheless their main field of operation are exhaust expansion joints for gas turbines or flue-gas ducts where high temperatures may occur. Therefore steel parts for ROTH expansion joint kits will be manufactured in various material qualities depending on their operating conditions. For we apply high temperature carbon steels or heat resistant stainless steels, we may handle temperatures up to 1000 °C.

Especially for gas turbine applications fabric expansion joint kits are superior to stainless steel expansion joints because of their low spring rates and their excellent sound absorption. Whilst the efforts for installation are nearly the same, during operation significant lower reaction forces will occur. Thus no expensive bearings and fix points are required and the external loading of the gas turbine is reduced substantially due to lower reaction forces and moments at the connecting flanges. Pre-assembled ROTH fabric expansion joint kits are in service under various operating conditions for years now. Please benefit of our great experience and contact us. It will be a pleasure for us to give you comprehensive advice.

Installation and Servicing Instructions

Storage

ROTH fabric expansion joints are delivered well secured and sufficiently packed. Until the time of installation they must be stored dry and clean and be not subjected to solar radiation.

Assembly Preparations

The following steps should be taken before and during assembling ROTH fabric expansion joints to ensure a proper installation:

- All packing materials should only be removed immediately before installation;
- Transportation devices should be removed as late as possible but before starting service;
- Verify that flange dimensions and bolt circles match at all connecting parts
- Check all edges and surfaces of the system components for burrs and pollution;
- Components not supplied by ROTH must not be sharp-edged. Edges which may contact the joint require a radius of at least 3 mm.

Installation

ROTH fabric expansion joints should be installed at the end, as a conclusion of the pipe work to prevent damages resulting from other work such as welding, grinding scaffolding etc. They also must be protected against sharp-edged objects or tools.

We deliver numerous different types of joints with a great variety of materials for various applications. Thus, the installation and especially the closing of open-ended expansion joints require a great number of different techniques and methods.

For comprehensive assistance we recommend our leaflets available for download on our website in the Documentation section:

- “ROTH Installation and Servicing Instructions”;
- “Closing Instructions for ROTH Fabric Expansion Joints”.

Service and Maintenance

Compared to stiff piping systems, expansion joints are limited-life-time components. According to strains and operating conditions, but at least every 3 months, routine inspections should be done (i.e. visual check-up, screw fixings). Solvents may damage the surface coatings of fabric expansion joints. Therefore, do not paint the joint or use any caustic cleansing agents or those containing solvents.

Important Information

Fabric expansion joints are no supporting components of the piping system, therefore the correct positioning of guides and fixed-points is of utmost importance. Inside and outside of ROTH fabric expansion joints are unmistakably marked. These marks must be observed in order to grant correct installation.

- Protect expansion joints against weld-sparks and sharp-edged objects whilst any work is carried out nearby;
- Lift pre-assembled joint kits only at marked transportation devices;
- Expansion joints have to be lifted with several spread loops or butt straps or have to be supported by plates;
- All dimensions and measures for installation must be strictly adhered to, otherwise no warranty can be given by manufacturer;
- PTFE-foils and coated fabrics tend to become brittle at low temperatures. Hence, fabric expansion joints made of these materials have to be handled with care at temperatures below +10 °C (50° F) and must not be installed at these temperatures;
- The allowable working temperature of the adhesives used during closing and mounting has to be sufficient to avoid burning!

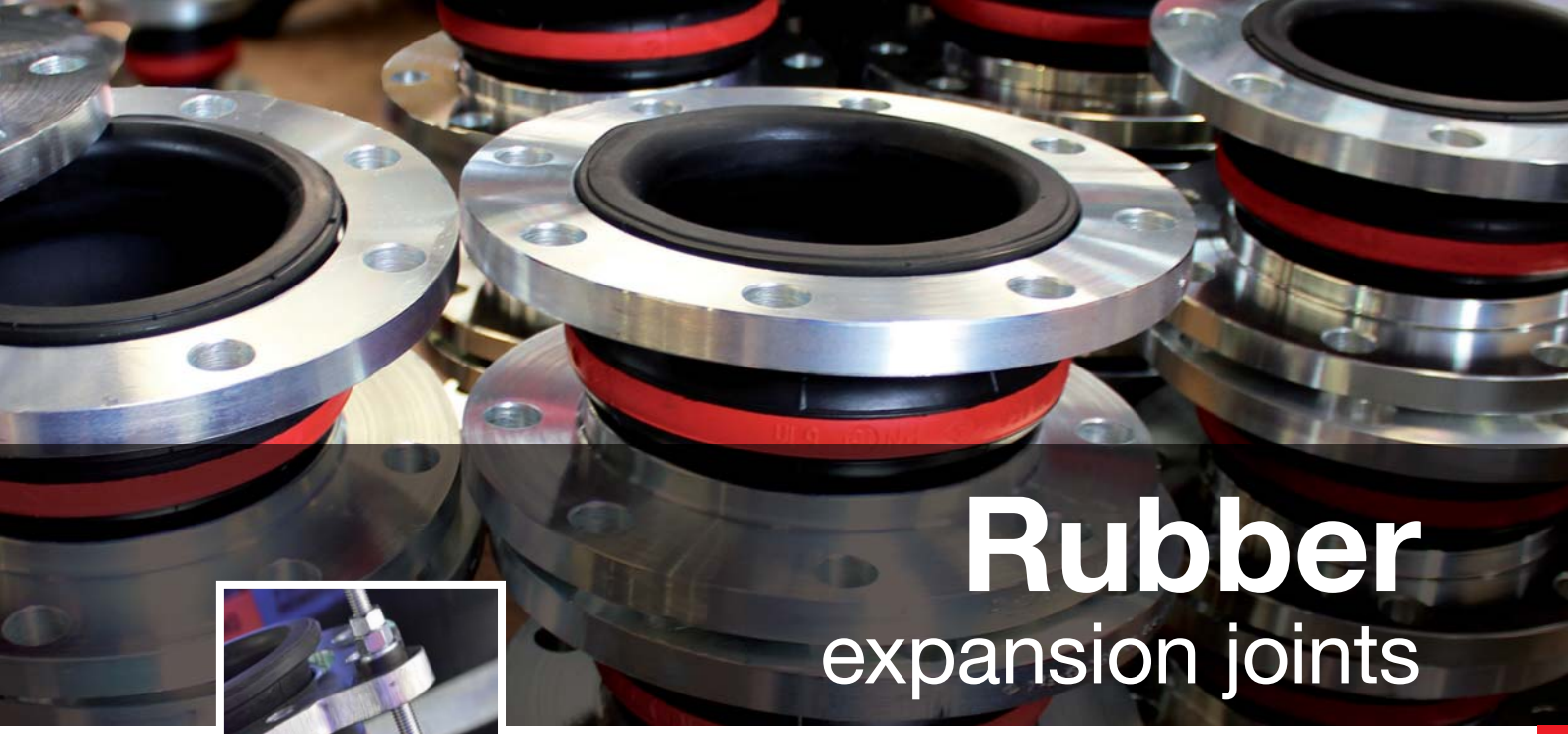
Attention: If defects may cause the risk of injuries, appropriate safety devices must be supplied!

Note: The manufactured length (BH) is determined by taking into account the movements and assembly tolerances, so that the expansion joint may be installed without stress.

Installation Service

Our experienced service team is available immediately on job-site at any time. All installation and assembly work will be executed promptly and competently by our skilled workers. We also may provide a foreman who may support your workers. Of course, our team will be at your service for measuring up your mounting situation and for disassembly too.

Please do not hesitate to contact our service department (service may not be available in all countries, for more details please check our website).



Rubber
expansion joints

Introduction

Rubber expansion joints are flexible connecting elements manufactured of natural or synthetic elastomers, fluoro-plastics and fabrics used to absorb movements in a piping system while containing pressure and a medium running through it. Sometimes it is necessary to include metallic reinforcements to assure proper and safe operation of the expansion joint.

ROTH rubber expansion joints are designed according to the Pressure Equipment Directive PED 97/23/EC for the specified operating conditions and are available with DVGW approval for gas or with TÜV approval for heating applications acc. to DIN4809.

Rubber expansion joints are used in heating systems, air-conditioning and ventilation systems, power plants, refineries, chemical plants, ship-building and many other industries. Their outstanding features are high absorption of movements and excellent noise reduction.

ROTH rubber expansion joints are designed and manufactured considering all environment related factors, including the following:

- Chemical resistance of internal layers;
- Temperature resistance of internal layers;
- Pressure-resistant reinforcing fabrics;
- Weather conditions;
- Ozone and UV-resistance of external layers.

Available with flanges or threaded connectors, ROTH rubber expansion joints are versatile and convenient solutions for most piping systems. They provide high flexibility, wide movement compensation, good environmental resistance and easy installation.

Type A

Applications, Construction

ROTH rubber expansion joints are used in heating systems, air-conditioning and ventilation systems, power plants, refineries, chemical plants, ship-building and many other industries. The outstanding features are high absorption of movements and excellent noise reduction.

According to their individual applications, different rubber qualities are available. Fabrics that are reinforced with nylon-cord or aramid-cord serve as pressure bearers.

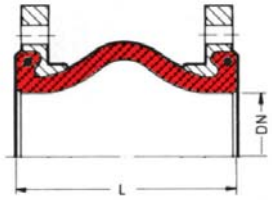
Constructive Types

Type A rubber expansion joints consist of a rubber bellow and two backing flanges. The sealing is made directly on the rubber collar which extends the bellow and overlaps the flanges.

Type A series includes two basic models: restrained and unrestrained bellows. The unrestrained design provides more flexibility but it does not protect the bellow from any accidental movements, above its capacity, that could damage it permanently.

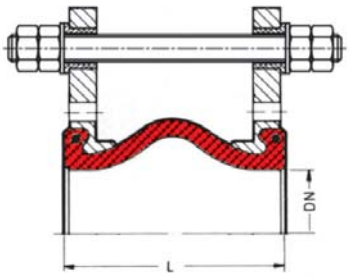
A1

Rubber Expansion Joint
with flange.



A1-T

Rubber Expansion Joint
with flange and tie rods.



Flanges are manufactured according to international standards DIN, ANSI, also available with threaded holes. Common materials used for flanges are: carbon steel, galvanized steel, aluminum and stainless steel.

Materials

Common rubber qualities and their applications are listed in the following table. Other rubber qualities for higher temperatures and other types of applications are available on request.

Material	Color (marking)	Common applications	Max. Temp
NEOPRENE	▲ black	air, gas, low-conc. acids	70 °C
NEOPRENE	▲ gray	water	70 °C
EPDM	▲ red	warm water	90 °C
EPDM SP	▲ red	hot water - heating systems	110 °C
NITRIL	▲ yellow	oils, mineral fats	80 °C
NITRIL	△ white	potable water - food grade	80 °C
HYPALON	▲ green	acids, alkaline	80 °C
BUTYL	▲ blue	potable water	90 °C
VITON	▲ purple	strong acids, aromatic solvents	90 °C

Pressure and Vacuum Strength

The recommended pressure ratings are listed in the following table. This data apply to Type A from DN 32 up to DN 400 and to Type B from DN 20 up to DN 50.

Material	Color	Permissible operating data					
		Pressure	Temp.	Pressure	Temp.	Pressure	Temp.
NEOPRENE	▲ black	16	50	10	70	-	-
NEOPRENE	▲ gray	16	70	16	70	-	-
EPDM	▲ red	16	50	12	70	10	90
EPDM SP	▲ red	16	70	10	100	6	110
NITRIL	▲ yellow	16	50	12	70	10	80
NITRIL	△ white	16	50	12	70	10	80
HYPALON	▲ green	16	50	12	70	10	80
BUTYL	▲ blue	16	50	12	70	10	90
VITON	▲ purple	16	50	12	70	10	90

The vacuum strength depends on whether an expansion joint is equipped with internal support rings or not. The ring are made out of stainless steel for a higher durability.

DN	Without support ring		With support ring	
	Pressure [bar]	Suction [mm]	Pressure [bar]	Suction [mm]
32 - 1000	-0.2	2	-1	10

Standard Program PN16

Our standard program for rubber expansion joints Type A includes the following items for a nominal pressure of 16 bar. Please note that the standard overall length for all items is 130mm, if not specified otherwise. Other sizes, overall lengths, nominal pressures and movements are available on request.

DN	Overall length [mm]	Capable movements			
		Axial compression [-mm]	Axial extension [+mm]	Lateral [+/-mm]	Angular [+/- deg]
32	130	30	30	30	35
40	130	30	30	30	35
50	130	30	30	30	35
65	130	30	30	30	30
80	130	30	30	30	30
100	130	30	30	30	25
125	130	30	30	30	25
150	130	30	30	30	20
200	130	30	30	30	15
250	130	30	30	30	10
300	130	30	30	30	10

Depending on individual working conditions, we recommend to consider some degree of movement limitations in order to achieve a higher life-span of the bellows.

Working temperature	up to 50°C	up to 70°C	up to 90°C
Movement limitation	≈ 100%	≈ 75%	≈ 60%

Installation Instructions

The screws of the flange must be crosswise in stages firmly tightened to avoid the jamming of the sealing surfaces. The sealing bead thickness should be compressed evenly around from 3 to 1,5 mm.

The tightening torque is sufficient for an operating pressure of 16 bar (approval pressure of 25 bar). Further tightening of the screws is not necessary, particularly since this could destroy the sealing surfaces. The screw heads must face the bellows to avoid damaging the bellows body during the operating of the installation.

The sealing surfaces should fit without a burr at the whole width of the flanges. If there are differences to the inner pipe or collar diameter, this must be equivalent to the nominal dimension with rubber sealing rings (min. 5 mm thick).

Type B

Applications, Construction

ROTH rubber expansion joints Type B in a low convolution high pressure design are suitable for sanitary, heating, air-conditioning and swimming pool use and for solar technology, as well as apparatus, pipeline and motor construction. They absorb thermal expansion and vibration, compensates axial and lateral movements, and are resistant to chemical and mechanical stresses.

Constructive Types

Type B rubber expansion joints consist of a rubber bellow and a threaded coupling at both ends. Couplings are manufactured according to international standards ISO280 or DIN2999. Common materials used for the couplings are: malleable cast iron, galvanized steel, yellow brass.

B1	B2	B3
Rubber Expansion Joint with external thread couplings.	**Rubber Expansion Joint** with internal thread couplings.	**Rubber Expansion Joint** with internal/ external thread couplings.

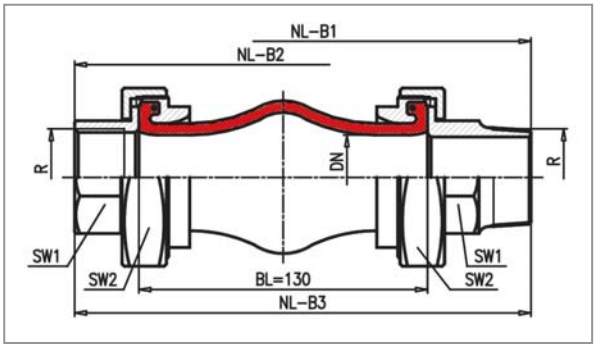
Materials

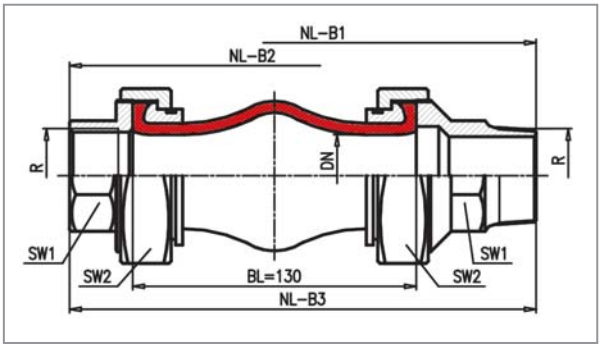
Materials and applications are similar to those used for Type A expansion joints. The data is given in the following table.

Material	Color (marking)	Common applications	Max. Temp
NEOPRENE	▲ black	air, gas, low-conc. acids	70 °C
NEOPRENE	▲ gray	water	70 °C
EPDM	▲ red	warm water	90 °C
EPDM SP	▲ red	hot water - heating systems	110 °C
NITRIL	▲ yellow	oils, mineral fats	80 °C
NITRIL	△ white	potable water - food grade	80 °C
HYPALON	▲ green	acids, alkaline	80 °C
BUTYL	▲ blue	potable water	90 °C
VITON	▲ purple	strong acids, aromatic solvents	90 °C

Standard Program PN16

Our standard program for rubber expansion joints Type B includes the following items for a nominal pressure of 16 bar. Please note that the overall length (NL) differs from a constructive type to another, although the bellow length is the same (BL). Designs with two cascading bellows are also available on request.





DN	Thread DIN 2999 [inch]	Bellow length BL [mm]	Width a/f SW				Overall length NL		
			Nylon cord		Aramid/ Steel cord		Type B1 [mm]	Type B2 [mm]	Type B3 [mm]
			SW1 [mm]	SW2 [mm]	SW1 [mm]	SW2 [mm]			
20	3/4	130	36	80	36	80	228	186	207
25	1	130	40	80	40	80	236	192	214
32	1 1/4	130	48	80	48	80	246	196	221
40	1 1/2	130	53	90	53	90	250	202	226
50	2	130	66	110	66	110	256	215	235

Installation Instructions

The installation should be free of any tension. Screws should always be tightened with two wrenches to avoid damaging torsions to the compensator.

Installation procedure:

- Attach the screw-joining parts to the pipes and check the installation gap;
- The installation gap must be equal to the compensator length (130 mm ± 5 mm);
- Insert the expansion joint in the gap;
- Tighten with two wrenches;
- Check for any leaks during the pressure test.

DN 20-25	DN 32-50
The front screw-in part is used as a steady and the union nut is tightened	The rear screw-in part is used as a steady and the union nut is tightened

Type C

Applications, Construction

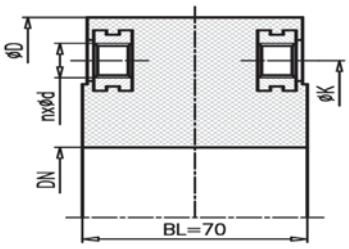
ROTH rubber expansion joints Type C are rubber-metal pipe joints for absorbing noise and surface vibrations in piping systems, on pumps, machines and apparatus.

The rubber expansion joints Type C are a cylindrical rubber buffer with vulcanized flange rings and holes according to DIN standards. The rubber-metal pipe joint construction is self-sealing, so that no additional gaskets are required.

Rubber expansion joints Type C can be installed in heating plants and in water/hot water piping systems, in houses, hospitals and schools. They can also be used with mild acids and lyes in industrial plants.

Constructive Types

Type C rubber expansion joint comes in two models which differ based on the quality of rubber used for the buffer. TÜV-Approval certificates for installing in heating plants are available only with the use of EPDM-SP rubber.



C1	C2
Rubber Expansion Joint EPDM.	**Rubber Expansion Joint** EPDM-SP with TÜV approval.

Materials

Type C rubber expansion joints are manufactured only in EPDM (rubber) with carbon steel flange on the inside. The flange pattern can be either PN6 or PN10. For higher pressure ratings we recommend installing an other type of rubber expansion joint (Type A or Type B), or even a stainless steel expansion joint.

Material	Color (marking)	Common applications	Max. Temp
EPDM	▲ red	warm water	90 °C
EPDM SP	▲ red	hot water - heating systems	110 °C

Standard Program PN6 / PN10

Our standard program for rubber expansion joints Type C includes the following items for a nominal pressure of 6 bar or 10 bar. The flange patterns for both standards are detailed in the following table. Please note that these items are not to be used in PN16 piping systems.

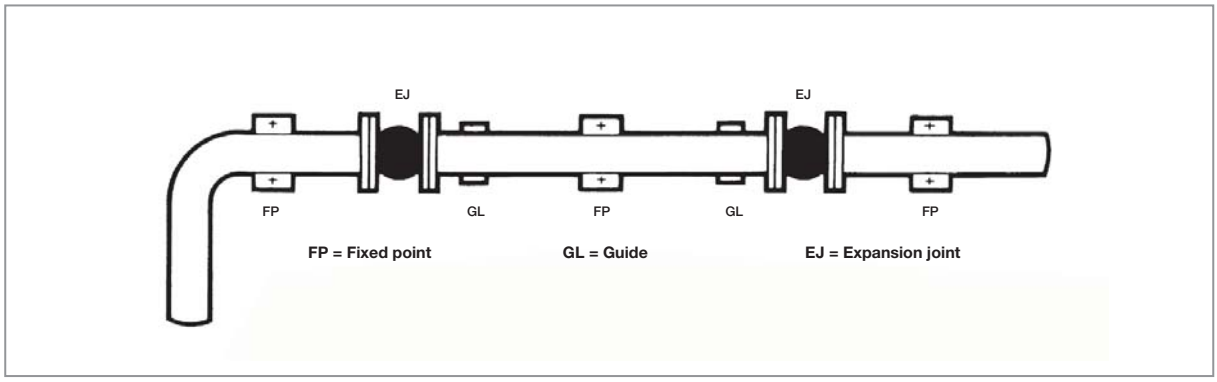
DN	Length [mm]	Flange DIN PN 6					Flange DIN PN 10				
		Ø D [mm]	Ø K [mm]	Ø d [mm]	n	Bolts	Ø D [mm]	Ø K [mm]	Ø d [mm]	n	Bolts
20	70	90	65	M10	4	M10x25	105	75	M12	4	M12x30
25	70	100	75	M10	4	M10x25	115	85	M12	4	M12x30
32	70	120	90	M12	4	M12x30	140	100	M16	4	M16x30
40	70	130	100	M12	4	M12x30	150	110	M16	4	M16x30
50	70	140	110	M12	4	M12x30	165	125	M16	4	M16x30
65	70	160	130	M12	4	M12x30	185	145	M16	4	M16x30
80	70	190	150	M16	4	M16x35	200	160	M16	8	M16x35
100	70	210	170	M16	4	M16x35	220	180	M16	8	M16x35
125	70	240	200	M16	8	M16x35	250	210	M16	8	M16x40
150	70	265	225	M16	8	M16x35	295	240	M20	8	M20x40
200	70	340	295	M20	8	M16x40	340	295	M20	8	M20x45

Installation Instructions

Reliable functioning requires guided pipelines and precisely designed fixed points. The rubber-metal pipe connections should be installed free of restraint. Installation gaps must be 70 mm wide. No tension, torsion or bending loads allowed.

