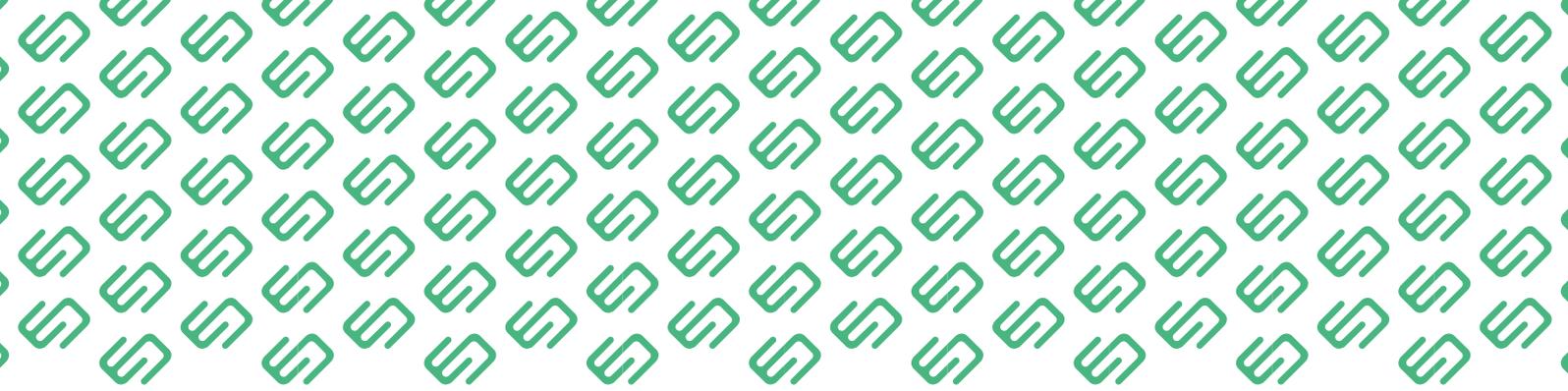




FLEXIBLE METAL TUBES AND EXPANSION JOINTS



HAENKE®



About Us

Haenke is a 100% Brazilian company that manufactures Flexible Metal Tubes and Expansion Joints. With around 40 years in the market and high credibility with customers, it stands out for its quality, fair prices, and timely deliveries.

Aiming at improvement, it makes constant investments in the manufacturing area, acquiring machinery and equipment that enable it to improve product quality, which is ensured by the Quality Management System based on the ISO 9001:2015 standard.

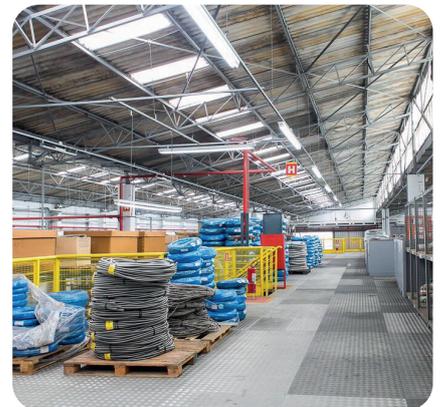
Warranty Policy

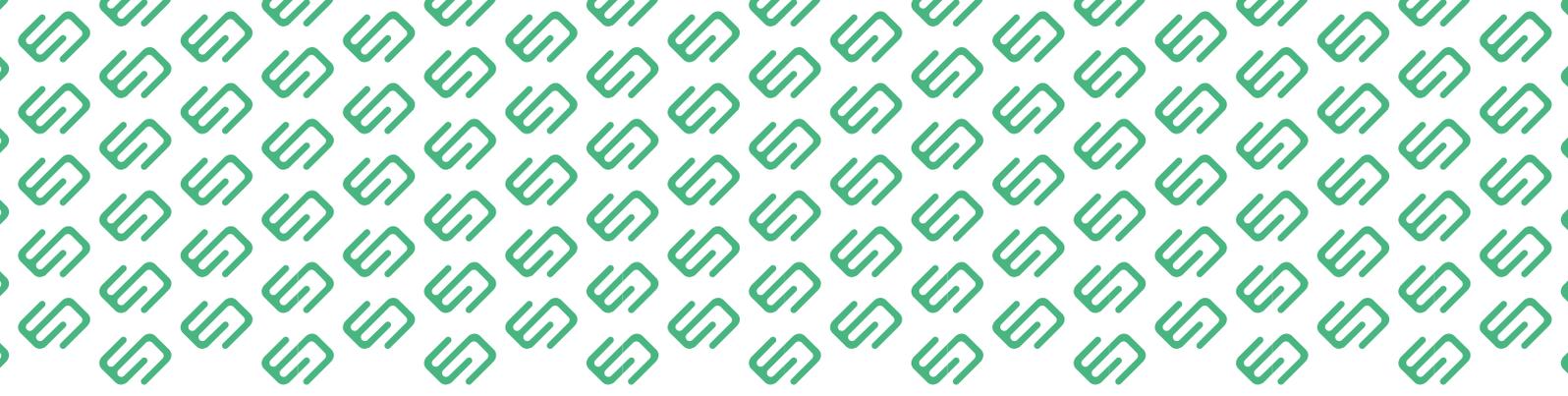
Haenke Flexible Metal Tubes are guaranteed for 12 (twelve) months from the date of installation, or 18 (eighteen) months from the date of issue of the invoice (whichever comes first).