If unrestrained installation is not possible, or if axial or radial movements are expected, then rubber expansion joints Type A or Type B should be used instead.

Additional gaskets are not required, since the sealing surfaces are made of rubber, expansion joints Type C are self-sealing. A bolt torque of 3 kpm is recommended for a proper tightening.



Handling, Servicing and Installation

In order to function correctly and safely, all rubber expansion joints require some precautions to be considered, which will also prolong their useful life (life-span), thus becoming elements with minimal maintenance requirements.

Most important information to bear in mind in the different stages of assembly for any type of rubber expansion joints are mentioned below:

- Do not expose any rubber expansion joints directly or indirectly to any solar radiation;
- Do not store rubber expansion joints vertically to avoid deformation (compression);
- Rubber expansion joints must be protected against oil, color, weld beads, sparks, sharp objects or excessive heat;
- Rubber expansion joints must not be insulated because of heat built-up!

Important Notes

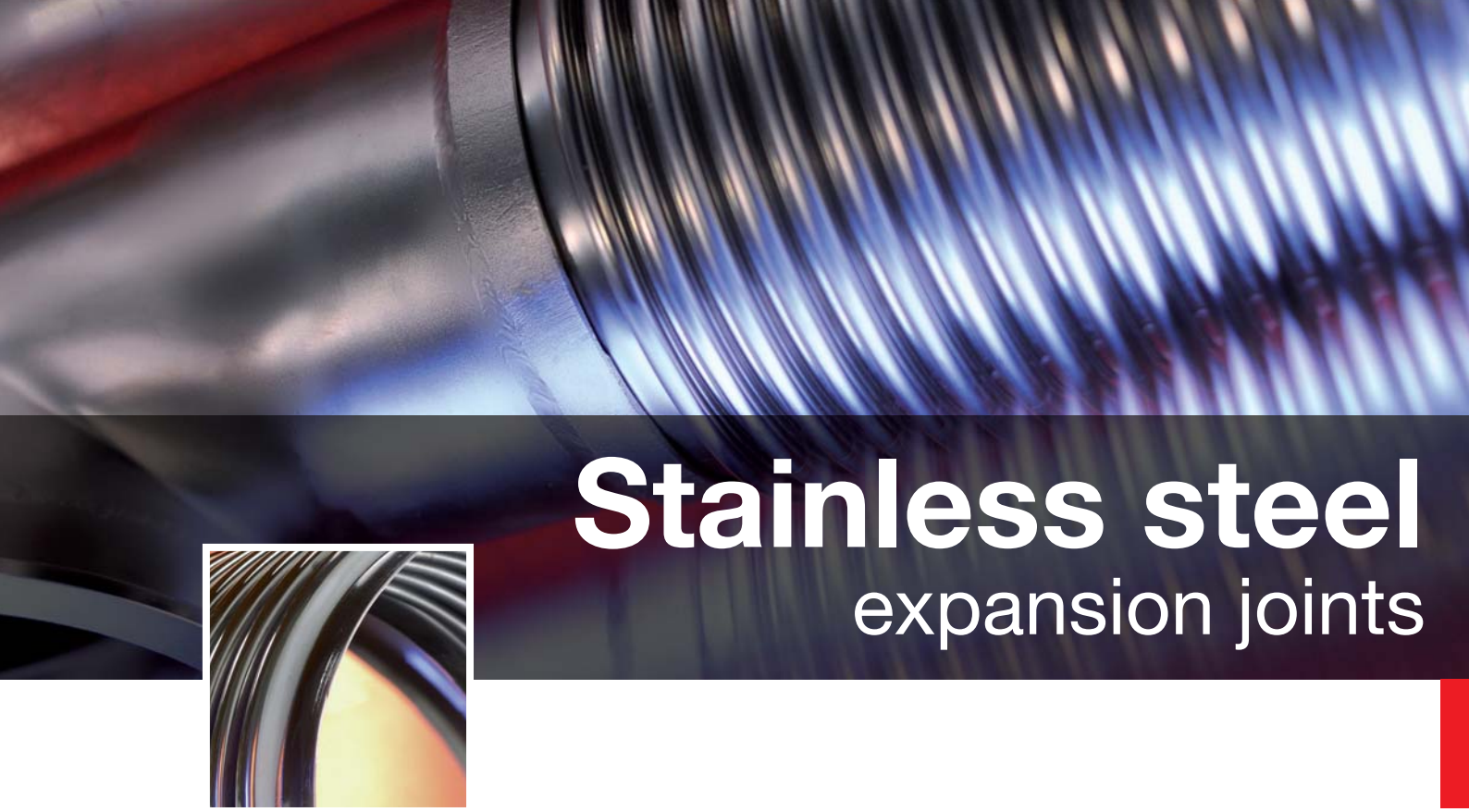
Expansion joints are to be placed between sufficiently dimensioned fixed points. The fixed points must bear the full reactional forces and he pipe guides must be strictly regarded to avoid lateral shifting (pipe bend, overtension) of the expansion joints.

If installation according to these instructions is not guaranteed, joints equipped with tie-rod supports should be used. Such supports also help avoiding transmission of high-pressure forces to the pipe system.

The installation should be in an easily accessible location so that checks without any problems can be carried out. Rubber expansion joints must be regularly examined for the first signs of aging (leakage, embrittlement, blister).

Rubber expansion joints do not require any maintenance, but they must be regarded as wear-and-tear parts.

Rubber expansion joints are classified as pipeline accessories acc. PED (Pressure Equipment Devices)!



Stainless steel
expansion joints

Introduction

Stainless steel expansion joints are essential elements of modern pipe technology. They offer the perfect solution in absorbing expansion caused by temperature changes in pipe systems. Furthermore, they are able to compensate any vibrations which may occur in pumping systems, motors, compressors, or turbines. The basic advantages to be gained from using expansion joints are:

- Small space required for installation;
- Absorption of movements in multiple directions due to their inherent flexibility;
- They require almost no maintenance;
- They reduce load and temperature loss to a minimum.

Axial, lateral or angular movements and vibration can be absorbed, according to the each individual situation. For choosing the most appropriate type of expansion joint, our technical department will be at your disposal for consultation at any time.

The characteristics of an expansion joint are based on the flexibility of its bellow. This flexibility results from the bellow's geometrical shape and the number of convolutions. Also, the thickness of each ply and the materials used for construction play an important role in defining the characteristics of the expansion joint.

ROTH stainless steel expansion joints can be made of single-ply or multi-ply bellows depending on the requirements of each given application. We recommend to provide us with all necessary data, enabling us to take into account values of movement, pressure, temperature and other environment variables and thus to find the optimum technical design and the best cost-saving solution for your application.

Design and Construction

ROTH – expansion joints are designed, manufactured and approved in accordance to: EJMA-Standards (EXPANSION JOINTS MANUFACTURERS ASSOCIATION INC.), APPENDIX BB OF SECTION VIII OF ASME – CODE “PRESSURE VESSEL AND HEAT EXCHANGER EXPANSION JOINTS“

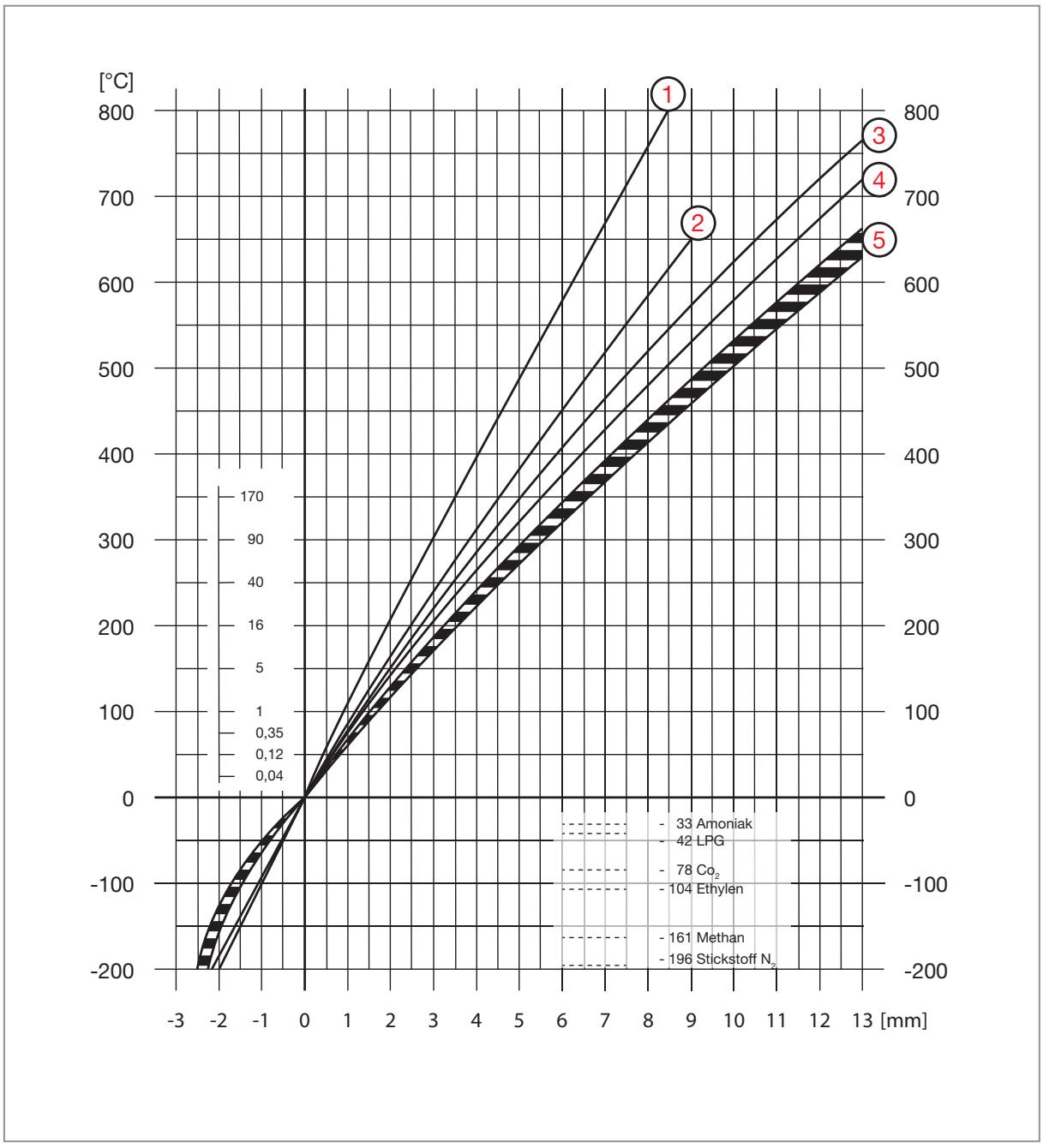
Materials and Thermal Expansion

The most commonly used materials for bellows, connecting components and tie-rod systems are shown in the following table. Other materials are also available on request.

Part	Material No.	Short name	DIN EN	AISI	ASTM
Bellows and internal sleeves	1.4301	X5CrNi18-10	10088	304	SA 240 TP 304
	1.4306	X2CrNi19-11	10088	304L	SA 240 TP 304 L
	1.4310	X10CrNi18-8	10088	301	–
	1.4401	X5CrNiMo17-12-2	10088	316	SA 240 TP 316
	1.4404	X2CrNiMo17-12-2	10088	316L	SA 240 TP 316L
	1.4435	X2CrNiMo18-14-3	10088	–	–
	1.4436	X3CrNiMo17-13-3	10088	–	–
	1.4462	X2CrNiMoN-22-5	10888	–	–
	1.4541	X6CrNiTi18-10	10088	321	SA 240 TP 321
Connecting components (stainless steel)	1.4571	X6CrNiMoTi17-12-2	10088	316Ti	SA 240 TP 316Ti
	1.4828	X15CrNiSi20-12	10095	309	SA 240 TP 309
	1.4841	X15CrNiSi25-20	10095	310	SA 240 TP 310
	1.4893	X8CrNiSiN21-11	–	–	S 30815
Connecting components (carbon steel)	1.0037	S235JR	10025	–	A 570 Gr 36
	1.0305	St35.8	17175	–	A 106-65 Gr A
	1.0308	St35	17175	–	A 53-65 Gr A
	1.0345	P235GH	10028	–	A 515 Gr 65,55
	1.0425	P265GH	10028	–	A 515-65 Gr 60
	1.0481	P295GH	10028	–	A 515 Gr 70
	1.0570	S355J2G3	10025	–	–
Tie-rod systems	1.5415	16Mo3	10028	–	A 204 Gr A
	1.7335	13CrMo4-5	10028	–	A 182-F11, F12

Please use the following diagrams in order to identify the resulting values for thermal expansion at a specific temperature and for a given category of material. For other materials please contact our technical department.

Diagrams for Thermal Expansion



Titanium	1	3.7024					
Carbon steel	2	St. 37.2 1.0114	St. 35.8 1.0305	C. 22.N 1.0402	H-II 1.0425	15Mo3 1.5415	13CrMo44 1.7335
Inconel	3	2.4816	2.4856				
Monel/ Incoloy	4	2.4360	1.4876	2.4858			
Stainless steel	5	1.4301	1.4404	1.4435	1.4541	1.4571	1.4539

▶ Axial Expansion Joints

MWA	HTE	HTI	MFA/MFG
			

▶ Lateral Expansion Joints

MWL	MFL	MWD	MFD
			

▶ Angular Expansion Joints

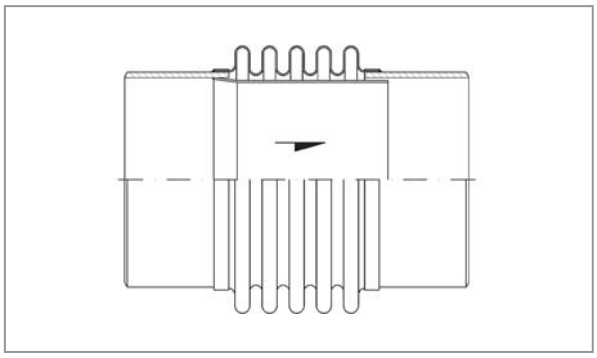
MWP	MFP	MWC	MFC
			

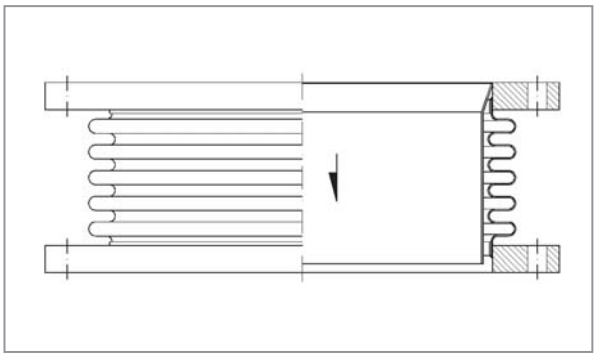
▶ Special Design Expansion Joints

MWY	MFY	MPB	MRW
			

Axial Expansion Joints

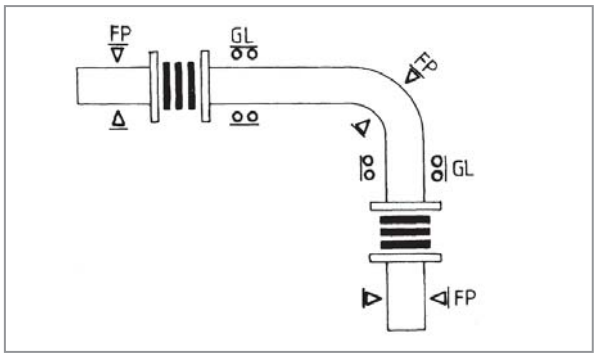
The most common and simple type of compensation is provided by axial expansion joints. These counteract linear changes in the longitudinal direction of a pipeline, but are usually also able to absorb some angular movements and vibrations.

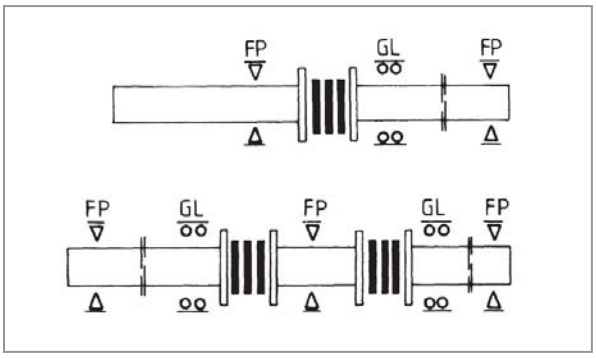




Unrestrained axial expansion joints do not restrain pressure thrust so adequate anchors and guides must be provided and they can be used only in piping systems that incorporate correctly designed anchors and pipe alignment guides.

As illustrated below, axial expansion joints necessitates properly dimensioned and arranged fixed points and guides.





FP = fixed point, GL = guide

In the case of axial expansion joints, the load acting on the required fixed points derives from the pressure and inherent resistance of the expansion joint as well as the pipe frictional forces.

The thrust is the product of the effective cross-sectional area and the operating pressure, the inherent resistance is the spring rate value, and the pipe frictional forces depend on the pipe bearing, pipeline weight, and pipe friction coefficient.

In order to assure proper operation for any axial expansion joint please take in consideration the following notes regarding basic installation:

- Only one expansion joint between two fixed points;
- Locate fixed points and guides as close to the expansion joint as possible;
- The pipelines must be exactly aligned;
- The expansion joint must not be subjected to torsional stress;
- Only low-frequency vibration loads are permissible;
- Where welding is required in assembly, the bellows must be protected from sparks;
- Protect bellows, supports, and pipe guides against soiling and damage.

Constructive Types

Axial expansion joints are based on a single bellow construction. Available with weld-ends, flanges or thread-ends and with or without tie-rods. The couplings are made out of steel or stainless steel.

MWA/HWA

Axial Expansion Joint
weld-ends, inner sleeves on request.

MFA/MFG

Axial Expansion Joint
with fixed or swivel flanges.

Type	Series	Press. thrust restraint	Movements		
			Axial	Lateral	Angular
				Single-Plane	**Single-Plane**
Single Unrestrained**	**MWA / HWA MFA / MFG HFA / HFG RFA / RFG**	no**	yes	yes*	yes*
				Multi-Plane	**Multi-Plane**
				yes*	yes*

HTE

Axial Expansion Joint
with external thread.

HTI

Axial Expansion Joint
with internal thread.

Type	Series	Press. thrust restraint	Movements		
			Axial	Lateral	Angular
				Single-Plane	**Single-Plane**
Single Unrestrained**	**HTE HTI**	no**	yes	yes*	yes*
				Multi-Plane	**Multi-Plane**
				yes*	yes*

* Limited use.

** Constructions with tie-rods systems are available on request. Pressure thrust restrain can be achieved.

Standard Program H-Line PN16 / PN25

Our standard H-Line program for axial stainless steel expansion joints includes weld-ended HWA and flanged HFA/G items for a nominal pressure up to 25 bar, within a size-range of DN15-DN250.

HWA

Axial Expansion Joint with weld-ends, pipes acc.to ISO, DIN or others, inner sleeves on request.

HFA/HFG

Axial Expansion Joint with fixed flanges (HFA) or swivel flanges (HFG), inner sleeve on request.

Nominal diameter DN	Axial movement [mm]	Spring rate [N/mm]	Overall length [mm]		Approx. weight [kg]	
			HWA/HWAI	HFA / HFG	HWA/HWAI	HFA / HFG
15	± 12,0	29	175	100	0,1	1,3
20	± 12,0	29	175	100	0,2	1,6
25	± 15,0	65	185	105	0,3	2,2
32	± 15,0	60	185	120	0,4	3,5
40	± 15,0	72	190	125	0,5	3,9
50	± 23,0	82	205 220*	150	0,8	4,7
65	± 23,0	72	230 240*	155	1,2	5,9
80	± 23,0	91	230 240*	165	1,7	8,0
100	± 23,0	79	230 250*	170	2,2	8,7
125	± 23,0	119	270 280*	185	3,3	10,9
150	± 33,0	162	270 315*	205	4,3	12,7
200	± 35,0	149	300 355*	235	6,5	18,2
250	± 35,0	153	300 355*	240	8,0	12,7

* HWA type with inner sleeve.

Standard Program H-Line PN16 (threaded)

Our standard H-Line program for axial stainless steel expansion joints is extended by two constructive types featuring threaded ends. These are available either with external threads (HTE) or either with internal threads (HTI), both for a nominal pressure of 16 bar. Thread-ends are available in all existing international standards and can be made out of carbon steel or stainless steel.

HTE

Axial Expansion Joint with external thread.

HTI

Axial Expansion Joint with internal thread.

Nominal diameter DN / R”	Capable movement			Spring rate [N/mm]	Cross-section [mm]	Overall length [mm]	Outer - Ø [mm]
	axial [mm]	lateral [mm]	angular [z °]				
15 1/2”	± 12,0	± 5	± 30°	29	7	170	36
20 3/4”	± 12,0	± 5	± 30°	29	7	170	36
25 1”	± 15,0	± 8	± 30°	65	10	170	42
32 1 1/4”	± 15,0	± 12	± 30°	60	14,5	185	50
40 1 1/2”	± 15,0	± 12	± 30°	72	22	200	60
50 2”	± 23,0	± 11	± 25°	82	34	225	75
65 2 1/2”	± 23,0	± 11	± 25°	72	50	260	90
80 3”	± 23,0	± 10	± 20°	91	74	275	110
100 4”	± 23,0	± 10	± 20°	79	111	310	133

* Other sizes available on request. Subject to alteration.

Stainless steel expansion joints with threaded ends have a higher bellow flexibility that makes them capable to compensate movements in any planes (axial, lateral and angular). This feature, beside the threaded coupling make them an ideal solution in application where there is less mounting space at disposal.

Standard Program R-Line PN1 / PN2,5 / PN6

Our standard R-Line program for axial stainless steel expansion joints is designed to offer very competitive items for low-pressure ventilation, exhaust application, etc. These expansion joints are available with flanges (RFA/RFG) or with weld-ends (RWA). The materials used for flanges or weld-ends can be for the couplings can be carbon-steel or stainless steel.

RWA

Axial Expansion Joint with weld-ends, pipes acc.to ISO, DIN or others, inner sleeves on request.

RFA/ RFG

Axial Expansion Joint with fixed flanges (RFA) or swivel flanges (RFG), inner sleeve on request.

Nominal diameter DN	Axial movement [mm]	Spring rate [N/mm]	Overall length [mm]		Approx. weight [kg]	
			RWA	RFA / RFG	RWA	RFA / RFG
300	±30	58	280	300	5	20
350	±30	59	280	300	5.7	21
400	±30	79	250	270	6.3	24
450	±30	80	250	270	7.1	26
500	±30	70	260	280	8	29
560	±30	72	260	280	8.8	32
600	±30	72	260	280	12	36
630	±30	74	260	280	12.4	38
700	±30	67	260	280	14	42
800	±30	67	260	280	16	48
900	±30	68	260	280	18	54
1000	±30	104	290	320	27	91
1200	±30	112	290	320	32	110
1400	±30	118	290	320	55	143
1500	±30	122	290	320	58	150
1600	±30	126	290	320	62	162
1700	±30	130	290	320	66	207
1800	±30	134	290	320	70	220
2000	±30	143	290	320	77	250

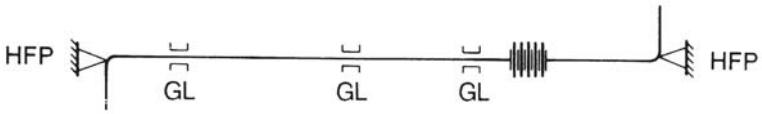
* Other sizes available on request. Subject to alteration.

Typical Cases Examples

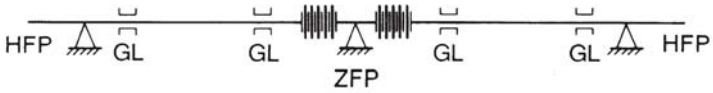
Axial expansion joints cannot withstand thrust from the internal pressure and must therefor always be fitted in between two principal fixed points. Secondary (intermediate) fixed points can also be installed along the pipe segment. Guides are to be used to ensure that there will be no displacements along the pipe line. The following are typical layout examples:

A. Basic case, expansion joint situated in a straight between two principal fixed points.

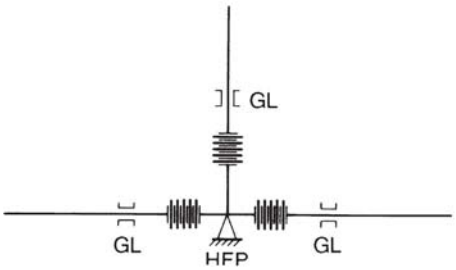
B. HFP's are situated at pipe bends, compensating the straight length in-between as shown in case A.



C. Applies for very long straights; ZFP and two axial expansion joints required, situated between two HFP's.



D. The principal fixed point is located at the intersection of two pipe lengths.

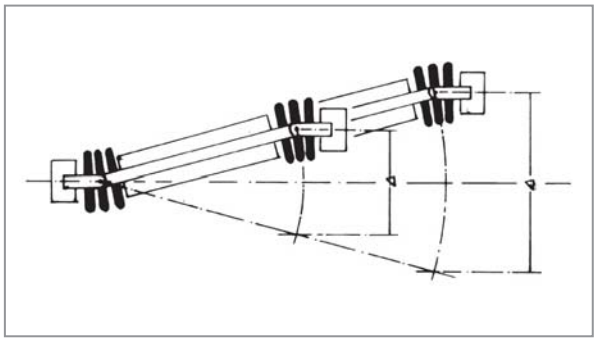


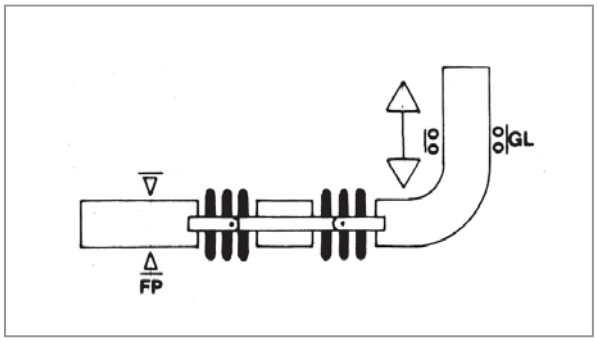
E. The HFP is located at the meeting point of two pipes of different sections, as a consequence of the different reactional forces.

HFP = principal fixed point; ZFP = interm. fixed point; GL = guide.

Lateral Expansion Joints

Lateral expansion joints are designed with tie-rod supports, allowing movements only to the sides; therefor, installation must be executed vertically to the direction of movement of the conduit. Axial expansion can not be absorbed. The most favorable types are those absorbing expansion in a circular plane.





The standard joint construction allows movements in one plane only. The bellows' flexibility as well as the distance between the middle of the bellows are crucial for the value of the permissible movement: the longer the intermediate pipe, the larger the lateral movement.

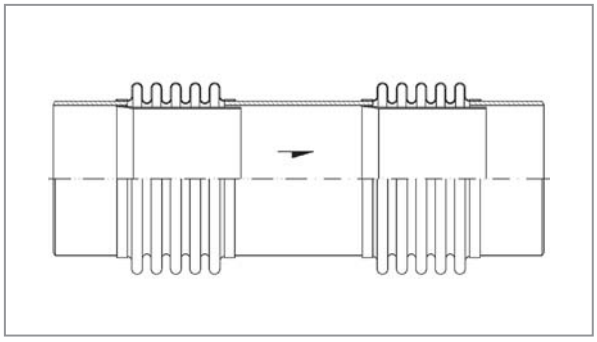
A lateral expansion joint depicts a complete 2-joint-system. The axial reactional forces caused by the internal pressure are absorbed by these joints, so that the resulting fixed point loads are very low. Large movements can be absorbed by relatively simple pipe constructions.

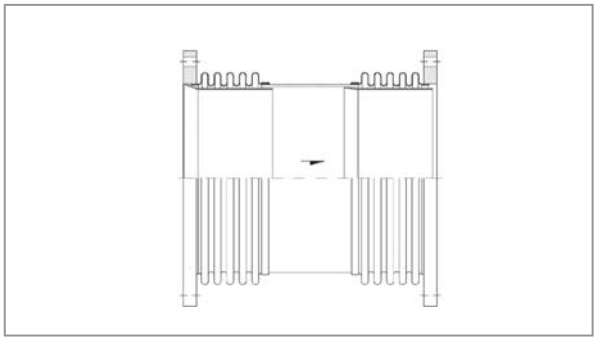
Important factors are the spring rate and joint frictional forces. Lateral expansion joints with tie-rod supports are also able to absorb vibrations at pumps and compressors, with fixed points assembled directly behind the expansion joints.

A particular case of lateral expansion joint are universal expansion joints. A particular case of lateral expansion joint are universal expansion joints. These items are a special type construction, available both with weld-ends and flanges, that allow multi-plane movement compensation. Universal expansion joints have similar construction as lateral expansion joints with the exception of the tie-rods system.

Universal Expansion Joints

Our universal expansion joints are the special types of our product range: lateral expansion joints without tie-rods, absorbing both lateral and axial movements. They mainly apply for pipe systems with low internal pressure; any reactional forces are to be compensated by the conduit.





Constructive Types

Lateral Expansion Joints are based on a two in-line bellow construction with an intermediate pipe between. Available with weld-ends or flanges and with or without tie-rods.

MWD

Universal Expansion Joint with weld-ends and intermediate pipe.

MFD

Universal Expansion joint with flanges and intermediate pipe.

Type	Series	Press. thrust restraint	Movements		
			Axial	Lateral	Angular
				Single-Plane	**Single-Plane**
Universal Unrestrained	**MWD MFD**	no	yes	yes*	yes*
				Multi-Plane	**Multi-Plane**
				yes*	yes*

MWL

Lateral Expansion Joint with weld-ends, with tie-rod supports.

MFL

Lateral Expansion Joint with flanges, with tie-rod supports.

Type	Series	Press. thrust restraint	Movements		
			Axial	Lateral	Angular
				Single-Plane	**Single-Plane**
Lateral Tied	**MWL MFL**	yes	no*	yes	no**
				Multi-Plane	**Multi-Plane**
				yes	no**

* some axial movements may be absorbed with a specific design.
** some angular movement can be absorbed providing 2 tie rods at 180 degrees only.

Standard Program R-Line PN1 / PN2,5 / PN6

Our standard R-Line program for universal stainless steel expansion joints includes unrestrained weld-ended (RWD) and flanged (RFD) items for a nominal pressure of 1 bar or more.

RWD

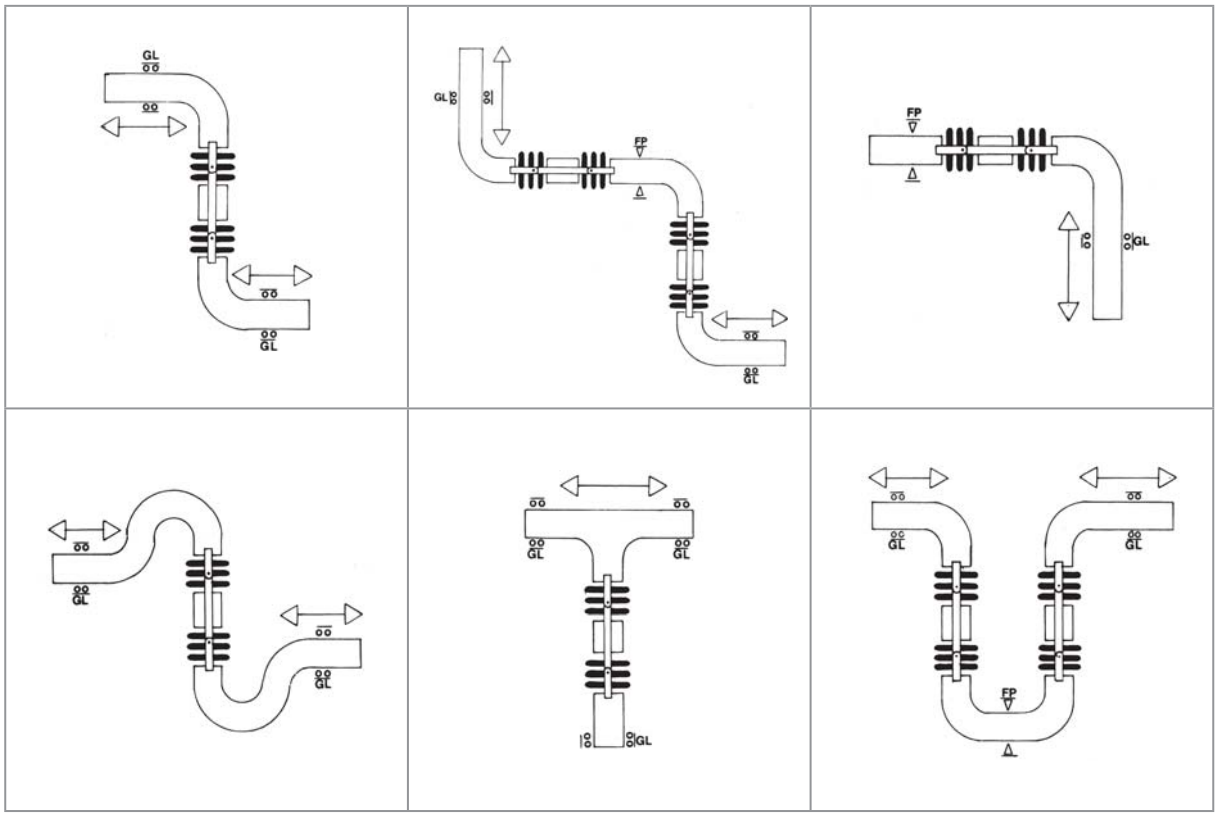
Universal Expansion Joint with weld-ends and intermediate pipe.

RFD

Universal Expansion joint with flanges and intermediate pipe.

Nominal diameter DN	Axial movement [mm]	Lateral movement [mm]	Axial spring rate [N/mm]	Lateral spring rate [N/mm]	Overall length [mm]		Approx. weight [kg]	
					RWD	RFD	RWD	RFD
300	±30	±60	51	6	800	800	15	30
350	±30	±60	60	7	800	800	16	32
400	±30	±60	61	9	800	800	19	37
450	±30	±60	61	9	850	850	23	42
500	±30	±60	58	11	850	850	25	46
560	±30	±60	58	13	850	850	27	50
600	±30	±60	58	16	850	850	38	62
630	±30	±60	44	15	850	850	36	62
700	±30	±60	47	14	950	950	48	76
800	±30	±60	42	14	1000	1000	55	87
900	±30	±60	46	18	1000	1000	62	98
1000	±30	±60	61	32	1100	1100	95	159
1200	±30	±60	63	41	1100	1100	110	188
1400	±30	±60	65	55	1100	1100	177	265
1500	±30	±60	58	44	1200	1200	232	324
1600	±30	±60	61	50	1200	1200	248	350
1700	±30	±60	64	57	1200	1200	265	406
1800	±30	±60	67	63	1200	1200	280	430
2000	±30	±60	58	44	1300	1300	350	523

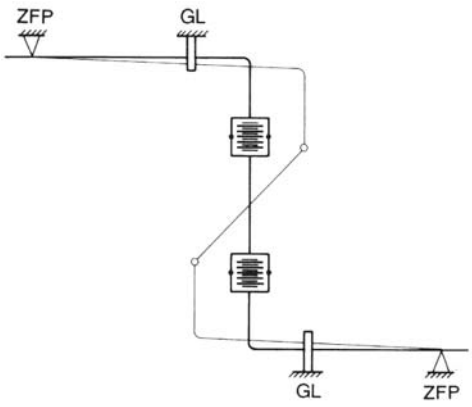
*Other sizes available on request. Subject to alteration.



Typical Cases Examples

Lateral expansion joints with tie-rod supports allow lateral movements in a circular plane. Thrusts from the internal pressure are absorbed by the supports, so they might be installed between two intermediate fixed points.

Formation Z-shaped in one plane. Two angular expansion joints or one lateral expansion joint with intermediate pipe.



HFP = principal fixed point; ZFP = interm. fixed point; GL = guide.

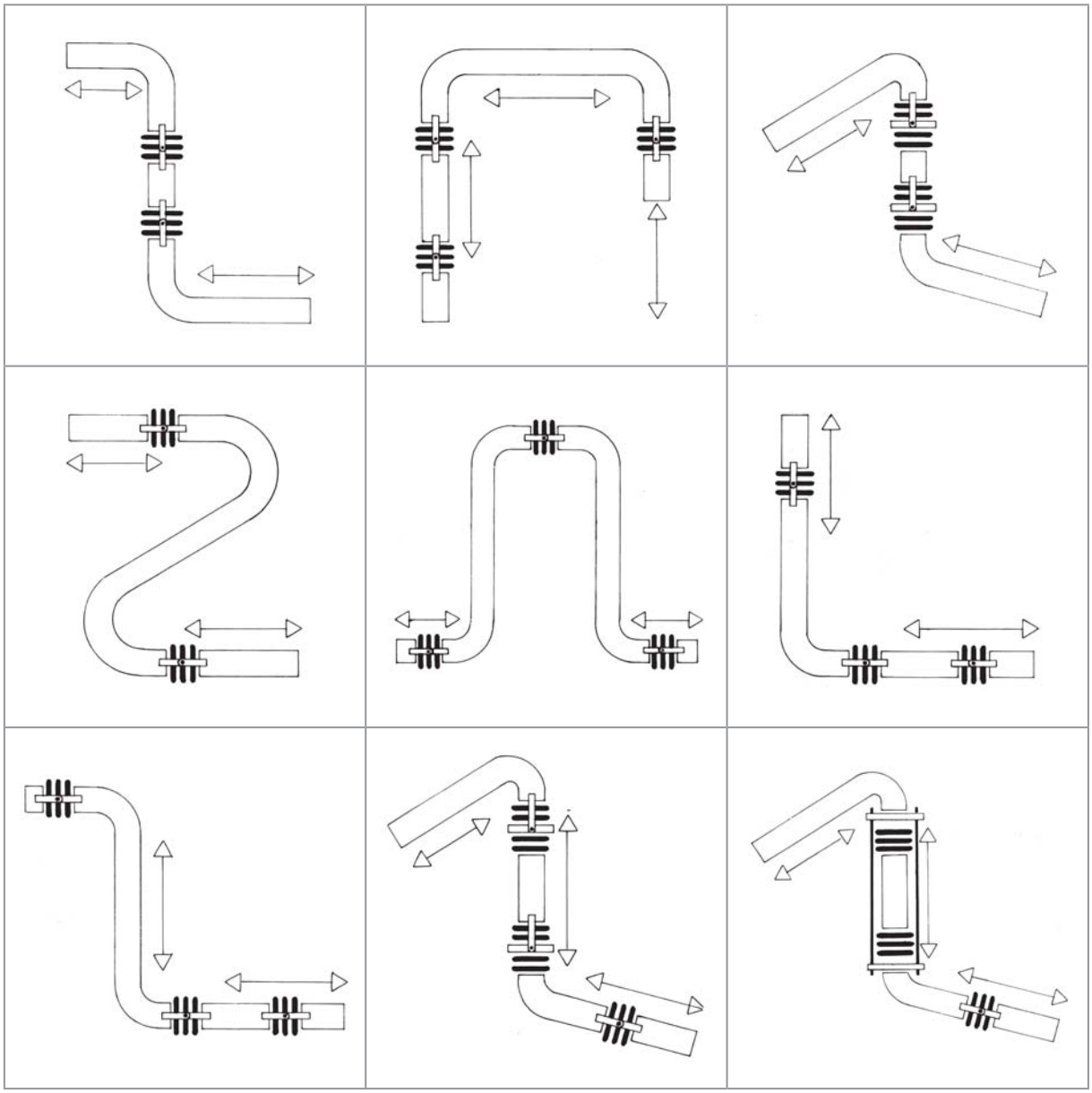
Angular Expansion Joints

Angular expansion joints exclusively execute angled movements and are therefor always installed as a 2- or 3- joint system. The distance between the joints is decisive for the value of absorption.

Standard type angular expansion joints absorb angled movements in one plane. If angled movements in a circular plane are to be absorbed, cardan expansion joints must be used.

The axial reactional forces are compensated by the joints, so that no heavy demands are made to the conduit and the design of the fixed points. The angular spring rate and the frictional moment of the joints must be considered.

Angular expansion joints are designed according to the operating conditions on site and to your specifications. There is no standard range. Please ask for details.



Constructive Types

Angular Expansion Joints are generally based on a single bellow construction restrained with hinged bars or a cardanic system. Available with weld-ends or flanges.

MWP

Angular Expansion Joint with weld-ends and hinged-bar supports.

MFP

Angular Expansion Joint with flanges and hinged-bar supports.

Type	Series	Press. thrust restraint	Movements		
			Axial	Lateral	Angular
				Single-Plane	**Single-Plane**
Single Hinged	**MWP MFP**	yes	no	no	yes
				Multi-Plane	**Multi-Plane**
				no	no

MWC

Angular Expansion Joint with weld-ends and gimbal system

MFC

Angular Expansion Joint with flanges and gimbal system.

Type	Series	Press. thrust restraint	Movements		
			Axial	Lateral	Angular
				Single-Plane	**Single-Plane**
Gimbal	**MWC MFC**	yes	no	no	yes
				Multi-Plane	**Multi-Plane**
				no	yes

Some applications require compensation for both angular and lateral movements. In these cases special hinged constructions involving two in-line bellows with an intermediate pipe between them are considered the optimal solution. The restrain can be achieved by cardanic system as well.

MWY

Angular-Lateral Double Hinged Expansion Joint
with welding ends.

MFY

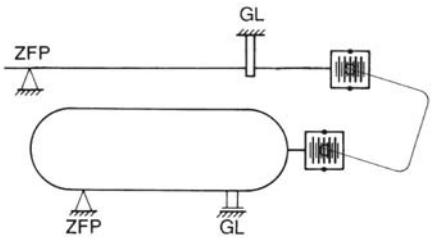
Angular-Lateral Double Hinged Expansion Joint
with flanges.