This warranty exclusively covers manufacturing defects and does not extend to situations arising from failure to follow the installation instructions, incorrect handling during use, or inadequate storage and preservation of the product.

Flexible metal pipes for natural gas transmission are manufactured from metal alloys, which are non-perishable materials. Standard NBR 14177 does not specify their validity.

Haenke reserves the right to change any item in its products without prior notice. For further information, please consult the technical department.

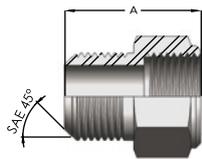




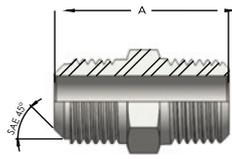
Summary

Terminals for welding and brazing on Flexible Metal Tubing	03
Flexible Metal Tubes in Stainless Steel - AISI -304/321 or AISI-316L	03
Flexible Metal Tubes in Tombac 85/15 (ASTM-B.135-UNS 23000)	03
Flexible Metal Conduit for Explosive Atmospheres - Eletroprov Stainless Steel/Eletroprov Brass	04
Flexible Metal Conduit for Explosive Atmospheres - Weatherproof - Eletroinox - Reusable (IP-66)	05
Flexible Metal Conduit for Explosive Atmospheres - Eletroinox - Pressed (IP-66)	05
Flexible Metal Conduit for Explosive Atmospheres - Weatherproof Welded	05
Vibration Damper for Generator Set	06
Flexible Metal Tube for loading and unloading ships and trucks	06
Special Line of Flexible Metal Tubes	07
Installation recommendations - Flexible Metal Tubes	09
Expansion Joints - Types of Movement	11
Expansion Joints - Models	12
Axial and Vibration Damper	13
Universal	14
Gimbal	14
Hinge	14
Rubber	14
Design Concepts	15
Installation Recommendations	16
Specification Sheet	17

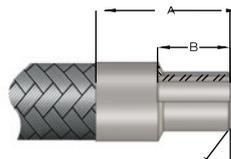
TERMINALS FOR WELDING AND BRAZING ON FLEXIBLE METAL TUBING



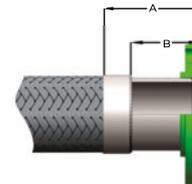
AFS - Male/Female Adapter in Stainless Steel
 AFC - Male/Female Carbon Steel Adapter
 AFB - Male/Female Brass Adapter



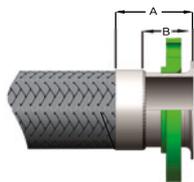
MAS - Male/Male Adapter in Stainless Steel
 MAC - Male/Male Adapter in Carbon Steel
 MBA - Male/Male Brass Adapter



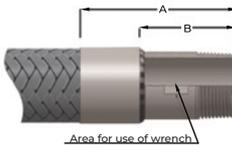
SWFT - Stainless Steel Welded Bevelled Flat Tip
 CWFT - Carbon Steel Welded Bevelled Flat Tip



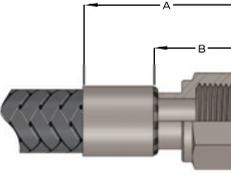
WFFS - Welded Fixed Flange in Stainless Steel
 WFFC - Welded Fixed Flange in Carbon Steel



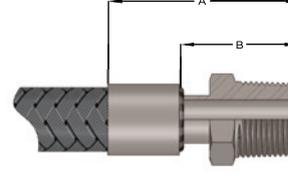
SMF - Stainless Steel Movable Flange
 CMF - Carbon Steel Movable Flange



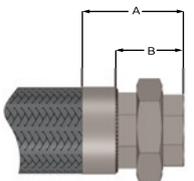
WTT - Welded Threaded Tip in Carbon Steel
 WTTT - Welded Threaded Tip in Stainless Steel



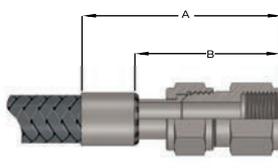
SWFFT - Stainless Steel Welded Fixed Female Terminal
 CWFFT - Carbon Steel Welded Fixed Female Terminal
 BWFFT - Brass Welded Fixed Female Terminal



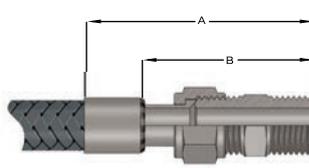
SWFMT - Stainless Steel Welded Fixed Male Terminal
 CWFMT - Carbon Steel Welded Fixed Male Terminal
 BWFMT - Brass Welded Fixed Male Terminal