Type	Series	Press. thrust restraint	Movements		
			Axial	Lateral	Angular
				Single-Plane	**Single-Plane**
Double Hinged	**MWY MFY**	yes	no	yes	yes
				Multi-Plane	**Multi-Plane**
				no	no

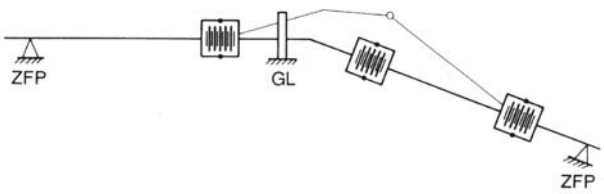
Typical Cases Examples

Angular expansion joints are generally used in groups of 2 or 3 and absorb lateral deflections in one or more directions in one plane, whilst one single unit of these joints can only absorb angular movements. Given that these expansion joints themselves bear the internal pressure thrust, they can be fitted between intermediate fixed points. Here are some typical application schemes:

A. Case of angular movement only



B. Compression in a pipe with angles of up to 90 degrees



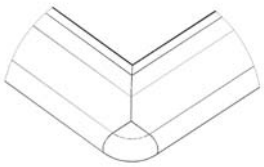
HFP = principal fixed point; ZFP = interm. fixed point; GL = guide.

Special Design Expansion Joints

Rectangular Expansion Joints

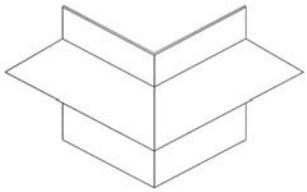
MRU

Rectangular Expansion Joint with U-shaped convolutions and round corner.



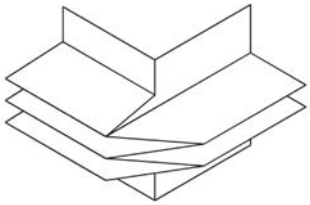
MRV

Rectangular Expansion Joint with V-shaped convolutions and miter corner.



MRW

Rectangular Expansion Joint with V-shaped convolutions and camera corner.

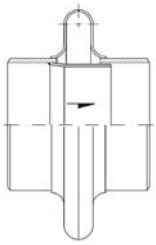


Type	Series	Press. thrust restraint	Movements		
			Axial	Lateral	Angular
				Single-Plane	**Single-Plane**
Rectangular	**MRU MRV MRW**	no	yes	yes*	yes*
				Multi-Plane	**Multi-Plane**
				yes*	yes*

* with limitations.

LENS Expansion Joints

LENS Expansion Joints are characterized by a high convolution profile and thick-ply construction. They can be manufactured in circular, oval or almost any particular shape in various materials.

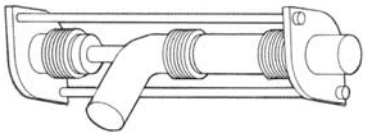


M-LENS

Lens Expansion Joint
with one thick convolution.

Type	Series	Press. thrust restraint	Movements		
			Axial	Lateral	Angular
				Single-Plane	**Single-Plane**
Lens	**M-LENS**	no	yes	yes*	yes*
				Multi-Plane	**Multi-Plane**
				yes*	yes*

Pressure Balanced Expansion Joints



MPB

Pressure Balanced Expansion Joint
with elbow.

Type	Series	Press. thrust restraint	Movements		
			Axial	Lateral	Angular
				Single-Plane	**Single-Plane**
Elbow Pressure Balanced	**MPB**	yes	yes	yes	yes*
				Multi-Plane	**Multi-Plane**
				yes	yes

* with limitations.

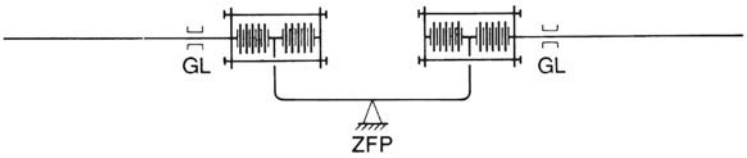
Layouts for Pressure Balanced Expansion Joints

Pressure balanced expansion joints have similar applications to axial or lateral types, although they do not transfer the effort due to internal pressure to the pipework.

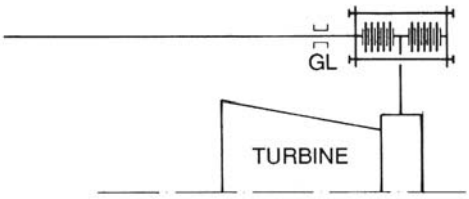
This characteristic is especially interesting at the union of pipes with turbines or other equipment not able to bear such loads. These joints are always situated where the system changes direction and between intermediate fixed points. It is not necessary to locate them between principal fixed points.

The following are typical examples:

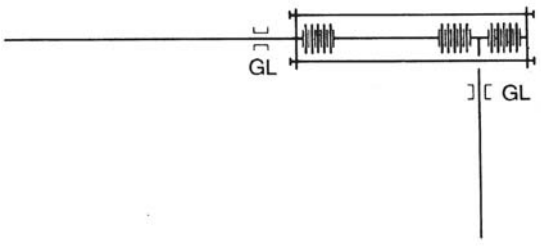
A. Absorption of axial movements in a straight pipe section, with small deviation.



B. Connection of a turbine. Thrusts from the internal pressure are absorbed by the pressure balanced expansion joint.



C. When axial and lateral movements must be absorbed, a 2+1 bellows configuration as shown below is necessary.



HFP = principal fixed point; ZFP = interm. fixed point; GL = guide.

General Notes on Installation

For their correct function, the expansion joints require some precautions which will prolong their useful life, thus becoming elements virtually free from maintenance.

Most important to bear in mind in the different stages of assembly are described in the following paragraphs.

Installation

Avoid damaging of the bellows with knocks, strikes, weld splatters, etc. Avoid any movement of the expansion joints with their ends misaligned or beyond the limits established at the time of supply, as regards magnitude of movement or maximum angle.

Presetting are to be carried out in accordance to the established limits, which include direction and magnitude of movement. Expansion joints with inner sleeve must be fitted according to the direction of flow. Transport supports, if any, must be removed after installation.

Checks Before Putting into Service

Verify that the expansion joints are fitted in the correct place and correctly fitted with respect to the direction of flow. Verify that all transport supports have been removed and any supports and guides are installed according to plan.

Check that there are no misalignments in the expansion joints!

Checks During and Immediately after Pressure Test

Check if there are any leaks or pressure losses or any instability in the bellows. Also control the firmness of the tie-rods, guides, and any other components of the system.

Periodical Checks

Verify visually that the expansion joints absorb the movements for which they were designed. Check for unexpected vibrations, signs of external corrosion, looseness of any of the mechanical elements, deterioration of the guides, etc. Verify that there are no accumulations of dust or other particles between the convolutions of the expansion joints which may limit or restrict their movement.

Expansion joints are wear and tear parts. In case of a defect, take precautions and provide for appropriate safety devices.

Fixed Points and Guides

The first step in selecting expansion joints and in the positioning of the fixed points and guides in a pipeline is to divide the pipe into individual lengths having relatively simple configurations (straight lengths, „L"- or „Z"- shapes, etc.) and establish their expansions, since the number of fixed points as well as their position will depend as much on the configurations and dimensions of the expansion joints.

After deciding on the positions of the fixed points, principal fixed points (HFP) and intermediate fixed points (ZFP) must be found. Principal fixed points divide the pipe line into lengths considered individual and whose purpose is to bear the thrust from the internal pressure of the pipe (see loads).

Generally, the principal fixed points are placed:

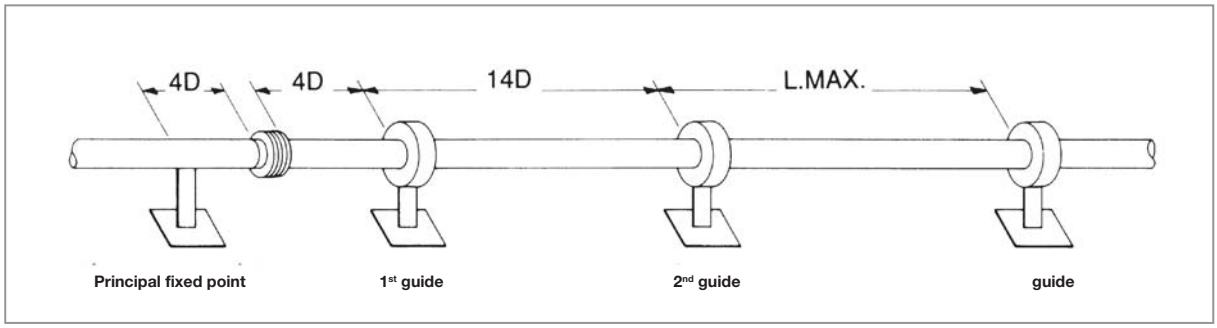
- At changes of direction in the pipe line;
- Between 2 straight lengths of different sections;
- At valves and other accessories which might be fitted on a straight length;
- At blind pipe ends;
- Anywhere the piping layout requires.

Principal fix points are located at the end of a piping system and must bear high loads. Intermediate fix points either divide two compensation systems in one axis, or support hinged systems. In both cases, the loads are normally rather low.

In the case of L- or Z- shaped lengths, many variables are met within this calculation, such as the type of expansion joint, the different expansions, etc. Our technical department will advice you in each specific case.

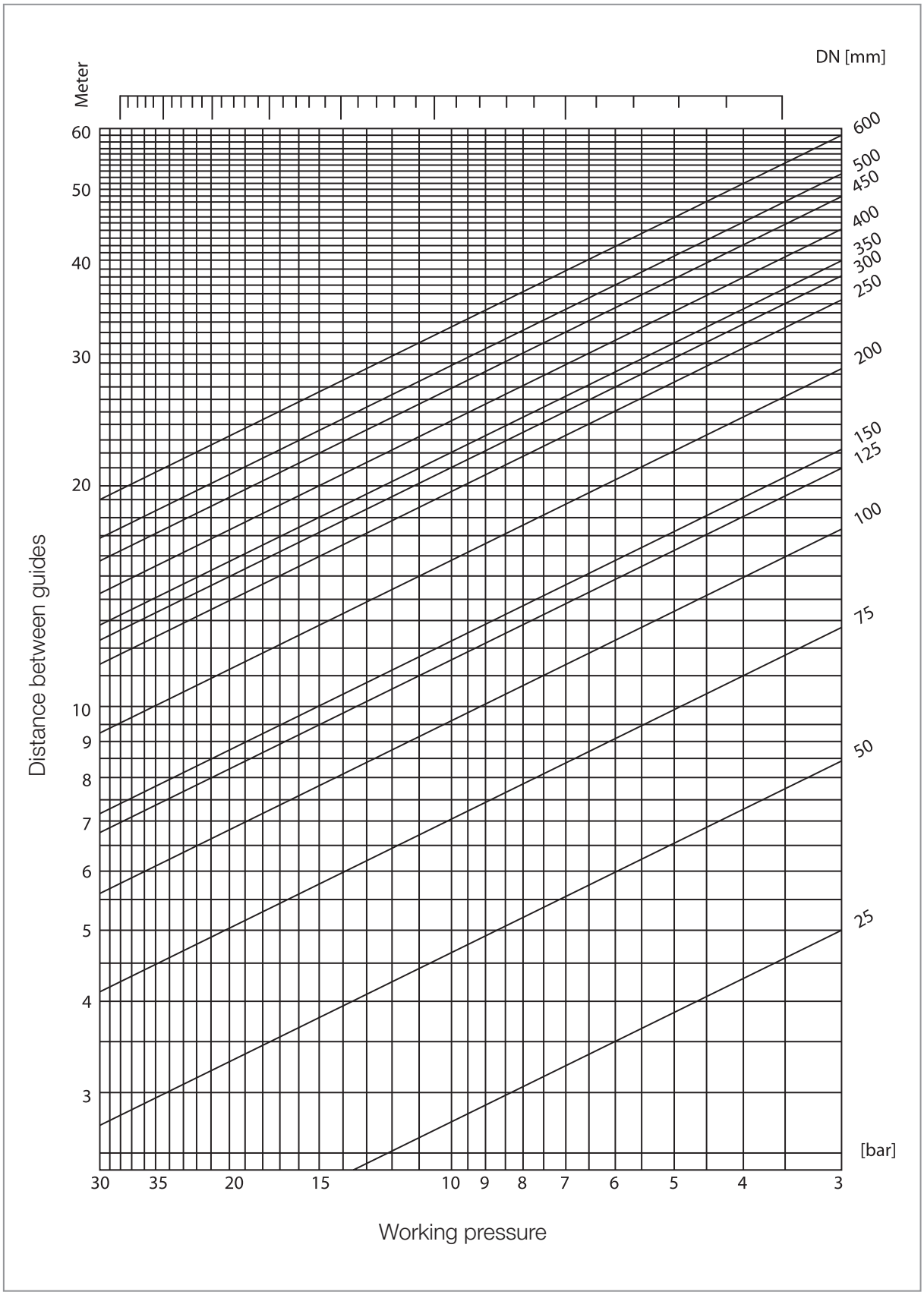
Guides

Serve the purpose of supporting the pipework and avoiding misalignments of the expansion. Please find below a typical scheme of positioning of the guides.



D – diameter of the pipe
Lmax – maximum recommended distance between guides (see diagram on the following page)

Common distances between fixed points are showed in the following diagram. Please note that these values are only a recommendation and may vary from one application to the other.


DN [mm]
Meter
60
50
40
30
20
10
9
8
7
6
5
4
3
600
500
450
400
350
300
250
200
150
125
100
75
50
25
[bar]
30
35
20
15
10
9
8
7
6
5
4
3
Distance between guides
Working pressure

Stainless steel
corrugated hoses

Introduction

Flexible pipe joints in the form of stainless steel tubes and expansion joints are important and essential components of pipe technology. As a specialist company with many years of product and market experience, we offer a comprehensive range of high-quality designs for all industrial applications.

ROTH stainless steel corrugated hoses are for general use in a variety of applications and are compatible with a large number of chemicals as well as steam, water, oil, gas, vacuum use, for absorbing expansion, lifting movements, vibrations, neutralizing installation imprecisions or as suction hoses for tanker vehicles, etc.

Besides SE111 and SE112 types with standard pressure resistance and vibration strength we manufacture custom design flexible hose with up to 3 layers of wire braid and spiral metallic protection. The braiding of all our high-quality corrugated hoses, if required, is also made solely from stainless steel wire. Similarly, the end protection sleeves are made only of stainless steel and the connecting components are WIG welded. Flexible pipe joints in the form of stainless steel tubes and expansion joints are important and essential components of pipe technology.

The service life of flexible metal hoses depends on a number of factors, such as:

- Operating pressure;
- Pressure thrusts;
- Temperature;
- Installation conditions;
- Degree of movement;
- Frequency of movement.

In addition, more demanding loads can be exerted by aggressive media, incorrect installation, torsion, improper treatment, etc.

Design and Production

The essential parameters for calculating a theoretical service life have been determined in the laboratory. Depending on the load or failure risk in individual cases, the actual anticipated service life must be calculated with an accordingly high or low safety factor.

Corrugated metal hose, made from butt-welded tube. Common materials: 1.4541 (AISI 321), 1.4301 (AISI 304), 1.4404 (AISI 316L), 1.4571 (AISI 316Ti). Please note that our standard program is based on stainless steel 1.4404 (AISI 316L). Other materials or sizes are available on request.

Permissible linear deviation

Please take in consideration our special installation recommendations in order to prolong the life span of the products.

Nominal length [mm]	Permitted linear tolerance
NL < 500	+ 7 / - 3 [mm]
NL > 501	+ 3 % / - 1 % (according to ISO 10380)

Life Time

According to DIN EN ISO 10380 the life cycles of flexible metal hoses are specified as a minimum value of 8000 and an average value of 10000. Up to DN100 the reference testing procedure is a U-bend, for larger sizes the shear force bend testing is applied, both procedures with non-greased wire braid.

The working conditions pressure, temperature, means of installation (radius and geometry), dynamic stress and medium flow have their affect on the number of life cycles, as well as assembly, handling, storage and corrosive action from inside and outside.

Life cycle forecasts often base on empirical values. Therefore, generally all non-static applications (i.e. movements, flow- and pressure pulsations) should be discussed with and configured by the hose manufacturer, in order to obtain an appropriate installation and hose configuration.

Nominal Pressure

The requirements of PED 97/23/CE are met completely. Hose design with increased pressure resistance is available on request. Please check table on page 4.4 for detailed information regarding pressure ratings for each constructive type.

For PN without braid	For PN with braid
Elongation less than 1% at 1.5 × PN.	Quadruple protection against braid fracture, according to ISO 10380.

Pressure Reduction Factors

The maximum permissible operating overpressure p w. for an expansion joint or corrugated hose with a given nominal pressure (PN) and the reduction factor ft for higher operating temperature is calculated with the following formula

$$p_w = PN \cdot ft$$

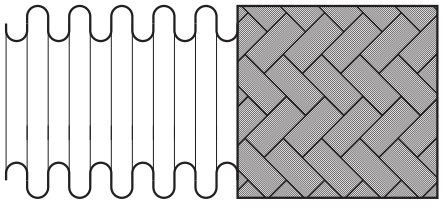
where ft values are given in the following table based on material and temperature range.

Material	Temperature [°C]												
	-200 / -20	20	50	100	150	200	250	300	350	400	450	500	550
	Factor ft												
1.4301	1,0	1,0	0,90	0,73	0,66	0,60	0,55	0,51	0,49	0,48	0,46	0,46	0,46
1.4306	1,0	1,0	0,89	0,72	0,64	0,58	0,54	0,50	0,48	0,46	0,44	0,43	0,43
1.4541	1,0	1,0	0,93	0,83	0,78	0,74	0,70	0,66	0,64	0,62	0,60	0,59	0,58
1.4401	1,0	1,0	0,91	0,78	0,70	0,65	0,61	0,57	0,55	0,53	0,52	0,51	0,50
1.4404	1,0	1,0	0,90	0,73	0,67	0,61	0,58	0,53	0,51	0,50	0,49	0,47	0,47
1.4571	A	1,0	0,92	0,80	0,76	0,72	0,68	0,64	0,62	0,60	0,59	0,58	0,58
ungraded	–	1,0	0,98	0,90	0,89	0,86	0,82	0,76	0,73	0,70	0,41	0,24	–

▶ Constructive Types

Corrugated Metal Hoses

Our standard program for corrugated metal hoses is based on three constructive types which differ by the number of layers for the stainless steel wire braiding.



SE 110	SE 111	SE 112
Stainless steel corrugated hose without braiding.	**Stainless steel corrugated hose** with single layer wire braiding.	**Stainless steel corrugated hose** with double layer wire braiding.

Please note the following table for a detailed presentation of technical characteristics for each individual constructive type of ROTH stainless steel corrugated hoses.

DN [mm]/[inch]	Type	Braid fracture pressure [bar]	Service pressure at triple protection [bar]	Service pressure at quadruple protection [bar]	Nominal pressure (ISO 10380) [bar]	Static bend radius [mm]	Dynamic bend radius [mm]	Weight [g/m]
	110	–	–	18	16	25	100	70
6 1/4	111	600	200	150	150	25	100	155
	112	864	288	216	150	–	110	260
	110	–	–	13	10	25	120	110
8 1/4	111	528	176	132	100	25	120	215
	112	766	253	191	150	–	135	350
	110	–	–	9	6	35	130	110
10 3/8	111	400	133	100	100	35	130	280
	112	500	164	125	100	–	145	490
	110	–	–	7	6	45	160	130
12 1/2	111	280	93	70	65	45	160	330
	112	410	136	105	100	–	175	580
	110	–	–	5	4	50	180	150
15 5/8	111	256	85	64	65	50	180	360
	112	420	140	105	100	–	200	630
	110	–	–	3	2,5	70	200	250
20 3/4	111	172	57	43	40	70	200	540
	112	310	103	77	65	–	220	910
	110	–	–	2,5	2,5	80	220	320
25 1	111	196	65	49	40	80	220	800
	112	290	96	72	65	–	245	1410
	110	–	–	2	0,5	100	270	450
32 1 1/4	111	140	46	35	25	100	270	1000
	112	240	80	60	50	–	300	1700
	110	–	–	2	0,5	130	300	520
40 1 1/2	111	152	50	38	25	130	300	1250
	112	230	76	57	50	–	330	2180
	110	–	–	1	0,5	155	350	900
50 2	111	104	34	26	25	155	350	1650
	112	180	60	45	40	–	385	2640
	110	–	–	0,5	0,5	200	410	1020
65 2 1/2	111	96	32	24	20	200	410	2380
	112	152	50	38	25	–	450	4090
	110	–	–	0,5	0,5	220	450	1460
80 3	111	72	24	18	16	220	450	2600
	112	112	37	28	25	–	500	4210
	110	–	–	0,5	0,5	270	560	1900
100 4	111	64	21	16	16	270	560	3450
	112	104	34	26	25	–	620	5500
	110	–	–	0,5	0,5	–	660	2980
125 5	111	48	16	12	10	–	660	5800
	112	80	26	20	20	–	730	9480
	110	–	–	0,5	0,5	–	815	6290
150 6	111	40	13	10	10	–	815	8200
	112	64	21	16	16	–	900	11120
	110	–	–	0,5	0,5	–	1015	8210
200 8	111	32	10	8	6	–	1015	11500
	112	48	16	12	10	–	1120	16270
	110	–	–	0,5	0,5	–	1200	13160
250 10	111	24	8	6	6	–	1200	17250
	112	40	13	10	10	–	1320	23470

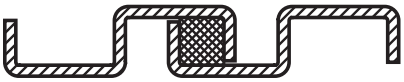
* Other sizes available on request (up to DN400). Subject to alteration.