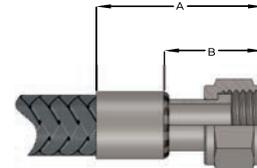
SU - Stainless Steel Female Union
 CU - Carbon Steel Female Union



SFST+FSA - Swivel Female Terminal plus Male/Female Stainless Steel Adapter
 CFST+FCA - Swivel Female Terminal plus Male/Female Carbon Steel Adapter
 BFST+FBA - Swivel Female Terminal plus Male/Female Brass Adapter



SFST+MSA - Swivel Female Terminal plus Male/Male Stainless Steel Adapter
 CFST+MCA - Swivel Female Terminal plus Male/Male Carbon Steel Adapter
 BFST+MBA - Swivel Female Terminal plus Male/Male Brass Adapter



SFST - Stainless Steel Female Swivel Terminal
 CFST - Carbon Steel Female Swivel Terminal
 BFST - Brass Female Swivel Terminal

FLEXIBLE METAL TUBES IN STAINLESS STEEL - AISI-304/321 OR AISI-316L

Manufactured in Austenitic Stainless Steel AISI-304/321 or AISI-316L, externally coated with one or two braided layers of AISI-304 or AISI-316L Stainless Steel wire.

APPLICATION: For transporting Liquids, Vapors, Corrosive Gases, Fuels, and Lubricants for Industry in general, Liquid Oxygen, Nitrogen, LPG, Natural Gas, Naphtha, Ammonia, Food Products, Chemicals, Pharmaceuticals, Vacuum, etc.

WORKING TEMPERATURE: from -196°C to +600°C

1/4" to 12"



CLOSED PITCH



NORMAL PITCH

FTSS = Flexible Tube in Stainless Steel normal pitch without braided cover.
FTSS1 = Flexible Tube in Stainless Steel with normal pitch and 1 braided layer.
FTSS2 = Flexible Tube in Stainless Steel with 2 braided layers.

FLEXIBLE METAL TUBES IN TOMBACK 85/15 (ASTM-B.135-UNS 23000)

Manufactured from Tomback 85/15 (ASTM-B. 135-UNS 23000), externally coated with one or two layers of braided Tomback 85/15 (ASTM-B. 134-UNS 23000) wire.

Designed for various static and dynamic applications, provided that its radius of curvature is observed.

APPLICATION: Widely used in the transfer of liquids, vapors, gases, and air.

WORKING TEMPERATURE: from -60°C to +250°C.

1/4" to 2"



CLOSED PITCH



NORMAL PITCH

FTX = Flexible Tube in Tomback without braided cover.
FTX1 = Flexible Tube in Tomback with 1 braided cover.
FTX2 = Flexible Tube made in Tomback with 2 braided layers.

FLEXIBLE METAL CONDUIT FOR EXPLOSIVE ATMOSPHERES ELETROPROV-STAINLESS STEEL/ELETROPROV-BRASS

APPLICATION:

The Flexible Metal Conduit with a nominal diameter of 1/2" to 4" manufactured by Haenke is suitable for electrical installations in environments with explosive atmospheres of flammable vapors and gases of Group IIA and IIB + H² (Brass) and gases of groups IIA, IIB, and IIC (Stainless Steel).

Also used to protect electrical wires and cables from weather and environmental conditions (IP-66) in installations and assemblies of machines and equipment, ideal for compensating for misalignment, allowing movement, and dampening equipment vibrations without affecting the line or installed unit.

Designed, manufactured, and tested to meet the requirements of ABNT NBR IEC 60079-0 - Explosive atmospheres; Part 0: Equipment

- General requirements and INMETRO Ordinance No. 179 of May 18, 2010. The total length may vary by up to 1.5% more or 1% less.

CONSTRUCTION:

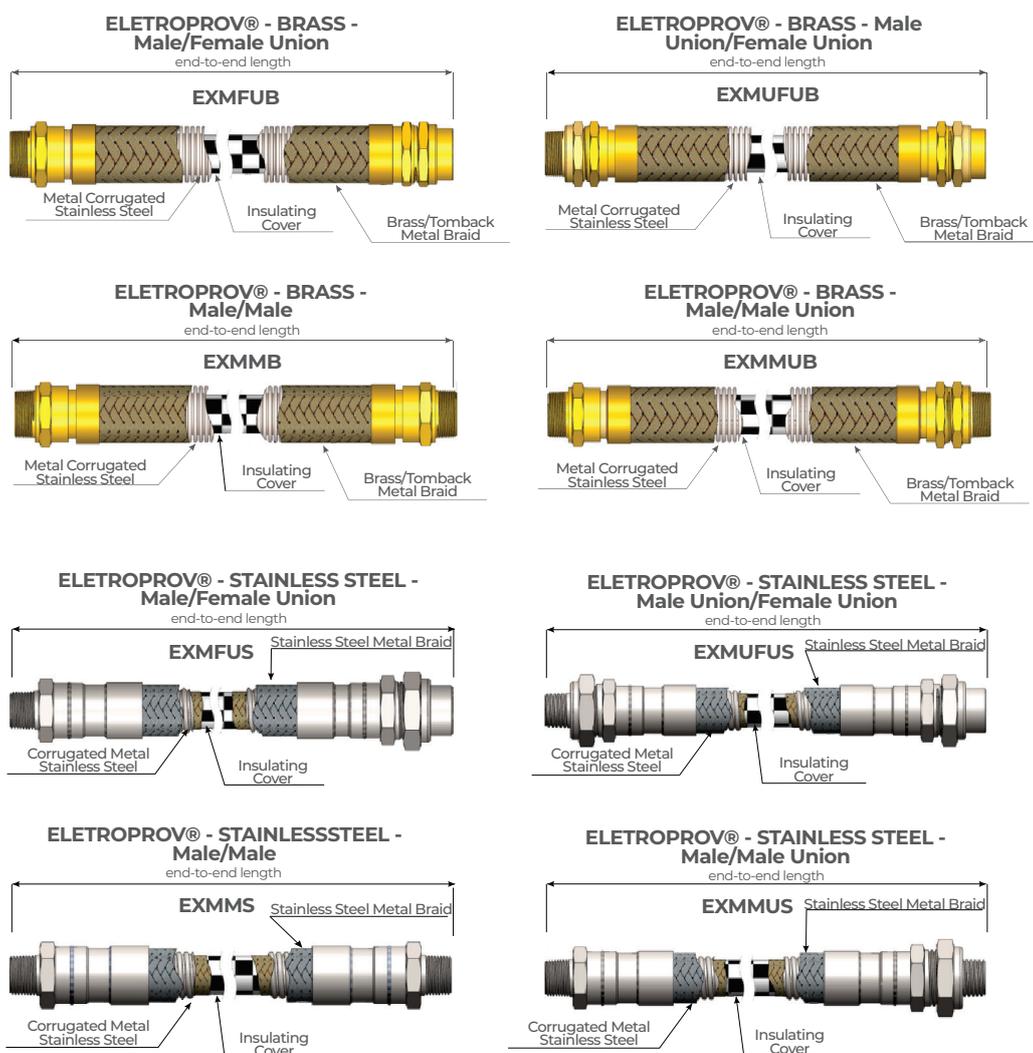
The brass version is manufactured with a 300 series stainless steel alloy corrugated pipe and is externally coated with a copper/Tombac braided mesh, while the stainless steel version is manufactured with a 300 series stainless steel corrugated pipe and is externally coated with a braided mesh of the same material. Both are internally coated with a braided synthetic fiber insulation cover to provide additional insulation for the electrical cables, thereby preventing possible electric arcs and increasing thermal insulation in the event of electrical system failures.

Supplied in nominal diameters of 1/2", 3/4", 1", 1.1/4", 1.1/2", 2", 2.1/2", 3", and 4", assembled with terminals made of brass or 300-grade stainless steel, in the following models:

- ▶ Male / Male - EXMMB ou EXMMS
- ▶ Male / Female Union - EXMFUB ou EXMFUS
- ▶ Male / Male Union - EXMMUB ou EXMMUS
- ▶ Male Union / Male Union - EXMUB ou EXMUS
- ▶ Female Union / Female Union - EXFUB ou EXFUS
- ▶ Male Union / Female Union - EXMUFUB ou EXMUFUS

Threads according to standards:

- ▶ NBR 12912 (NPT) and/or NBR NM-ISO 7-1 (BSPT)



WEATHERPROOF FLEXIBLE METAL CONDUIT (ELETROINOX- REUSABLE: IP-66)

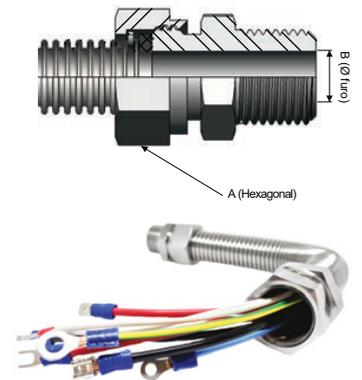
This conduit is manufactured with flexible (corrugated) metal tubing in 300 series stainless steel (AISI-304, AISI-321, and AISI-316L), normal pitch, ring corrugation, and without external coating.

Its terminals and conduit are designed to ensure IP-66 protection, in accordance with ABNT NBR IEC 60529, and to be field-mounted, ensuring watertightness and preventing accidental disassembly, provided that the Assembly Instructions are followed.

This assembly is simple and does not require special tools, as the system is composed of a metal mounting ring and a sealing ring which, once connected to the conduit, give the structure a permanent and secure shape.

It is recommended for protecting electrical wires and cables in machine and equipment installations that are subject to weather and harsh conditions (IP-66), in the food industry (subject to periodic washing), installed on the seafront, underground applications, and others.

Eletroinox-Reusable IP-66: It can be supplied in rolls according to customer requirements.