Exhaust Metal Hoses

ROTH Exhaust Metal Hoses are a distinct category of metallic hoses that are used mainly for low pressure exhaustion or as a protective hosing. They feature a high flexibility, very good mechanical resistance and are very easy to install with collars. Common applications are: hot and cold air exhaust, steam, smoke, transportation of dust and other granulates.

ASF

Exhaust Metal Hose with auto-seal profile.



ASG

Exhaust Metal Hose with material seal profile.

The characteristics of each constructive type are given by the material used and also by the material used for sealing between the profiles. The ASF type provides auto-sealing capabilities, whereas the ASG type requires an adequate choosing of sealing materials as listed below:

Constructive type	Hose material	Sealing material	Temperature resistance [°C]	Delivery lengths [m]
ASF	carbon steel (1.0330)	auto-seal	400	10 m ≤ DN100 5 m > DN100
	stainless steel (1.4301)	auto-seal	600	
ASG	carbon steel (1.0330)	rubber	60	10 m ≤ DN100 5 m > DN100
		fabric	120	
		ceramic	400	
	stainless steel (1.4301)	rubber	60	
		fabric	120	
		ceramic	600	

Please note the following table for a detailed presentation of all technical characteristics and available sizes for ROTH Exhaust Metal Hoses.

DN [mm]	Ø -inside [mm]	Ø -outside [mm]	Allowance/ Tolerance [mm]	Minimal bend radius [mm]	Weight [kg/m]
20	20,0	22,5	± 0,4	135	0,32
23	23,0	25,5	± 0,4	155	0,36
25	25,0	27,5	± 0,4	165	0,39
28	28,0	30,5	± 0,4	185	0,44
30	30,0	33,1	± 0,4	180	0,58
32	32,0	35,1	± 0,4	195	0,62
35	35,0	38,1	± 0,4	210	0,67
38	38,0	41,0	± 0,4	230	0,73
40	40,0	43,1	± 0,5	240	0,77
42	42,0	45,1	± 0,5	250	0,80
45	45,0	48,1	± 0,5	270	0,86
50	50,0	53,1	± 0,5	300	0,95
55	55,0	58,1	± 0,5	325	1,04
60	60,0	64,0	± 0,6	335	1,55
65	65,0	69,0	± 0,6	360	1,67
70	70,0	74,0	± 0,6	390	1,80
75	75,0	79,0	± 0,6	415	1,92
80	80,0	84,0	± 0,7	440	2,04
84	84,0	88,0	± 0,7	460	2,10
90	90,0	94,0	± 0,7	495	2,30
100	100,0	104,0	± 0,8	550	2,55
110	110,0	115,0	± 0,8	605	2,81
120	120,0	125,0	± 0,8	660	3,06
125	125,0	130,0	± 0,8	685	3,18
130	130,0	137,0	± 1,0	600	4,05
140	140,0	147,0	± 1,0	645	4,34
150	150,0	157,0	± 1,0	690	4,65
160	160,0	167,0	± 1,0	735	4,96
175	175,0	182,0	± 1,0	800	5,42
180	180,0	187,0	± 1,0	825	5,56
185	185,0	192,0	± 1,0	995	5,70
200	200,0	208,0	± 1,5	1085	7,74
225	225,0	233,0	± 1,5	1215	8,68
250	250,0	258,0	± 1,5	1350	9,60
275	275,0	283,0	± 1,5	1480	10,59
300	300,0	308,0	± 2,0	1615	11,49

* Other sizes available on request (up to DN400). Subject to alteration.

Classification acc. PED 97/23/CE

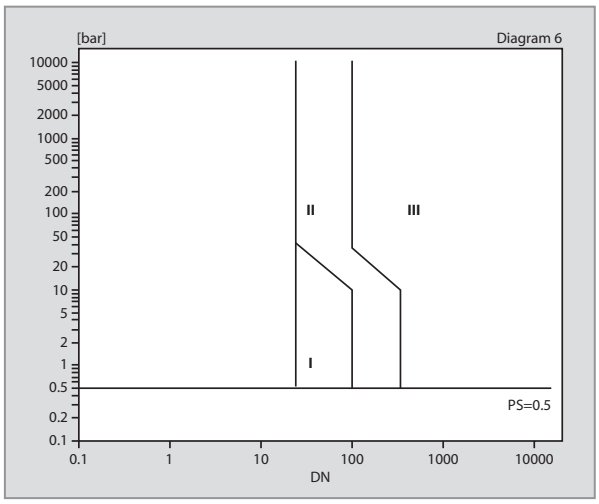
Modules

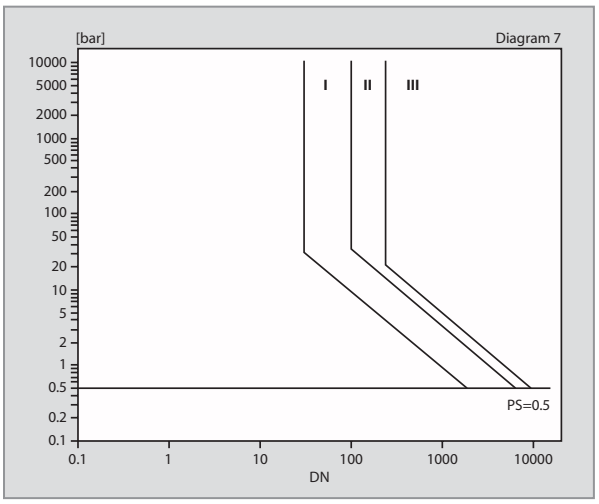
X	**Not applicable:** PS ≤ 0,5 bar
Y	**Applicable:** without CE-marking, good manufacturer experience
A	**Kat. I:** CE-marking + internal approval
A1	**Kat. II:** CE-marking + external approval

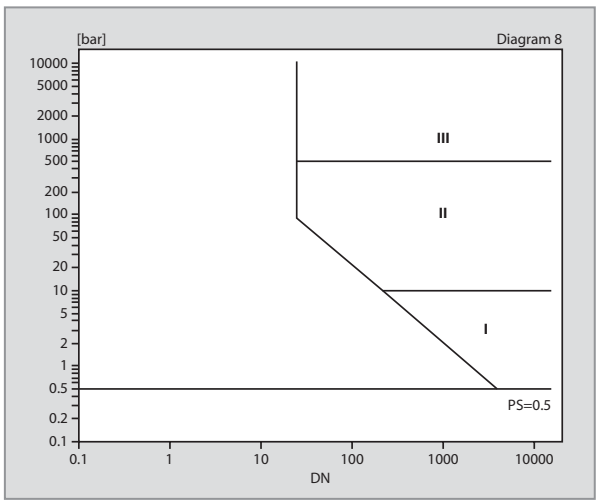
Medium Classification

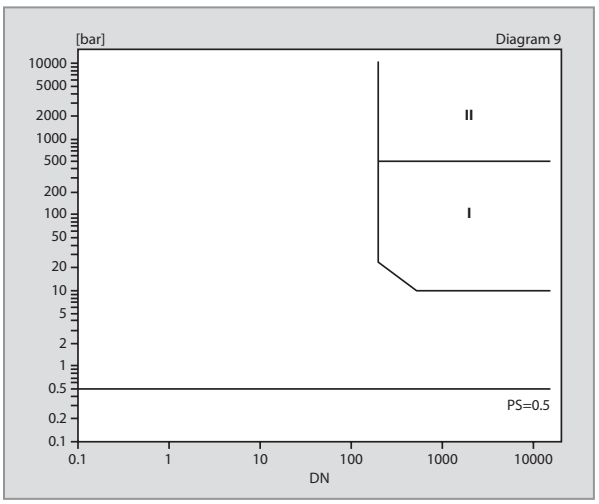
Medium	M1 Gr. 1 pD > 0,5 bar (Diagram 6)	M2 Gr. 2 pD > 0,5 bar (Diagram 7)	M3 Gr. 1 pD ≤ 0,5 bar (Diagram 8)	M4 Gr. 2 pD ≤ 0,5 bar (Diagram 9)

Gr. 1 = dangerous; Gr. 2 = others; pD = steam pressure.



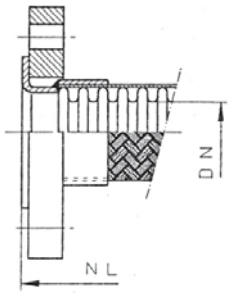






DN [mm]/[inch]	Type	Service pressure at quadruple protection [bar]	Medium			
			M1 Gr. 1 pD > 0,5	**M2** Gr. 2 pD >0 ,5	**M3** Gr. 1 pD ≤ 0,5	**M4** Gr. 2 pD ≤ 0,5
	PED 97/23/CE		Diagram 6	Diagram 7	Diagram 8	Diagram 9
	110	18	Y	Y	Y	Y
6 1/4	111	150	Y	Y	Y	Y
	112	216	Y	Y	Y	Y
	110	13	Y	Y	Y	Y
8 1/4	111	132	Y	Y	Y	Y
	112	191	Y	Y	Y	Y
	110	9	Y	Y	Y	Y
10 3/8	111	100	Y	Y	Y	Y
	112	125	Y	Y	Y	Y
	110	7	Y	Y	Y	Y
12 1/2	111	70	Y	Y	Y	Y
	112	105	Y	Y	Y	Y
	110	5	Y	Y	Y	Y
15 5/8	111	64	Y	Y	Y	Y
	112	105	Y	Y	Y	Y
	110	3	Y	Y	Y	Y
20 3/4	111	43	Y	Y	Y	Y
	112	77	Y	Y	Y	Y
	110	2,5	Y	Y	Y	Y
25 1	111	49	Y	Y	Y	Y
	112	72	Y	Y	Y	Y
	110	2	A	Y	Y	Y
32 1 1/4	111	35	A1 / A (30 bar)	Y	Y	Y
	112	60	A1 / A (30 bar)	Y	Y	Y
	110	2	A	Y	Y	Y
40 1 1/2	111	38	A1 / A (25 bar)	A / Y (25 bar)	Y	Y
	112	57	A1 / A (25 bar)	A / Y (25 bar)	Y	Y
	110	1	A	Y	Y	Y
50 2	111	26	A1 / A (20 bar)	A / Y (20 bar)	Y	Y
	112	45	A1 / A (20 bar)	A / Y (20 bar)	Y	Y
	110	0,5	A	Y	Y	Y
65 2 1/2	111	24	A1 / A (15 bar)	A / Y (15 bar)	Y	Y
	112	38	A1 / A (15 bar)	A / Y (15 bar)	A1 / Y (30 bar)	Y
	110	0,5	A	Y	Y	Y
80 3	111	18	A1 / A (12 bar)	A / Y (12 bar)	Y	Y
	112	28	A1 / A (12 bar)	A / Y (12 bar)	A1 / Y (25 bar)	Y
	110	0,5	A	Y	Y	Y
100 4	111	16	A1 / A (10 bar)	A / Y (10 bar)	Y	Y
	112	26	A1 / A (10 bar)	A / Y (10 bar)	A1 / Y (20 bar)	Y
	110	0,5	X	X	X	X
125 5	111	12	A1	A / Y (8 bar)	Y	Y
	112	20	A1	A / Y (8 bar)	A1 / Y (16 bar)	Y
	110	0,5	X	X	X	X
150 6	111	10	A1	A / Y (6 bar)	Y	Y
	112	16	A1	A / Y (6 bar)	A1 / Y (13 bar)	Y
	110	0,5	X	X	X	X
200 8	111	8	A1	A / Y (5 bar)	Y	Y
	112	12	A1	A / Y (5 bar)	A1 / Y (10 bar)	Y
	110	0,5	X	X	X	X
250 10	111	6	A1	A / Y (4 bar)	Y	Y
	112	10	A1	A / Y (4 bar)	A1 / A (10 bar)	Y

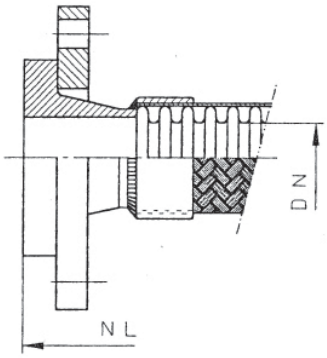
Connecting Components



AE 201

Collar and swivel flange

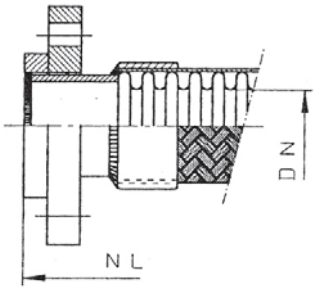
collar stainless steel
flange carbon steel
or stainless steel



AE 202

Weld-on shoulder and floating flange, also with tongue and groove and with raised and recessed face

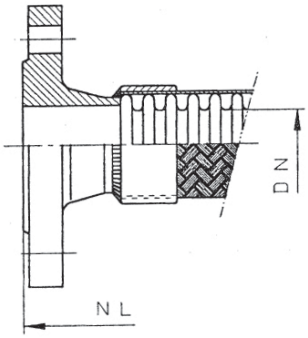
collar stainless steel
flange carbon steel
or stainless steel



AE 203

Collar sockets and swivel flange

collar stainless steel
flange carbon steel
or stainless steel



AE 204

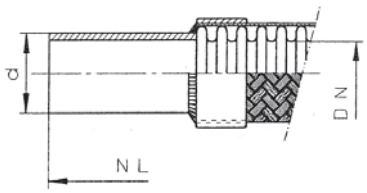
Weld-on flange

stainless steel
carbon steel

AE 301

Weld end

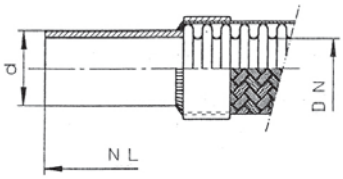
stainless steel
carbon steel



AE 302

Tubular fitting for pipe coupling with cutting and locking ring

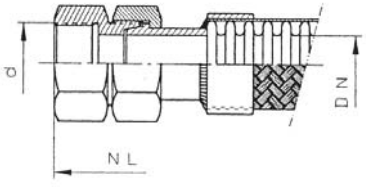
stainless steel
carbon steel



AE 401

Coupling with 24° Cone seal with internal thread

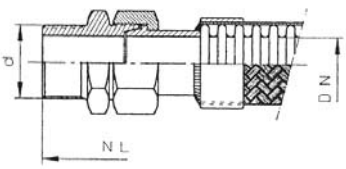
stainless steel
carbon steel



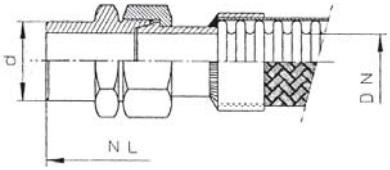
AE 403

Coupling with 24° Cone seal with external thread

stainless steel
carbon steel



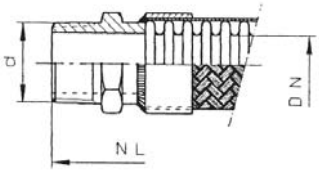
AE 404



Coupling with 24° Cone seal with weld end

stainless steel
carbon steel

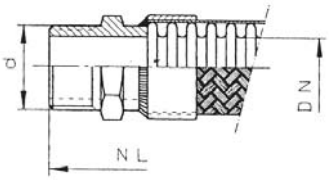
AE 405



Hexagon nipple and tapered external thread DIN 2999

stainless steel
carbon steel

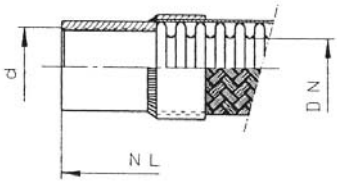
AE 406



Hexagon nipple and cylindrical external thread DIN ISO 228

stainless steel
carbon steel

AE 408



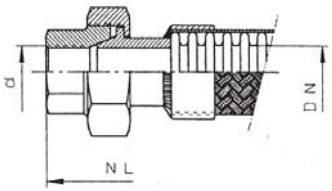
Socket with internal thread

stainless steel
carbon steel

AE 501

Pipe coupling with internal thread taper seal

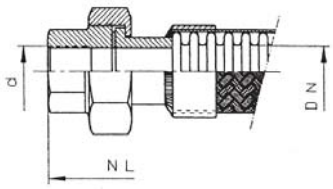
malleable cast iron
carbon steel
stainless steel



AE 502

Pipe coupling with internal thread flat seal

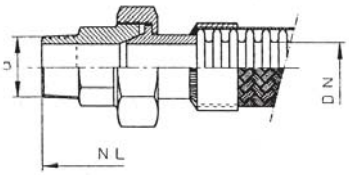
malleable cast iron
carbon steel
stainless steel



AE 503

Pipe coupling with external thread taper seal

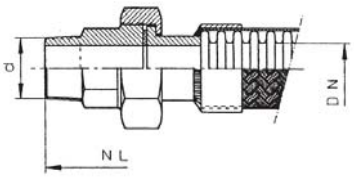
malleable cast iron
carbon steel
stainless steel

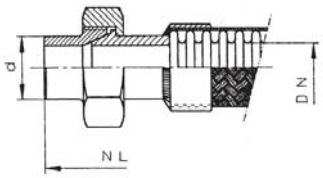


AE 504

Pipe coupling with external thread flat seal

malleable cast iron
carbon steel
stainless steel

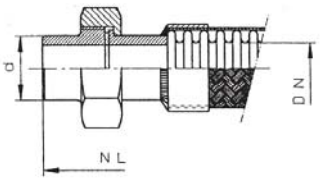




AE 505

Pipe coupling with weld end taper seal

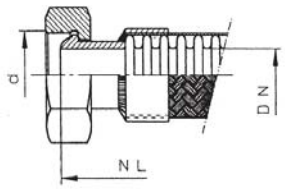
carbon steel
stainless steel



AE 506

Pipe coupling with weld end flat seal

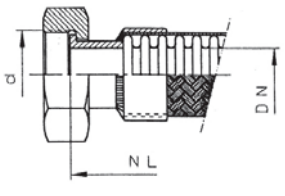
carbon steel
stainless steel



AE 507

Pipe coupling cone seal with nut

carbon steel
stainless steel

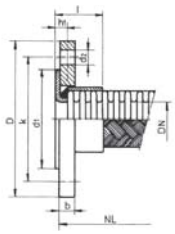


AE 508

Pipe coupling flat seal with nut

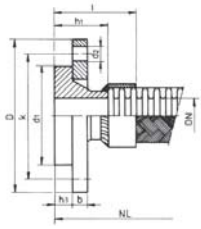
carbon steel
stainless steel

AE 201



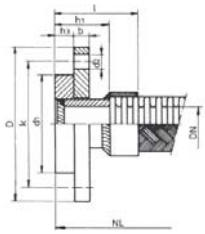
DN	l	h1
10	29	9
15	29	9
20	32	12
25	40	20
32	40	20
40	40	20
50	40	20
65	40	20
80	50	25
100	50	25
125	60	30
150	70	30

AE 202



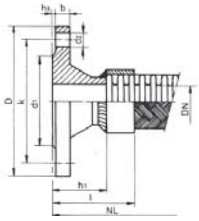
DN	l	h1	h3
10	55	35	(10) 12
15	55	(35) 38	(10) 12
20	60	40	(12) 14
25	60	40	(12) 14
32	60	(40) 42	(12) 14
40	60	(40) 45	(12) 14
50	65	45	(14) 16
65	65	45	(14) 16
80	75	50	16
100	75	(50) 52	18
125	80	(50) 55	18
150	90	(50) 55	(18) 20

AE 203



DN	l	h1	h3
10	75	55	(10) 12
15	75	55	(10) 12
20	80	60	(12) 14
25	85	65	(12) 14
32	90	70	(12) 14
40	95	75	(12) 14
50	95	75	(14) 16
65	100	80	(14) 16
80	110	85	16
100	115	90	16
125	120	90	18
150	135	95	(18) 20

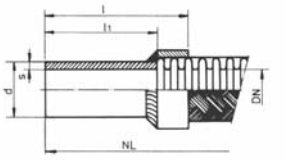
AE 204



DN	l	h1
10	55	35
15	55	(35) 38
20	58	(38) 40
25	58	(38) 40
32	60	(40) 42
40	62	(42) 45
50	65	45
65	65	45
80	75	50
100	77	52
125	85	55
150	95	55

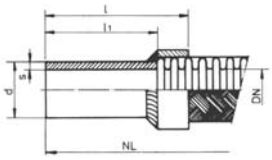
D, k ,d1, d2, b – measurements acc. to flange norm, refer to catalogue pages 5.5l other dimensions or norms on request
Measures in mm, subject to alterations.

AE301



DN	d	s	l	l1
6	8	1	70	50
10	13,5	1,8*	70	50
12	17,2	1,8*	70	50
15	21,3	2	70	50
20	26,9	2,6	75	55
25	33,7	2,6	80	60
32	42,4	2,6	85	65
40	48,3	2,6	90	70
50	60,3	2,9	90	70
65	76,1	2,9	95	75
80	88,9	3,2	105	80
100	114,3	3,6	110	85
125	139,7	4	115	85
150	168,3	4,5**	130	90
200	219,1	6,3**	140	100
250	273,0	6,3**	140	100
300	323,9	7,1**	140	100

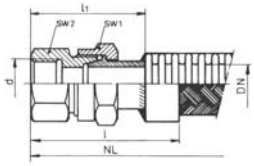
AE302



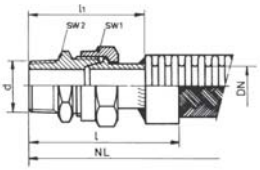
DN	d	s	l	l1
6	8	1	48	28
8	10	1	50	30
10	12	1,5	50	30
12	15	1,5	52	32
15	18	1,5	52	32
20	22	1,5	56	36
25	28	1,5	60	40
32	35	2	65	45
40	42	2	65	45

* stainless steel: 1,6mm; ** stainless steel: 4,0mm; *** Other pipe diameters, thickness or lengths on request.