WEATHERPROOF FLEXIBLE METAL CONDUIT ELETROINOX-PRESSED (IP-66)

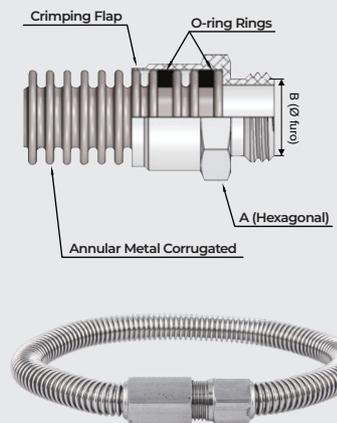
This conduit model is manufactured with flexible (corrugated) metal tubing in 300 series stainless steel (AISI-304, AISI-321, and AISI-316L), normal pitch, ring corrugation, and without external coating.

The terminals and the conduits were designed to guarantee an IP-66 protection rating, in accordance with the ABNT NBR IEC 60529 standard, while also ensuring watertightness and preventing accidental disassembly.

The terminals, male rotary and female rotary: are mounted on the conduit with O-ring seals (see figure opposite) and manufactured in AISI-304, AISI-316 stainless steel, aluminum, or CLA brass with BSP (ABNT NBR 8133), NPT (ABNT NBR 12912), metric (ABNT NBR ISO 724), PG, and other types of threads.

The assembly work requires special tools, so we recommend that it be done at our factory or that the customer purchase the tools, so that once completed, the assembly is watertight and the terminals remain rotatable.

They are recommended for protecting electrical wires and cables in machine and equipment installations that are subject to weather and harsh conditions (IP-66), in the food industry (subject to periodic washing), installed on the seafront, underground applications, and others.



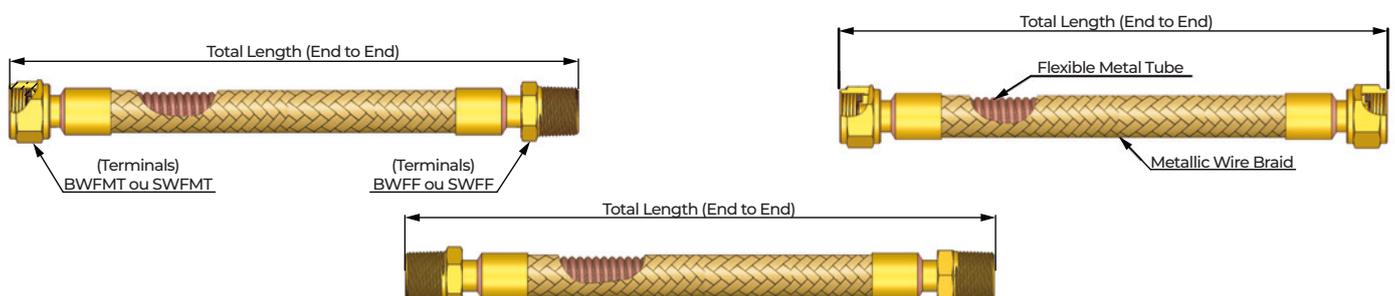
FLEXIBLE METAL CONDUIT WELDED TO WEATHERPROOF

APPLICATION:

The Weatherproof Flexible Metal Conduit is recommended for protecting electrical cables in installations and assemblies of machines and equipment (e.g., instrumentation) that are exposed to the exposure to the weather. As it does not have internal insulation coating and other construction features, it should not be used in electrical installations in environments with explosive atmospheres. The length of the Weatherproof Flexible Metal Conduit is determined according to the requirements of the installations and assemblies, with a manufacturing length tolerance of plus (+) 1.5% and minus (-) 1%.

CONSTRUCTION:

The Weatherproof Flexible Metal Conduits have been manufactured with Flexible Metal Tubing that is corrugated and externally coated with a Metal Wire Braid.



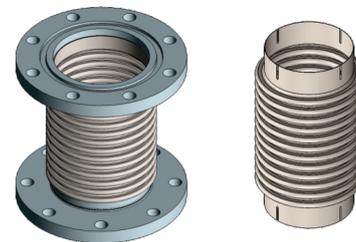
VIBRATION DAMPER FOR GENERATOR SET

The Vibration Damper for Generator Sets, also known as the "Elastic Segment," is manufactured with flexible (corrugated) metal tubing made of **300 series** stainless steel alloy.

Designed to be installed between the engine exhaust manifold and the rigid piping of the generator set exhaust system, thereby eliminating any stress on the rigid piping of the exhaust system, especially when the engine is turbocharged.

Its function is to absorb vibrations transmitted from the engine to the exhaust system and thermal expansion movements.

- ▶ Minimizes stress from rigid piping on the engine or turbine manifold;
- ▶ Absorbs movements and vibrations transmitted from the engine to the exhaust system;
- ▶ It increases the durability of the engine and the exhaust system components and their supporting parts.
- ▶ Compensates for movements and variations caused by thermal expansion;
- ▶ Promotes tightness between the turbine, manifold, and exhaust system.



Manufactured in diameters from 1.1/2" to 12", with the following terminals: welding tip, fitting tip, flanges, or others, according to the customer's design.

FLEXIBLE METAL TUBE FOR LOADING AND UNLOADING SHIPS AND TRUCKS (In ports and product transfer areas)

APPLICATION:

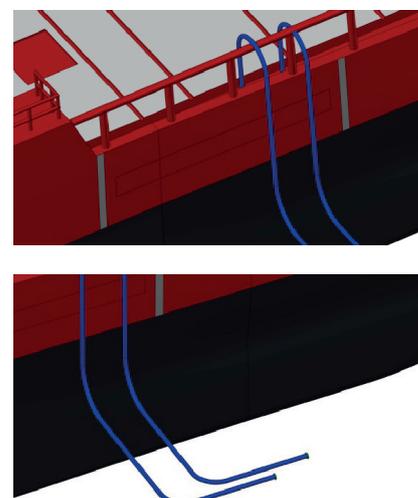
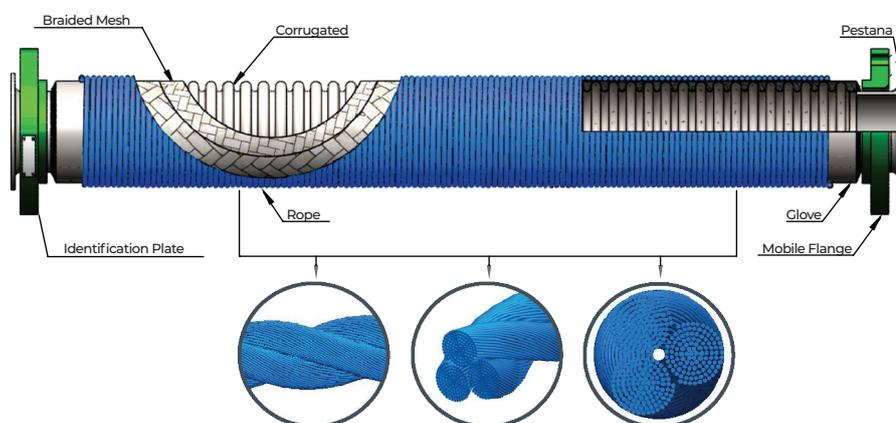
Fuel loading and unloading procedures are extremely important to ensure the safety of your establishment. Although they require extra attention, these processes (when done correctly) serve to prevent contamination and the risk of accidents.

These procedures require calm and must always be carried out in compliance with safety standards. Initially, the usual precautions are taken, with the area being cleared for the correct positioning of the tanker truck, the space being cordoned off with protective cones and safety warnings, and a fire extinguisher for flammable liquids being placed nearby.

In order to ensure this safety, Haenke has developed flexible metal hoses for loading and unloading ships and trucks, whose main features are safety, agility, and flexibility.

Flexible metal pipe with a nominal diameter of 3" to 12", suitable for transporting liquids, gases, and vapors. Designed, manufactured, and tested to the most rigorous international standards and norms.

We emphasize that, based on our production process controls, the total length may vary by up to 1.5% longer and 1% shorter, a variation that can be considered negligible given the length and flexibility of the tube.



SPECIAL LINE OF FLEXIBLE METAL TUBES

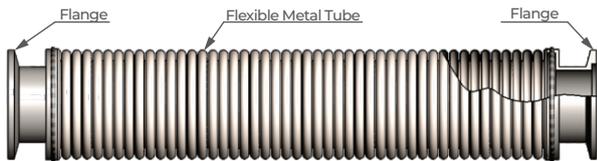
Materials: Stainless Steel, Brass, or Carbon Steel

Haenke offers Flexible Metal Tubes in other assembly options.

They can be assembled with material, length, and terminals according to the installation requirements. Other models can be manufactured upon request or design.

Flexible Metal Tube for Vacuum Application

The Flexible Metal Tubes do not change their shape or crack like rubber or plastic hoses and do not collapse under a vacuum. They allow the installation of pumps, rigid pipes, and valves with fewer connecting parts, further reducing the possibility of leaks in the vacuum system. Manufactured in AISI-321, AISI-304, or AISI-316L stainless steel for high performance, they are supplied in the length specified by the customer, with welded ISO-KF, ISO-K, ISO-F, CF, and special flange connections, meeting the most diverse installation requirements.



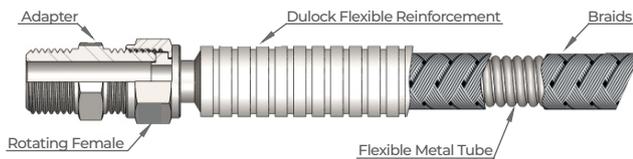
Flexible Metal Tube for Gas Transfer

Due to high demand, many companies choose to use bulk gases, eliminating the need for cylinders. In order to maintain an uninterrupted supply and ensure greater safety. With this in mind, Haenke has developed a flexible metal tube for transferring bulk gases, whereby the operator transfers the product in its liquid phase from the truck to the tank located at the customer's premises, ensuring total safety and agility in the process.