AE401



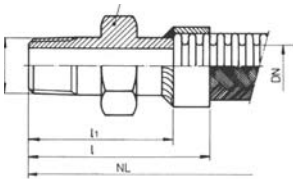
AE403 / AE404



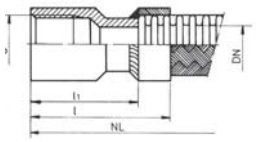
DN	d DIN2999		l	l1	SW1	SW2	l	l1	SW1	SW2
6		1/4	65	45	19	19	70	50	19	17
10		3/8	68	48	22	22	73	53	22	19
12		1/2	75	55	32	27	82	62	32	27
15		1/2	75	55	32	27	82	62	32	27
20		3/4	82	62	36	32	90	70	36	32
25	1		87	67	41	41	95	75	41	41
32	1	1/4	93	73	50	46	101	81	50	46
40	1	1/2	97	77	60	55	107	87	60	55
50	2		105	85	70	65	113	93	70	65

Other thread connections, i.e. metric precision threads, cylindrical external threads, NPT- threads, etc. available on request. Measures in mm, subject to alterations.

AE405 / AE406

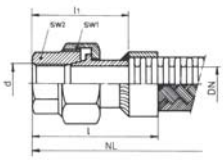


AE408

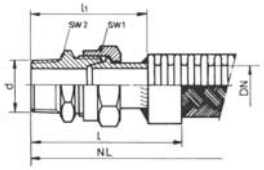


DN	d DIN2999	l	l1	SW	l	l1
6	1/4	45	25	17	45	25
10	3/8	48	28	19	46	26
12	1/2	51	31	22	54	34
15	1/2	51	31	22	54	34
20	3/4	52	32	27	56	36
25	1	60	40	36	63	43
32	1 1/4	63	43	46	68	48
40	1 1/2	66	46	50	68	48
50	2	70	50	60	76	56
65	2 1/2	80	60	80	85	65
80	3	100	75	95	96	71

AE501 / AE502



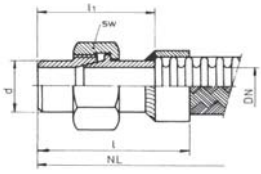
AE503 / AE504



DN	d DIN2999	l	l1	SW1	SW2	l	l1	SW1	SW2
6	1/4	65	45	28	18	78	58	28	18
10	3/8	67	47	32	22	83	63	32	22
12	1/2	74	54	39	26	93	73	39	26
15	1/2	74	54	39	26	93	73	39	26
20	3/4	79	59	48	31	101	81	48	31
25	1	84	64	54	38	107	87	54	38
32	1 1/4	87	67	67	48	111	91	67	48
40	1 1/2	91	71	73	54	117	97	73	54
50	2	102	82	90	66	131	111	90	66

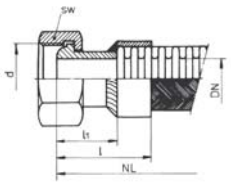
Size table Whitworth pipe thread DIN 2999 refer to catalogue page 5.3.
Measures in mm, subject to alterations.

AE505 / AE506

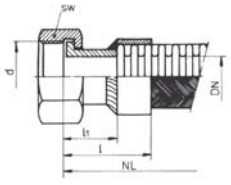


DN	d	l	l1	SW
10	13,5	62	42	27
12	17,2	65	45	27
15	21,3	74	54	32
20	26,9	80	60	41
25	33,7	87	67	50
32	42,4	95	75	60
40	48,3	101	81	70
50	60,3	114	94	85
65	76,1	122	102	100
80	88,9	132	107	120

AE507



AE508



DN	d M	SW	d R	SW	l	l1
6	14 × 1,5	17	1/4	17	44	24
8	16 × 1,5	19	3/8	20	44	24
10	18 × 1,5	22	1/2	24	45	25
12	22 × 1,5	27	5/8	27	48	28
15	26 × 1,5	32	3/4	32	49	29
20	30 × 2	36	1	41	50	30
25	36 × 2	41	11/4	50	55	35
32	45 × 2	50	11/2	55	55	35
40	52 × 2	60	2	65	55	35
50			21/2	75	65	45

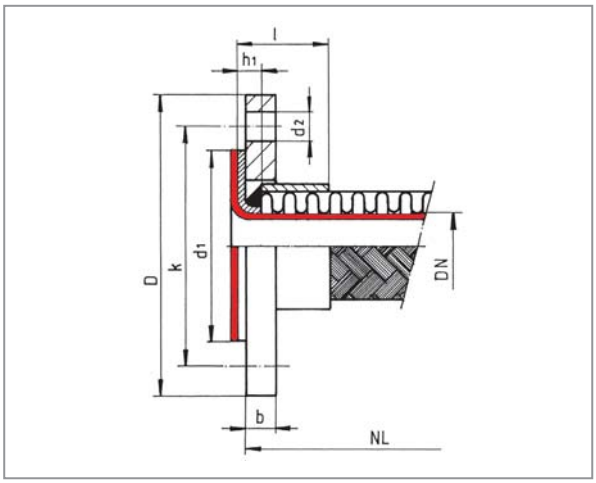
Measures in mm, subject to alterations.

Special Design Flexible Hoses

Corrugated Metal Hose with TEFLON-Liner

When setting a greater store on smooth passage and/or chemical resistance of TEFLON, hoses with internal TEFLON liner are used. Greater flexural stiffness and bending radii compared to conventional hoses are to be considered.

ROTH stainless steel corrugated hose type SE with stainless steel wire braiding and internal smooth TEFLON liner are available within the range of DN 20 - DN 150. The maximal production length for these items is 5000 mm. Greater lengths can be obtained by connecting together smaller individual lengths.



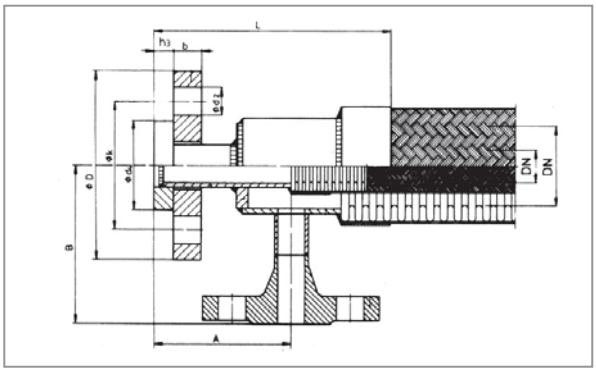
Available couplings for TEFLON-liner hoses:

Coupling type	Seal type	Matching couples
flanged	flat seal	AE201, AE202, AE203, AE204
threaded	flat seal	AE502, AE504, AE506, AE508

Double Shell Corrugated Metal Hose

Double Shell construction requires two corrugated hoses: one as primary (inner-hose) and one as secondary (outer-hose). The DNs for the hoses are chosen so that primary hose will fit easily inside the secondary hose. Usually that is obtained by choosing the secondary hose 2-sizes up from the DN of the primary hose.

ROTH Double Shell hoses are used for keeping the media in a pipeline permanently at the required temperature. By injecting either heating or cooling fluids into the secondary hose, the media temperature in the primary hose can be controlled at any time, even at difficult locations where other methods can't be applied.



ROTH Double Shell hoses can be fitted with any coupling available, based on the particular requirements of the application. Please note the following table for examples regarding the recommended DNs choosing and basic sizing.

DN (inside) **Primary/Main**	**DN** (outside) **Secondary**	L	A	B
25	50	125	80	95
50	80	150	90	115
65	100	150	90	125
80	125	165	100	150
100	150	180	110	150

* Other sizes and couplings available on request.

Installation Instructions

ROTH stainless steel corrugated hoses are high-quality products. They are reliable in operation and have a long service life. However, they can only function perfectly if, apart from choosing the correct hose design, they are properly fitted. The ways of installing metal hoses are primarily determined by direction, amplitude and frequency of their movement.

The following notes must be observed for correct installation of ROTH stainless steel corrugated hoses:

A. Correct handling and careful treatment.

Hose lines must be protected against external, mechanical damage. They must not be dragged along the floor or across sharp edges, and during operation they must not come into contact with one another or with adjacent objects.

B. Correct choice of hose length.

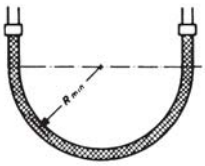
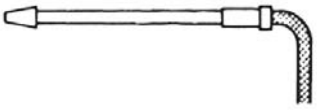
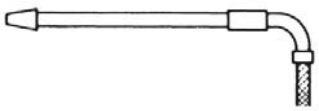
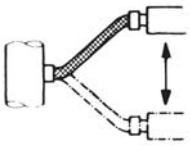
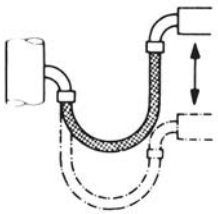
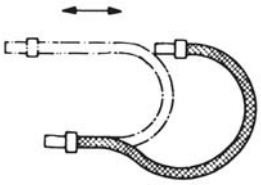
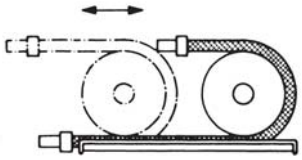
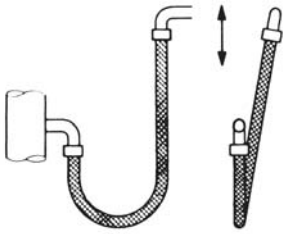
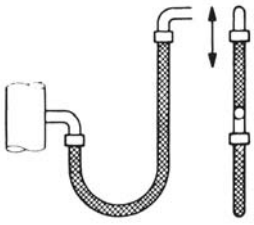
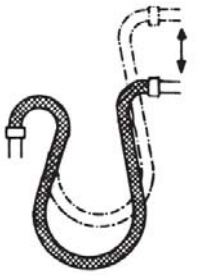
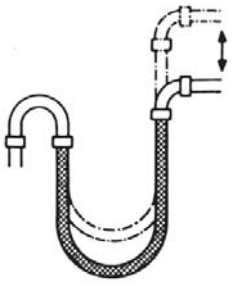
No movements or bending stresses must occur directly adjacent to the end fittings. This “neutral” section of the hose ends should be sufficiently long. If necessary, a corrugated buckling guard can be fitted at the ends.

C. The permissible bend radius must be respected.

The minimum bend radius depends on the pressure, the temperature and the required service life. The values are given on catalogue page 4.4.

D. Stress-free installation.

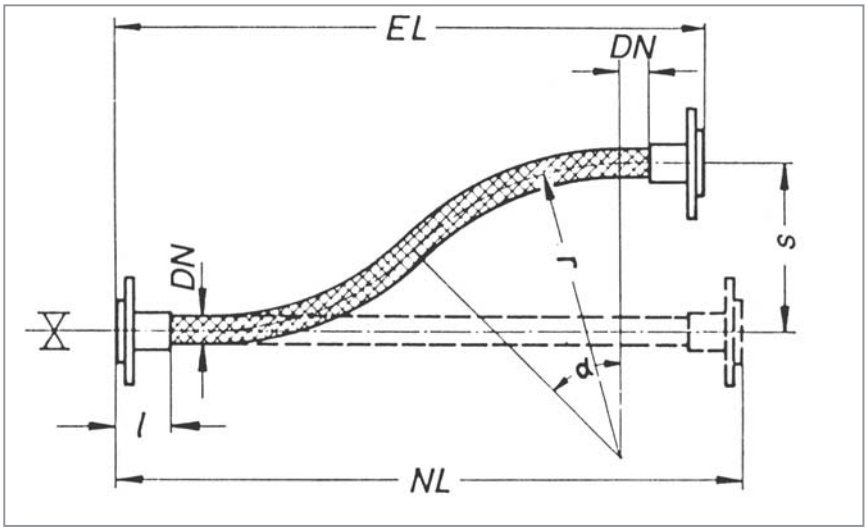
Tighten hose firmly at one end. Attach hose loosely at the other end. Move the hose two or three times in the desired direction of movement to allow it to relax and find its position without twisting, only then tighten the other end. In case of unions it is essential to use two spanners, one to stop the union from turning and the other one to tighten it. When choosing the end fittings, care must be taken that at least one end of the hose can be rotatably connected. In case of movements, fit the hose so that the hose axis and the direction of the movement are in the same plane, to make torsion possible.

Wrong	Right
	
	
	
	
	
	
	

Typical Cases Calculations

Absorption of Lateral Deflection without Movement

Determination of hose length. Installation in S-shape, only static demands, not for axial movements or vibrations.



s = axis deflexion [mm]
r = bend radius [mm]
(see tables on page 4.4 for bend radii)
α = bend angle [°]
l = length of connecting component [mm]
DN = nominal hose size [mm]
EL = installation length [mm]
NL = nominal length [mm]

- Bend angle α for hoses with braiding: max. 45°

$$NL = [(r \cdot \pi \cdot \alpha)/90] + 2(l + DN)$$
$$EL = 2r \cdot \sin\alpha + 2\,(l + DN)$$
$$s = 2r(1 - \cos\alpha)$$

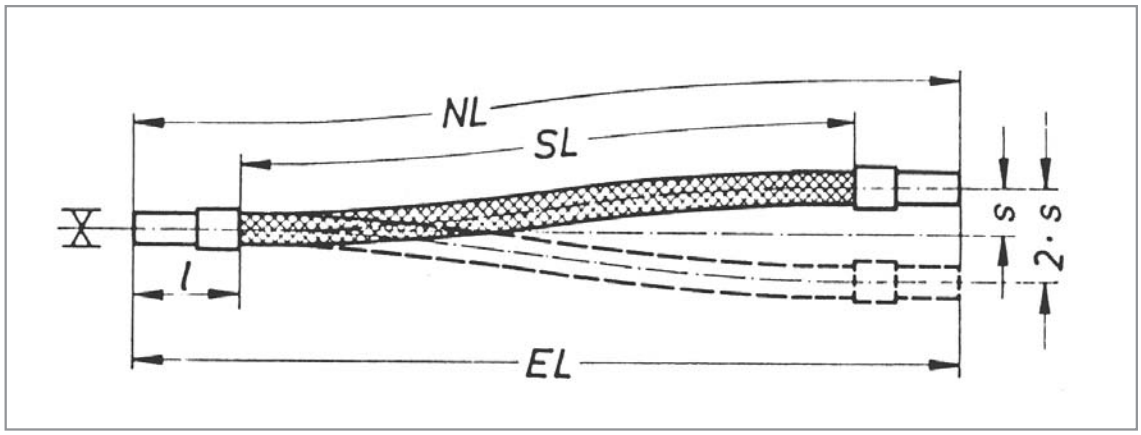
- If a is greater than 45°, installation length (EL) and nominal length (NL) are calculated as follows:

$$EL = 2{,}414s + 2(l + DN)$$
$$NL = 2{,}68s + 2(l + DN)$$

Absorption of Thermal Expansion

▷ Case 1

Length determination for metal hoses with lateral movements. Fit hose right-angled to the direction of movement. Max.lateral movement +/-100mm. Not for vibrations!



2 · s = total lateral movement [mm]
s = lat.movement from the middle axis [mm]
r = bend radius [mm]
(see tables on page 4.4 for bend radii)
l = length of connecting components [mm]
(see tables on connecting components)
SL = movable hose length [mm]
EL = installation length [mm]
NL = nominal length [mm]

EL = installation length
SL = hose length
SL_{min} = minimal hose length

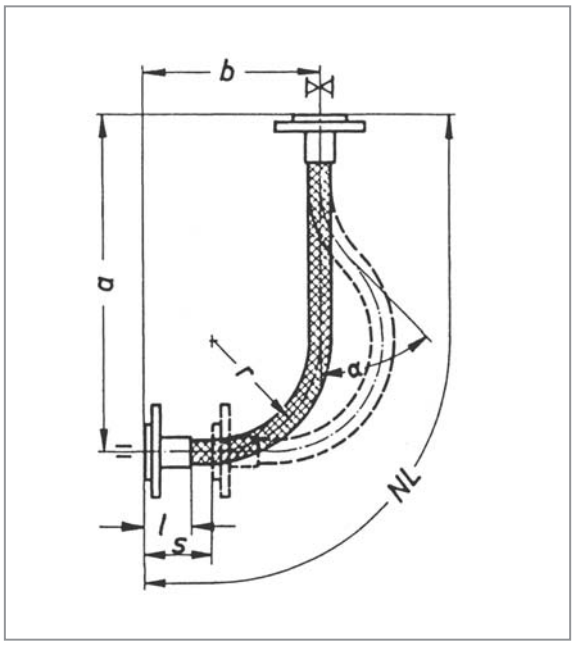
$$NL = \sqrt{20 \cdot r \cdot s} + 2l$$
$$s = SL^2/20r$$
$$EL = 0{,}995NL$$
$$SL = NL - 2l$$
$$SL_{min} = 6s$$

▸ Avoid condition of stress in neutral position.

▷ Case 2

Length determination for metal hoses for installation as a 90° bend for movements from one direction.

This layout does not apply to any vibration absorption!



s = movement [mm]
a = installation distance [mm]
b = installation distance [mm]
r = bend radius [mm]
(see tables on page 4.4 for bend radii)
l = length of connecting components [mm]
(see tables on connecting components)
α = bend angle [°]
NL = nominal length [mm]

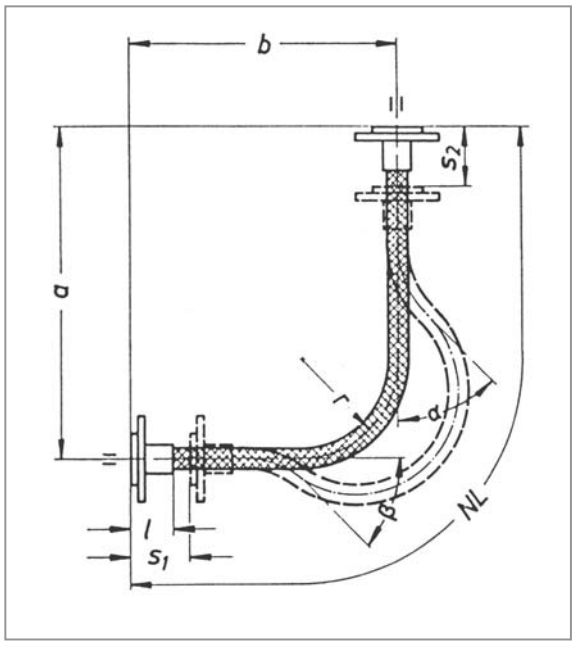
$$NL = 0{,}035r \cdot \alpha + 1{,}57r + 2l$$
$$a = r + (2r \cdot \sin\alpha) + l$$
$$b = r + r(0{,}035\alpha - 2\sin\alpha) + l$$
$$f_\alpha = s/r$$
$$\alpha < 60\ °$$

f_α - see table on page 4.4 for bend angles

▷ Case 3

Length determination for metal hoses for installation as a 90° bend for movements from two directions.

This layout does not apply to any vibration absorption!



s_1 = movements [mm]
s_2 = movements [mm]
a = installation distances [mm]
b = installation distances [mm]
r = bend radius [mm]
(see tables on page 4.4 for bend radii)
l = length of connecting components [mm]
(see tables on connecting components)
α = bend angles [°]
β = bend angles [°]
NL = nominal length [mm]

$$NL = 0{,}035r \cdot (\alpha + \beta) + 1{,}57r + 2l$$
$$a = r + 2r \cdot \sin\alpha + r(0{,}035\beta - 2\sin\beta) + l$$
$$b = r + 2r \cdot \sin\beta + r(0{,}035\alpha - 2\sin\alpha) + l$$
$$f_\alpha = s_1/r$$
$$f_\beta = s_2/r$$
$$\alpha < 45\ °$$
$$\beta < 45\ °$$

f_α , f_β – see table on page 4.4 for bend angles

Table of bend angles to determine the bend angle for calculating 90° bends.

0° – 30°				30° – 60°			
Bend angle α, β	Angle factor f_α , f_β			Bend angle α, β	Angle factor f_α , f_β		
Degr.\min.	0°	30°	60°	Degr.\min.	0°	30°	60°
0	0,0000	0,0001	0,0003	30	0,3151	0,3263	0,3377
1	0,0003	0,0007	0,0012	31	0,3377	0,3493	0,3611
2	0,0012	0,0019	0,0028	32	0,3611	0,3731	0,3853
3	0,0028	0,0038	0,0050	33	0,3853	0,3977	0,4104
4	0,0050	0,0063	0,0078	34	0,4104	0,4232	0,4363
5	0,0078	0,0095	0,0113	35	0,4363	0,4495	0,4630
6	0,0113	0,0133	0,0155	36	0,4630	0,4767	0,4906
7	0,0155	0,0179	0,0204	37	0,4906	0,5048	0,5191
8	0,0204	0,0231	0,0259	38	0,5191	0,5337	0,5484
9	0,0259	0,0289	0,0322	39	0,5484	0,5634	0,5786
10	0,0322	0,0355	0,0391	40	0,5786	0,5940	0,6096
11	0,0391	0,0428	0,0468	41	0,6096	0,6255	0,6415
12	0,0468	0,0509	0,0551	42	0,6415	0,6578	0,6743
13	0,0551	0,0596	0,0643	43	0,6743	0,6910	0,7079
14	0,0643	0,0690	0,0741	44	0,7079	0,7250	0,7424
15	0,0741	0,0793	0,0847	45	0,7424	0,7599	0,7777
16	0,0847	0,0903	0,0961	46	0,7777	0,7957	0,8139
17	0,0961	0,1020	0,1082	47	0,8139	0,8323	0,8510
18	0,1082	0,1145	0,1211	48	0,8510	0,8698	0,8889
19	0,1211	0,1278	0,1347	49	0,8889	0,9082	0,9277
20	0,1347	0,1418	0,1491	50	0,9277	0,9474	0,9673
21	0,1491	0,1567	0,1644	51	0,9673	0,9874	1,0078
22	0,1644	0,1723	0,1804	52	1,0078	1,0284	1,0491
23	0,1804	0,1887	0,1972	53	1,0491	1,0701	1,0914
24	0,1972	0,2059	0,2148	54	1,0914	1,1128	1,1344
25	0,2148	0,2239	0,2332	55	1,1344	1,1563	1,1783
26	0,2332	0,2428	0,2525	56	1,1783	1,2006	1,2230
27	0,2525	0,2624	0,2725	57	1,2230	1,2457	1,2686
28	0,2725	0,2829	0,2934	58	1,2686	1,2918	1,3150
29	0,2934	0,3042	0,3151	59	1,3150	1,3386	1,3623

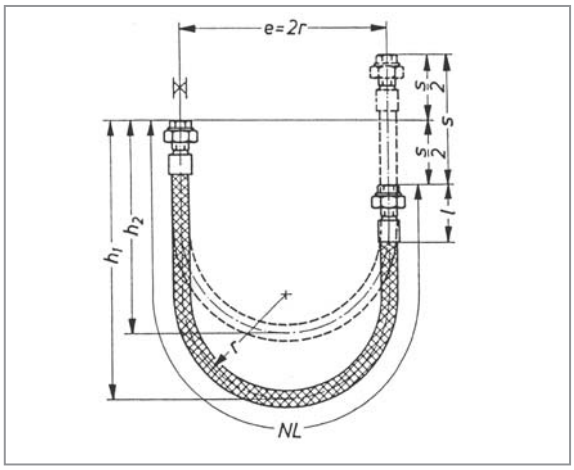
The bend angle must not exceed 60°. If the calculated value of s/r exceeds 1,3623, the bend angle must be calculated again with a larger bend radius r.

fα , fβ = angle factor
r = bend radius
(see tables on page 4.4)
s = movements in mm
α = bend angle
β = bend angle

Absorption of Reciprocating Movements

▷ Case 1

Length determination for metal hoses for installation as a 180° bend. Vertical movement.



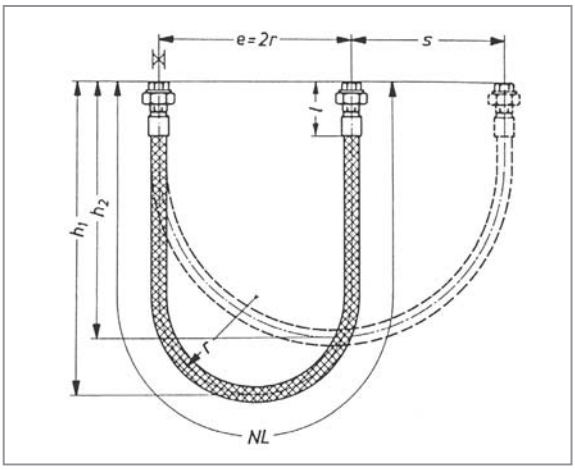
r = bend radius [mm]
(see tables on page 4.4 for bend radii)
e = installation distance [mm]
l = length of connecting components [mm]
(see tables on connecting components)
h_1 = max. height of the 180° bend [mm]
h_2 = min. height of the 180° bend [mm]
s = movement [mm]
NL = nominal length [mm]

$$NL = 4r + s/2 + 2l$$
$$h_1 = 1{,}43r + s/2 + l$$
$$h_2 = 1{,}43r + l$$

- The chosen bend radii shall be multiplied with a factor f_{si} for life-time between 1,5 and 4 according to the operating data and the requested life-time.

▷ Case 2

Length determination for metal hoses for installation as a 180° bend. Horizontal movement.



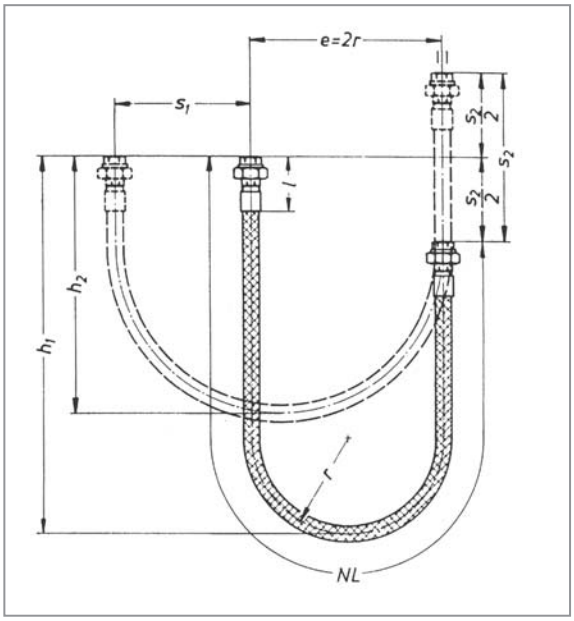
r = bend radius [mm]
(see tables on page 4.4 for bend radii)
l = length of connecting components [mm]
(see tables on connecting components)
h_1 = max. height of the 180° bend [mm]
h_2 = min. height of the 180° bend [mm]
s = movement [mm]
NL = nominal length in mm

$$NL = 4r + 1{,}57s + 2l$$
$$h_1 = 1{,}43r + 0{,}785s + l$$
$$h_2 = 1{,}43r + s/2 + l$$

- The chosen bend radii shall be multiplied with a factor f_{si} for life-time between 1,5 and 4 according to the operating data and the requested life-time.

▷ Case 3

Length determination for metal hoses for installation as a 180° bend. Vertical and horizontal movements (each side one direction of movement only).



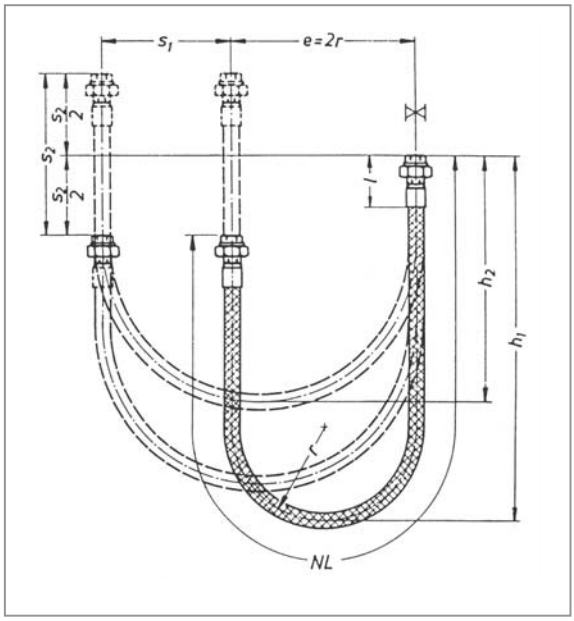
r = bend radius [mm]
(see tables on page 4.4 for bend radii)
l = length of connecting components [mm]
(see tables on connecting components)
h_1 = max. height of the 180° bend [mm]
h_2 = min. height of the 180° bend [mm]
s_1 = horizontal movement [mm]
s_2 = vertical movement [mm]
NL = nominal length [mm]

$$NL = 4r + 1{,}57s_1 + s_2/2 + 2l$$
$$h_1 = 1{,}43r + 0{,}785s_1 + s_2/2 + l$$
$$h_2 = 1{,}43r + s_1/2 + l$$

- The chosen bend radii shall be multiplied with a factor f_{si} for life-time between 1,5 and 4 according to the operating data and the requested life-time.

▷ Case 4

Length determination for metal hoses for installation as a 180° bend for absorption of movements from two directions with high amplitude and low frequency. Vertical and horizontal movements (one side fixed, other side moving in both directions).



r = bend radius [mm]
(see tables on page 4.4 for bend radii)
l = length of connecting components [mm]
(see tables on connecting components)
h_1 = max. height of the 180° bend [mm]
h_2 = min. height of the 180° bend [mm]
s_1 = horizontal movement [mm]
s_2 = vertical movement [mm]
NL = nominal length [mm]

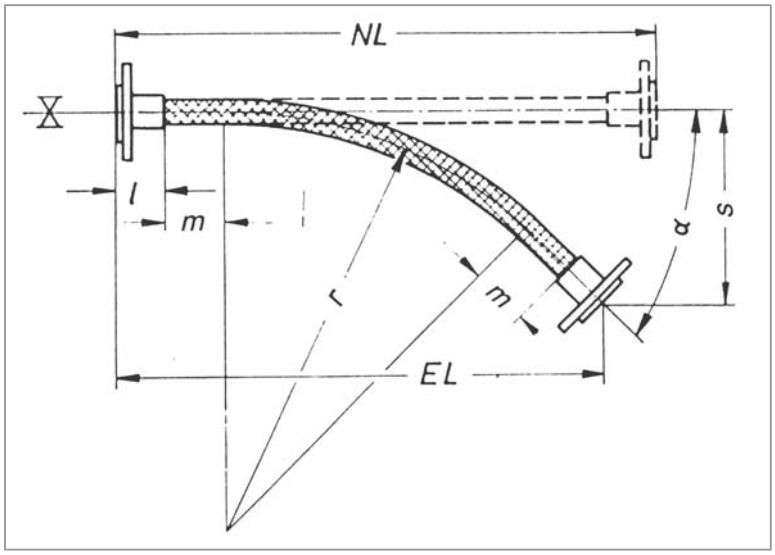
$$NL = 4r + 1{,}57s_1 + s_2/2 + 2l$$
$$h_1 = 1{,}43r + 0{,}785s_1 + s_2/2 + l$$
$$h_2 = 1{,}43r + s_1/2 + l$$

- The chosen bend radii shall be multiplied with a factor f_{si} for life-time between 1,5 and 4 according to the operating data and the requested life-time.

▷ Case 5

Length determination for metal hoses for absorption of angular movements. The hose bend must be in the plane of movement.

This case does not apply to any vibration absorption!



α = bend angle [°]
r = bend radius [mm]
(see tables on page 4.4 for bend radii)
l = length of connecting components [mm]
(see tables on connecting components)
m = length allowance [mm]
(see table below for values)
s = deflexion distance [mm]
EL = installation length [mm]
NL = nominal length [mm]

$$NL = [(r \cdot \pi \cdot \alpha)/180] + 2(l + m)$$
$$EL = r \cdot \sin\alpha + (l + m)(1 + \cos\alpha)$$
$$s = r(1 - \cos\alpha) + (l + m)\sin\alpha$$

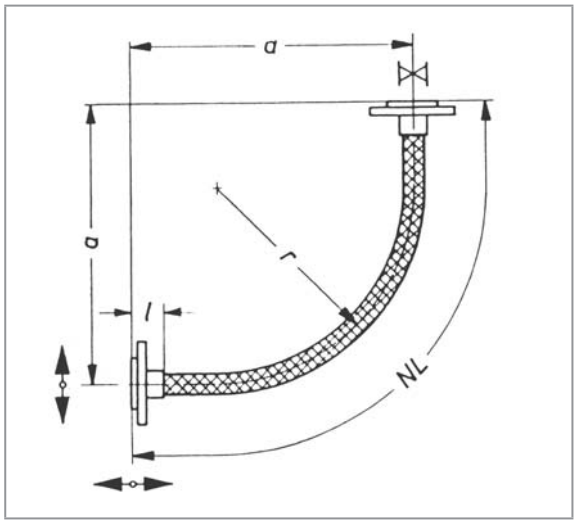
DN range [mm]	≥ 10	13 – 25	32 – 40	50 – 65	80 – 100	125 – 150	200 – 300
Length allowance [mm]	20	40	60	80	120	160	250

Absorption of Vibrations

▷ Case 1

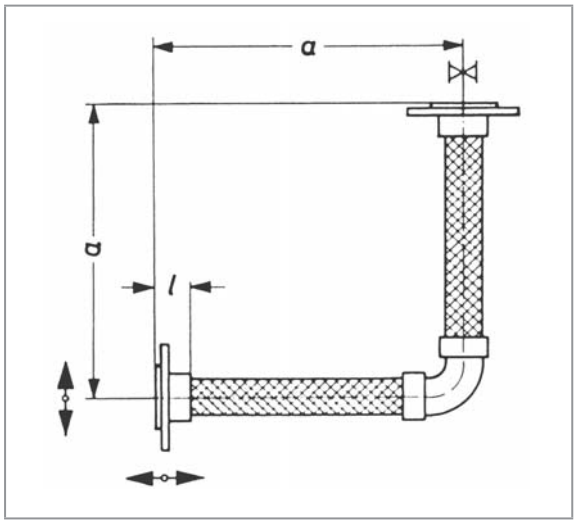
Length determination for metal hoses for installation as a 90° bend for absorbing vibrations.

▸ Installation form 1 (DN15-100), 90° bend for installation form 1:



NL = 2,3r + 2l
a = 1,365r + l

▸ Installation form 2 (DN125-300), 90° angle



Permissible amplitude at permanent load:
± 1 mm in the normal case
max. ± 10 mm during turn on and turn off

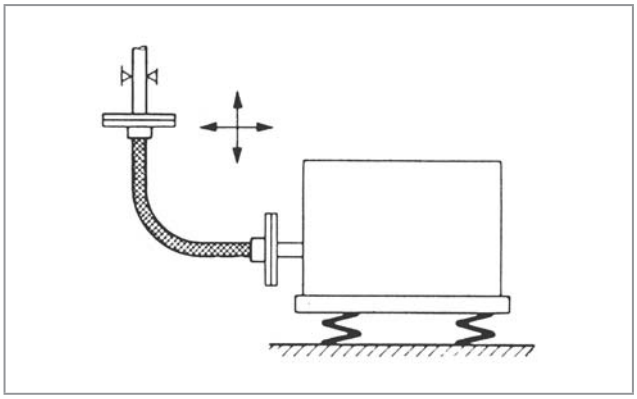
Note: Always fit the hose in hanging position as illustrated above.

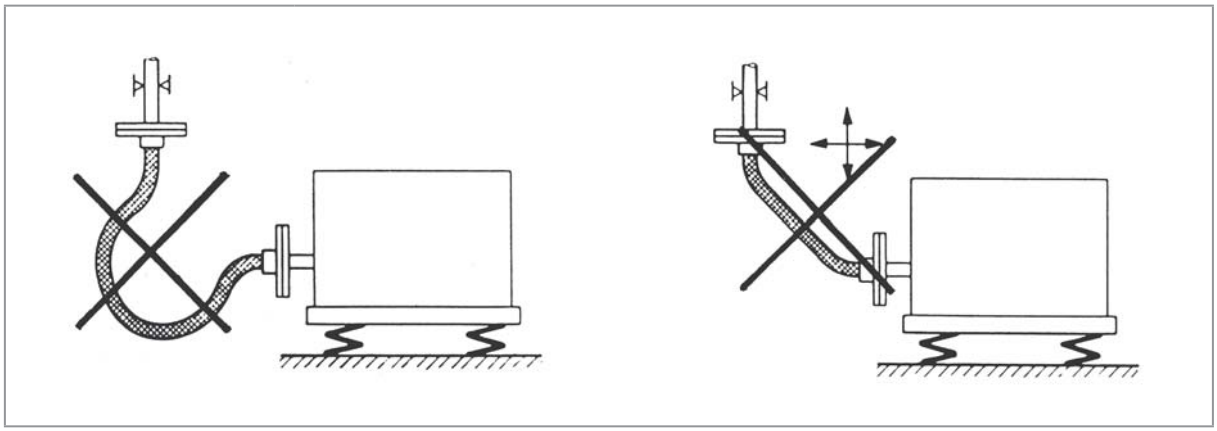
SE111 Type	Installation form 1 90° bend									Installation form 2 90° angle				
DN	15	20	25	32	40	50	65	80	100	125	150	200	250	300
r	110	150	170	200	240	280	300	350	400	-	-	-	-	-
a	200	255	285	340	400	460	490	575	635	700	800	950	1100	1300
l_{max}	50	50	55	70	75	80	80	95	95	120	130	140	150	160
NL	350	450	500	600	700	800	850	1000	1100	-	-	-	-	-

Measures in mm.

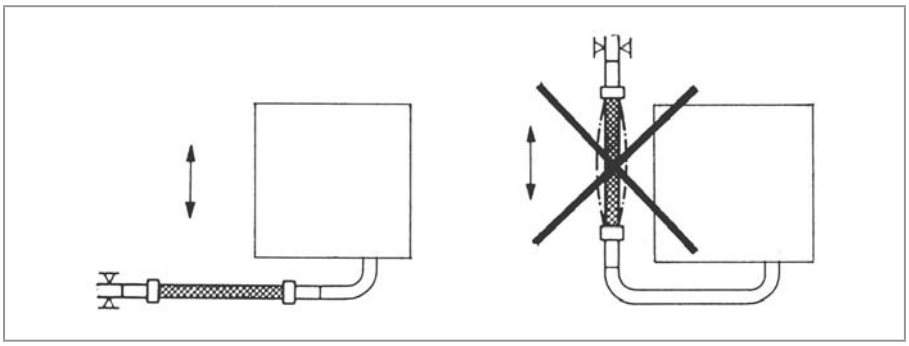
▷ Case 2

- Install 90° bend with permissible bend radius and sufficiently long neutral hose ends. Excessive curving and stretching of the hose elbow is not permissible!

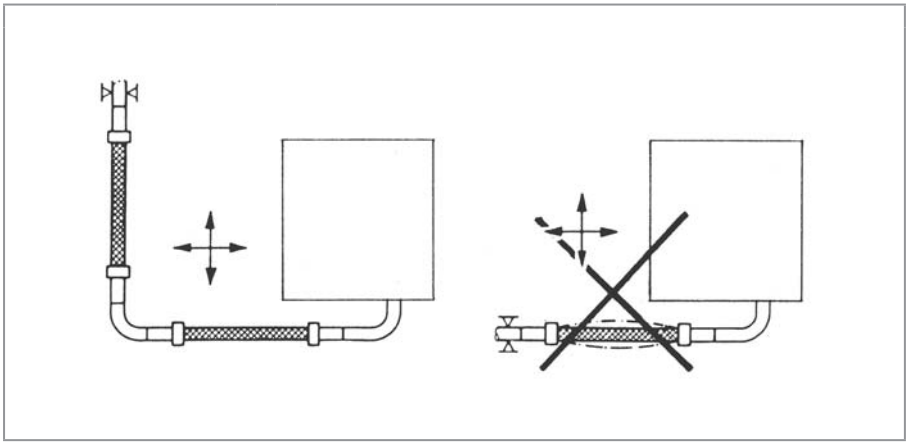


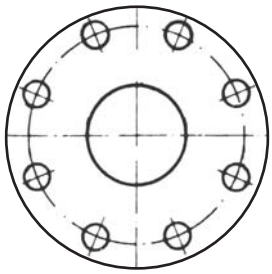


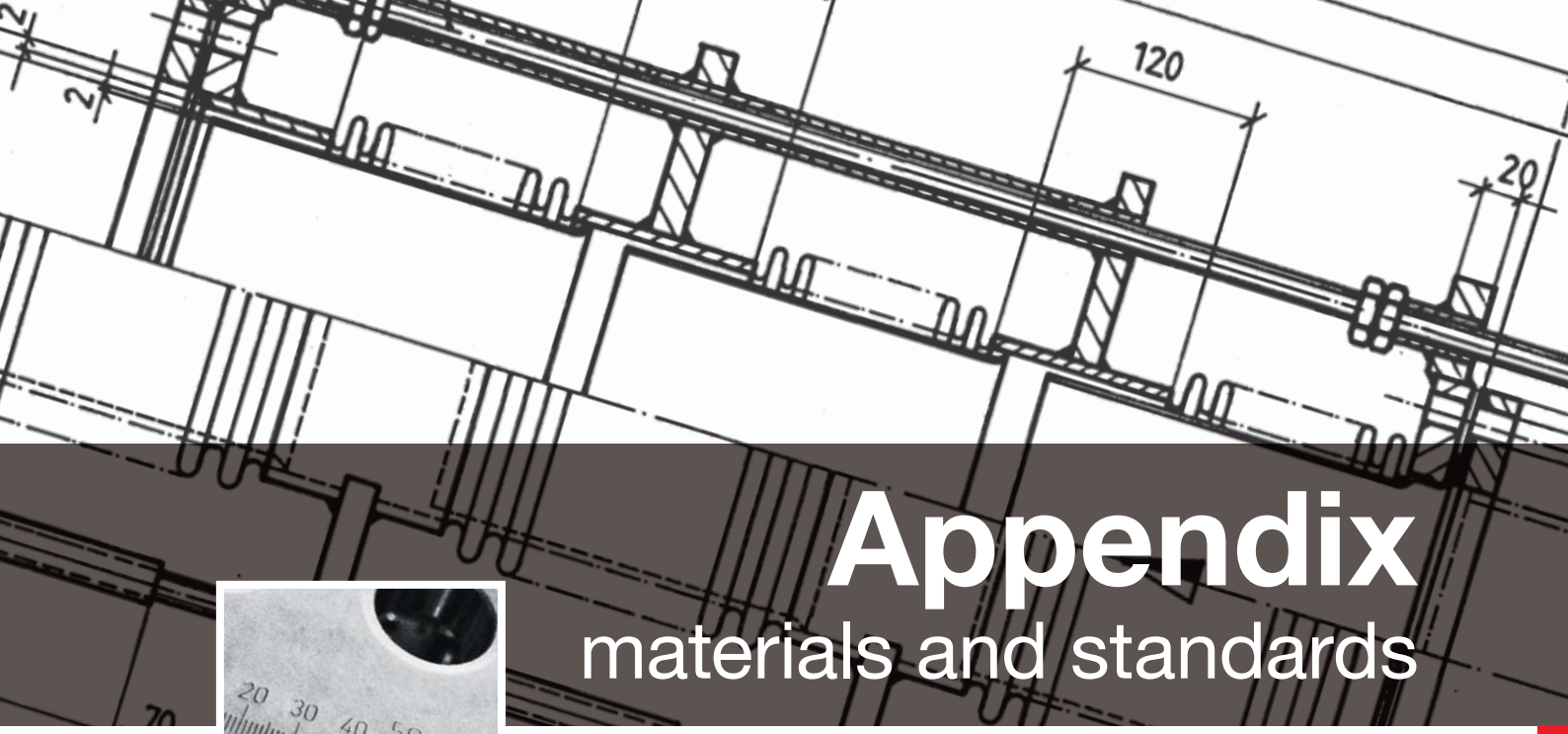
- Install hose right-angled to the direction of vibration.