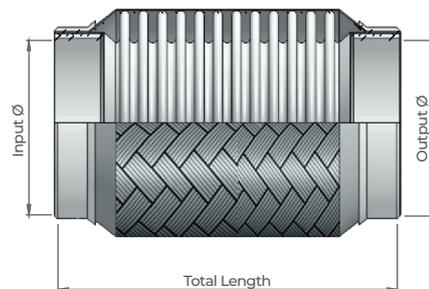
Flexible Metal Pipe with Full or Partial Reinforcement of Flexible Conduit - DULOK

Haenke Flexible Metal Tube in Stainless Steel or Copper Alloy with full or partial reinforcement for protection against splashes and abrasions, facilitating external cleaning, as well as limiting the bending radius.



Vibration Damper for Automotive Exhaust - AVA/AVB

The Automotive Vibration Damper, also known as "Steel Mesh," is manufactured with flexible (corrugated) metal tubing made of 300 series stainless steel alloy, externally coated with a braided cover made of the same material, and can be internally coated with a braided cover similar to the external one.



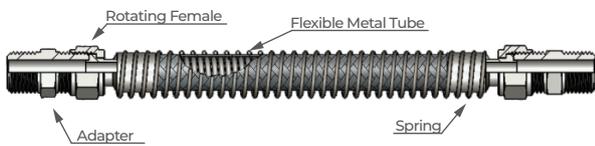
We have a specialized engineering department dedicated to special projects tailored to customer needs. For more information or assistance, please contact us.

SPECIAL LINE OF FLEXIBLE METAL TUBES

Materials: Stainless Steel, Brass, or Carbon Steel

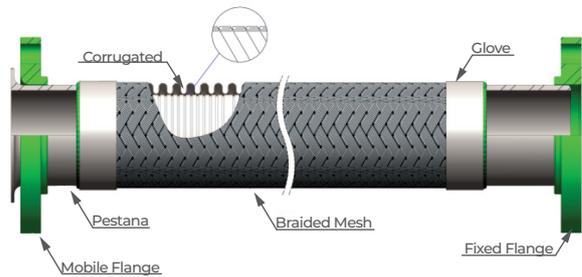
Flexible Metal Tube with Full or Partial Spring Reinforcement

Haenke Flexible Metal Tube in Stainless Steel or Copper Alloy with full or partial reinforcement of Galvanized Carbon Steel or Stainless Steel spring, to protect against dragging during handling and limit the bending radius of the flexible tube near the terminals.



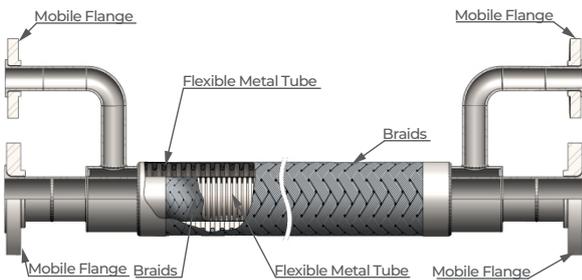
Flexible Metal Pipe with Dulock Interior

Haenke Flexible Metal Pipe, made of stainless steel coated internally with flexible pipe manufactured with stapled metal tape, with external coating of 1 or 2 braided metal wires, which can be manufactured entirely in stainless steel or tombac. This assembly configuration is suitable for high-speed drainage.



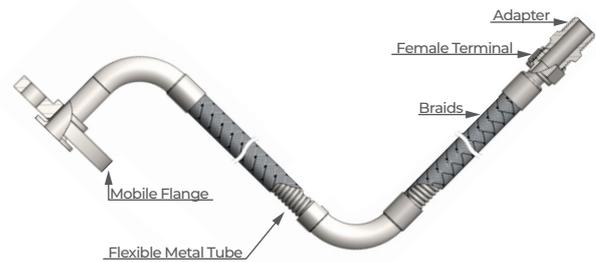
Flexible Metal Tube Jacketed

The Haenke Flexible Metal Tube is jacketed and can be made entirely of Stainless Steel, with a chamber for heating/cooling or for maintaining the temperature of the fluid being conveyed.



Flexible Metal Tube Mounted at 90°

The Haenke Flexible Metal Hose in Stainless Steel or Special Copper/Tombac Alloy for mounting at 90° in installations which require the absorption of vertical and horizontal vibratory movements at low or high frequencies, associated with low or high amplitudes, in compressors and machine installations.



INSTALLATION RECOMMENDATIONS FLEXIBLE METAL TUBES

Never bend the pipe beyond the minimum recommended bending radius. Do not twist the pipes, as they do not absorb radial movements. Refer to the installation examples below.

Install the hoses without twisting them. To prevent the hose from rotating, use two wrenches.



Protect the outside of the pipe to be welded with damp burlap, a wet cloth, or insulating paste.



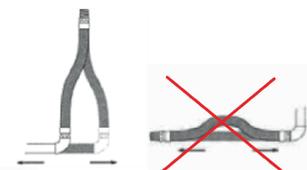
In case of condensation on the outside of the tube, it should be covered with rubber or special foam to absorb all moisture.