- To absorb two- or three-dimensional vibrations, install hoses in a 90° arrangement. Axial vibrations are not absorbed by hoses.







Appendix
materials and standards

Materials and Measuring Units

Materials acc. DIN EN 10088

W. Nr.	Short name DIN	AISI Nr.	C max.%	Cr %	Ni %	Mn max.%	Si max.%	S max.%	Mo %	Ti min. %
1.4301	X5CrNi18-10	304	0,07	17,0-19,0	8,5-10,5	2,0	1,0	0,03	–	–
1.4306	X2CrNi19-11	304L	0,03	18,0-20,0	10,0-12,0	2,0	1,0	0,03	–	–
1.4529	X2CrNiMoCuN25-20	B625	0,02	19,0-21,0	24,0-26,0	1,0	0,5	0,01	6,0-7,0	–
1.4539	X1CrNiMoCu25-20	904L	0,02	19,0-21,0	24,0-26,0	2,0	0,7	0,01	4,0-5,0	–
1.4541	X6CrNiTi18-10	321	0,08	17,0-19,0	9,0-12,0	2,0	1,0	0,03	–	5x%C
1.4571	X6CrNiMoTi17-12-2	316Ti	0,08	16,5-18,5	10,5-13,5	2,0	1,0	0,03	2,0-2,5	5x%C
1.4401	X5CrNiMo17-12-2	316	0,07	16,5-18,5	10,5-13,5	2,0	1,0	0,03	2,0-2,5	–
1.4404	X2CrNiMo17-12-2	316L	0,03	16,5-18,5	11,0-14,0	2,0	1,0	0,03	2,0-2,5	–
1.4435	X2CrNiMo18-14-3	316L	0,03	17,0-18,5	12,5-15,0	2,0	1,0	0,03	2,5-3,0	–
1.4436	X3CrNiMo17-13-3	316	0,07	16,5-18,5	11,0-14,0	2,0	1,0	0,03	2,5-3,0	–
2.4856	INCONEL625	B443	0,03	20,0-23,0	> 58	0,5	0,5	0,015	8,0-10,0	–

Units for Weights

Unit	g	kg	t	oz	lb
1 gram (g)	1	0,001	–	0,03527	0,0022
1 kilogram (kg)	1000	1	0,001	35,274	2,20462
1 tonne (t)	–	1000	1	35274	2204,62
1 ounce (oz)	28,3495	0,02835	–	1	0,0625
1 pound (lb)	453,592	0,45359	0,00045	16	1

Units for Pressure

Unit	Pa	Bar	mm H_2O	m H_2O	at
1 Pascal (Pa) = 1 N/m²	1	0,00001	0,10197	0,001	0,00001
1 Bar (bar)	100000	1	10197,2	10,1972	1,01972
1 water column millimeter ≤ kp/m²	9,80665	–	1	0,001	0.0001
1 water column meter (m H_2O)	9806,65	0,09807	1000	1	0,1
1 technical atmosphere (at) = kp/mm²	98066,5	0,98067	10000	10	1
1 physical atmosphere (atm)	101325	1,01325	10332,3	10,3323	1,03323
1 mm mercury column (mm Hg) = Torr	133,322	0,00133	13,5951	0,013595	0,00136
1 pound-force per sqare inch (lbf/in²)	6894,76	0,06895	703,07	0,70307	0,07031
1 pound-force per sqare foot (lbf/ft²)	47,8803	0,00048	4,88243	0,00488	0,00048
1 inch mercury column (in Hg)	3386,39	0,03386	345,316	0,34532	0,03453

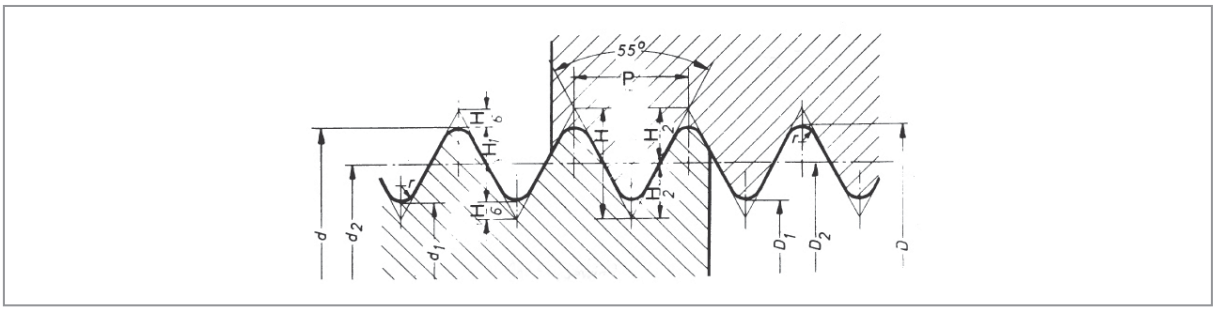
Unit	atm	mm Hg	lbf/in²	lbf/ft²	in Hg
1 Pascal (Pa) = 1 N/m²	–	0,0075	0,00014	0,02089	0,000295
1 Bar (bar)	0,98692	750,062	14,5037	2088,54	29,53
1 water column millimeter ≤ kp/m²	–	0,07356	0,00142	0,20482	0,0029
1 water column meter (m H_2O)	0,09678	73,5559	1,42233	204,816	2,8959
1 technical atmosphere (at) = kp/mm²	0,96784	735,559	14,2233	2048,16	28,959
1 physical atmosphere (atm)	1	760	14,696	2116,22	29,9213
1 mm mercury column (mm Hg) = Torr	0,00132	1	0,01934	2,78449	0,03937
1 pound-force per sqare inch (lbf/in²)	0,06805	51,7149	1	144	2,03602
1 pound-force per sqare foot (lbf/ft²)	0,00047	0,35913	0,00694	1	0,01414
1 inch mercury column (in Hg)	0,03342	25,4	0,49115	70,7262	1

Threads

Withworth Pipe Thread acc. to DIN 259 / DIN – ISO 228

British Standard Pipe Parallel Thread, with sealant compound, parallel or cylindrical.

Description	Sealing	Symbol	Detail
Pipe threads where pressure-tight joints are not made on the threads	not sealing on the thread	G	internal and external thread cylindrical



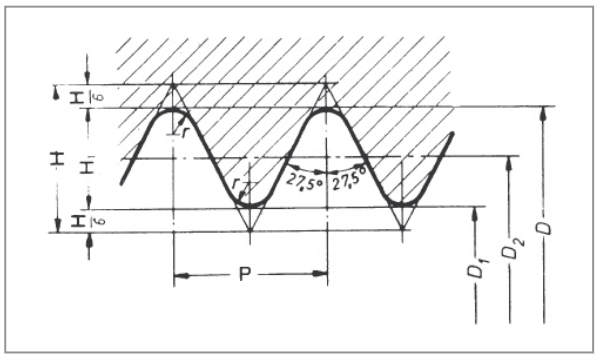
Size of thread	Nom. tube width	Thread dimensions						
		Outside diameter $d = D$	Flank diameter $d_2 = D_2$	Core diameter $d_1 = D_1$	Gradient P	No. of threads per 25,4 mm	Depth of thread H_1	Radius r ≈
R 1/8	6	9,728	9,147	8,566	0,907	28	0,581	0,125
R 1/4	8	13,157	12,301	11,445	1,337	19	0,856	0,184
R 3/8	10	16,662	15,806	14,950	1,337	19	0,856	0,184
R 1/2	15	20,955	19,793	18,631	1,814	14	1,162	0,249
R 3/4	20	26,441	25,279	24,117	1,814	14	1,162	0,249
R 1	25	33,249	31,770	30,291	2,309	11	1,479	0,317
R 1 ¼	32	41,910	40,431	38,952	2,309	11	1,479	0,317
R 1 ½	40	47,803	46,324	44,845	2,309	11	1,479	0,317
R 2	50	59,614	58,135	56,656	2,309	11	1,479	0,317
R 2 ½	65	75,184	73,705	72,226	2,309	11	1,479	0,317
R 3	80	87,884	86,405	84,926	2,309	11	1,479	0,317
R 4	100	113,030	111,551	110,072	2,309	11	1,479	0,317
R 5	125	138,430	136,951	135,472	2,309	11	1,479	0,317
R 6	150	163,830	162,351	160,872	2,309	11	1,479	0,317

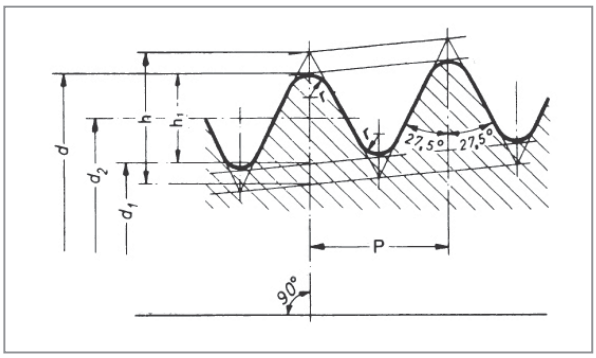
Measures in mm.

Pipe Thread acc. to DIN 2999 (excerpt)

Whitworth pipe thread for pipes and fittings. Parallel female thread and tapered male thread (taper 1 : 16). An appropriate sealing compound can be used in the thread to ensure a leak-proof joint. The flank angle is 55°.

Description	Sealing	Symbol	Detail
Whitworth pipe threads for threaded pipes and fittings	sealing on the thread	**Rp**	internal thread cylindrical
		R	external thread taper





Size of thread	Nom. tube width	Distance of the measure. plane	Thread dimensions							
			Outside diameter d = D	Flank diameter $d_2 = D_2$	Core diameter $d_1 = D_1$	Gradient P	No. of thread per 25,4 mm	Depth of thread H_1	Radius r ≈	Effective length of thread
R 1/8	6	4,0	9,728	9,147	8,566	0,907	28	0,581	0,125	6,5
R 1/4	8	6,0	13,157	12,301	11,445	1,337	19	0,856	0,184	9,7
R 3/8	10	6,4	16,662	15,806	14,950	1,337	19	0,856	0,184	10,1
R 1/2	15	8,2	20,955	19,793	18,631	1,814	14	1,162	0,249	13,2
R 3/4	20	9,5	26,441	25,279	24,117	1,814	14	1,162	0,249	14,5
R 1	25	10,4	33,249	31,770	30,291	2,309	11	1,479	0,317	16,8
R 1 ¼	32	12,7	41,910	40,431	38,952	2,309	11	1,479	0,317	19,1
R 1 ½	40	12,7	47,803	46,324	44,845	2,309	11	1,479	0,317	19,1
R 2	50	15,9	59,614	58,135	56,656	2,309	11	1,479	0,317	23,4
R 2 ½	65	17,5	75,184	73,705	72,226	2,309	11	1,479	0,317	26,7
R 3	80	20,6	87,884	86,405	84,926	2,309	11	1,479	0,317	29,8
R 4	100	25,4	113,030	111,551	110,072	2,309	11	1,479	0,317	35,8
R 5	125	28,6	138,430	136,951	135,472	2,309	11	1,479	0,317	40,1
R 6	150	28,6	163,830	162,351	160,872	2,309	11	1,479	0,317	40,1

Measures in mm.

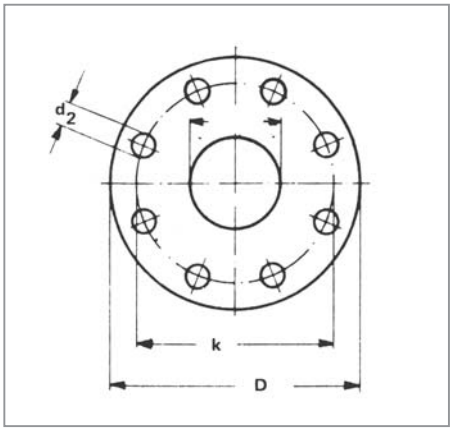
Flanges

Flange Dimensions acc. to DIN (PN 6 – PN 40)

Specific information about flanges according to DIN standards are described in the following tables.

The illustration on the right is only intended to show the arrangement of the bolt holes, not their quantity. Every flange shall be provided with a number of bolt holes divisible by 4.

The bolt holes shall in the case of piping and valve gear be arranged in such a way that they are symmetrical to the two main axes and that no holes come to be located in these axes. Other standards (like ANSI) or custom designed flanges can also be provided.



Nominal Pressure 6

Nom. diameter	Flange			Bolts			Flange thickness		
	D diameter	d_1 diameter seal	k hole circle	Quantity	Thread	d_2 hole diam.	DIN old	DIN EN 1092 Flange type	
								02	11
10	75	35	50	4	M10	11	10	12	12
15	80	40	55	4	M10	11	10	12	12
20	90	50	65	4	M10	11	10	14	14
25	100	60	75	4	M10	11	12	14	14
32	120	70	90	4	M12	14	12	16	14
40	130	80	100	4	M12	14	12	16	14
50	140	90	110	4	M12	14	12	16	14
65	160	110	130	4	M12	14	12	16	14
80	190	128	150	4	M16	18	14	18	16
100	210	148	170	4	M16	18	14	18	16
125	240	178	200	8	M16	18	14	20	18
150	265	202	225	8	M16	18	14	20	18
200	320	258	280	8	M16	18	16	22	20
250	375	312	335	12	M16	18	20	24	22
300	440	365	395	12	M20	22	24	24	22
350	490	415	445	12	M20	22	26	26	22
400	540	465	495	16	M20	22	28	28	22

Measures in mm.

▷ Nominal Pressure 10

Nom. diameter	Flange			Bolts			Flange thickness		
	D diameter	d_1 diameter seal	k hole circle	Quantity	Thread	d_2 hole diam.	DIN old	DIN EN 1092 Flange type	
								02, 04	11
DN 10 - 150	**For size 10 - 150 use flanges of nom. pressure PN 16**								
200	340	268	295	8	M 20	22	20	24	24
250	395	320	350	12	M 20	22	22	26	26
300	445	370	400	12	M 20	22	26	26	26
350	505	430	460	16	M 20	22	28	28	26
400	565	482	515	16	M 24	26	32	32	26

Measures in mm

▷ Nominal Pressure 16

Nom. diameter	Flange			Bolts			Flange thickness		
	D diameter	d_1 diameter seal	k hole circle	Quantity (old)	Thread	d_2 hole diam.	DIN old	DIN EN 1092 Flange type	
								02, 04	11
10	90	40	60	4	M 12	14	14	14	16
15	95	45	65	4	M 12	14	14	14	16
20	105	58	75	4	M 12	14	14	16	18
25	115	68	85	4	M 12	14	16	16	18
32	140	78	100	4	M 16	18	16	18	18
40	150	88	110	4	M 16	18	16	18	18
50	165	102	125	4	M 16	18	16	19	18
65	185	122	145	*(4) 8	M 16	18	16	20	18
80	200	138	160	8	M 16	18	18	20	20
100	220	158	180	8	M 16	18	18	22	20
125	250	188	210	8	M 16	18	18	22	22
150	285	212	240	8	M 20	22	18	24	22
200	340	268	295	12	M 20	22	20	26	24
250	405	320	355	12	M 24	26	24	29	26
300	460	378	410	12	M 24	26	28	32	28
350	520	438	470	16	M 24	26	32	35	30
400	580	490	525	16	M 27	30	36	38	32

* Also available / Measures in mm.

▷ Nominal Pressure 25

Nom. diameter	Flange			Bolts			Flange thickness		
	D diameter	d_1 diameter seal	k hole circle	Quantity	Thread	d_2 hole diam.	DIN old	DIN EN 1092 Flange type	
								02, 04	11
DN 10-150	**For size10-150 use flanges of nom. pressure PN 40**								
200	360	278	310	12	M 24	26	26	32	30
250	425	335	370	12	M 27	30	30	35	32
300	485	395	430	16	M 27	30	34	38	34
350	555	450	490	16	M 30	33	38	42	38
400	620	505	550	16	M 33	36	42	46	40

Measures in mm

▷ Nominal Pressure 40

Nom. diameter	Flange			Bolts			Flange thickness		
	D diameter	d_1 diameter seal	k hole circle	Quantity	Thread	d_2 hole diam.	DIN old	DIN EN 1092 Flange type	
								02, 04	11
10	90	40	60	4	M 12	14	16	14	16
15	95	45	65	4	M 12	14	16	14	16
20	105	58	75	4	M 12	14	16	16	18
25	115	68	85	4	M 12	14	18	16	18
32	140	78	100	4	M 16	18	18	18	18
40	150	88	110	4	M 16	18	18	18	18
50	165	102	125	4	M 16	18	20	20	20
65	185	122	145	8	M 16	18	20	22	22
80	200	138	160	8	M 16	18	22	24	24
100	235	162	190	8	M 20	22	22	26	24
125	270	188	220	8	M 24	26	24	28	26
150	300	218	250	8	M 24	26	24	30	28
200	375	285	320	12	M 27	30	30	36	34
250	450	345	385	12	M 30	33	36	42	38
300	515	410	450	16	M 30	33	40	42	42
350	580	535	510	16	M 33	36	46	54	46
400	660	615	585	16	M 36	39	50	60	50

Measures in mm.

Comparison of DIN Standards and DIN EN 1092-1

Application

The new DIN EN 1092-1 combines the previous flange norms in one single norm. Please find the comparison of old and new norms and flange types, applications and sizes of the most common flanges in the table below.

DIN	Flange type acc. to DIN EN	Application	Size acc. to previous standard DIN	Size acc. to DIN EN 1092-1
2566	13	Thread flange with shoulder PN 10 – PN 16	DN 6 – DN 100	DN 10 – DN 600
2573	01	Flange, even for brazing or welding PN 6	DN 10 – DN 500	DN 10 – DN 600
2576	01	Flange, even for brazing or welding PN 10	DN 10 – DN 500	DN 10 – DN 600
2630	11	Weld-on flange PN 1 – PN 2,5	DN 10 – DN 4000	DN 10 – DN 4000
2631	11	Weld-on flange PN 6	DN 10 – DN 3600	DN 10 – DN 3600
2632	11	Weld-on flange PN 10	DN 10 – DN 3000	DN 10 – DN 3000
2633	11	Weld-on flange PN 16	DN 10 – DN 2000	DN 10 – DN 2000
2634	11	Weld-on flange PN 25	DN 10 – DN 1000	DN 10 – DN 1000
2635	11	Weld-on flange PN 40	DN 10 – DN 500	DN 10 – DN 600
2636	11	Weld-on flange PN 63 (64)	DN 10 – DN 400	DN 10 – DN 400
2637	11	Weld-on flange PN 100	DN 10 – DN 350	DN 10 – DN 350
2641	02, 33, 32	Swivel flange; collar PN 6	DN 10 – DN 1200	DN 10 – DN 600
2642	02, 33, 32	Swivel flange; collar PN 10	DN 10 – DN 800	DN 10 – DN 600
2655	02, 33, 32	Swivel flange; collar PN 25	DN 10 – DN 500	DN 10 – DN 600
2656	02, 33, 32	Swivel flange; collar PN 40	DN 10 – DN 400	DN 10 – DN 600
2673	04, 34	Swivel flange; weld-on shoulder PN 25	DN 10 – DN 1200	DN 10 – DN 600

Flange Types and Corresponding Parts

Please find the new flange types and corresponding parts acc. to DIN EN 1092-1 in the following table.

Type no.	Denomination	Type no.	Denomination
01	Weld-on even flange	13	Thread flange with shoulder
02	Swivel flange for weld-on collar	32	Even collar
04	Swivel flange for weld-on collar	33	Weld-on collar
11	Weld-on flange	34	Weld-on shoulder

▷ Sealing Surface Denomination

Please find the new sealing surface denomination acc. to DIN EN 1092-1 in the table below.

Old denomination acc. to DIN	New denomination acc. to DIN EN 1092-1
Form A	Form A
Form B	Form A
Form C	Form B 1
Form D	Form B 1
Form E	Form B 2
Form F	Form C
Form N	Form D
Form V 13	Form E
Form R 13	Form F
Form V 14	Form H
Form R 14	Form G

▷ Example

Denomination of flanges and parts acc. to DIN EN 1092-1.

Denomination	Flange no.	Sealing surface form	DN	PN	Material
Flange EN 1092-1	02	A	DN 200	PN 10	1.0038
Bund EN 1092-1	32	A	DN 200	PN 10	1.4571
V-Flange EN 1092-1	11	B1	DN 100	PN 6	1.0402

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