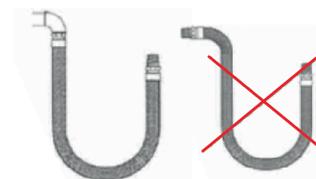
Do not expose the tube directly to flame.



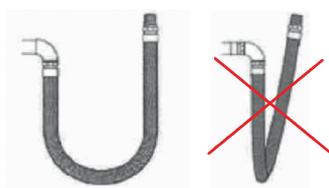
Lateral installation to absorb expansion up to 100mm.



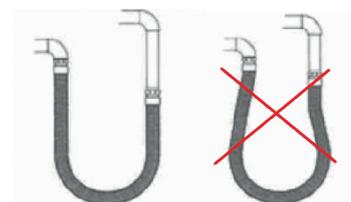
Avoid sharp bends near the fittings.



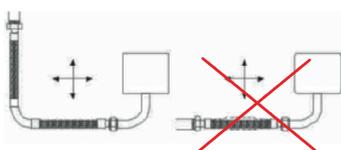
The direction of movement and the tube bend must be in the same plane.



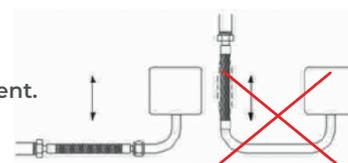
Respect the minimum bending radius. (see table on pages 3 to 5)



To absorb vibrations in more than one direction, install hoses at 90°. Always install at a right angle to the direction of movement or vibrations.



Install the hose at a right angle to the direction of movement.



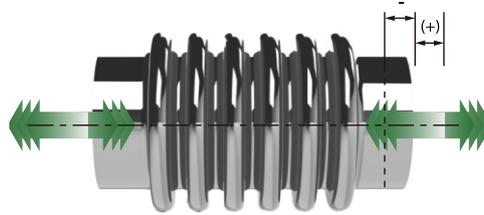
Flexible couplings do not absorb axial vibrations.

EXPANSION JOINTS



AXIAL MOVEMENT

Axial movement is the change in the dimensional length of the bellows from its free length in a direction parallel to its longitudinal axis. Compression is always expressed as negative (-) and extension as positive (+).



LATERAL MOVEMENT

Lateral movement is the relative displacement of one end of the bellows to the other end, in a direction perpendicular to its longitudinal axis. Lateral movement can be imposed on a single bellows, but to a limited degree (figure 1). A better solution is to incorporate two bellows in a universal arrangement (figure 2). This results in greater compensation movements and much lower compensation forces.

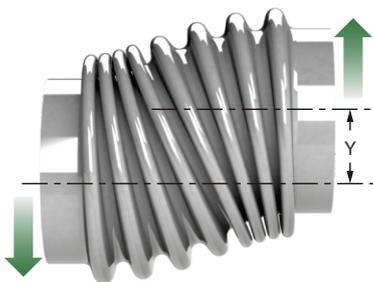
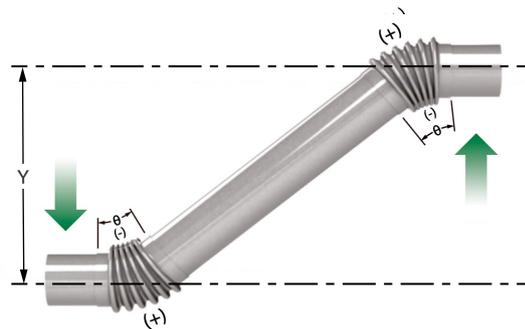
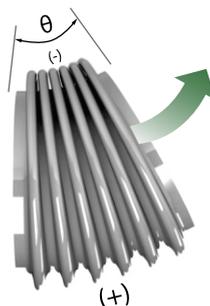


FIGURE 1



ANGULAR MOVEMENT

Angular movement is the rotational displacement of the bellows' longitudinal axis toward a point of rotation. The convolutions at the innermost point are in compression (-) while those further away are in extension (+). The angular capacity of a bellows is most often used with a second bellows.



EXPANSION JOINT MODELS

H-AEJW



Axial Expansion Joint with Weld Ends

H-AEJF



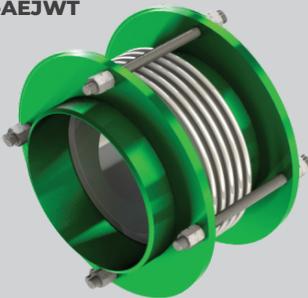
Axial Expansion Joint with Flanges

H-AEJFT



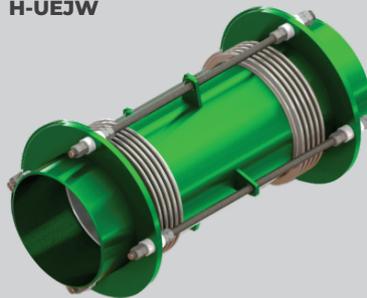
Axial Expansion Joint Flanged with Tensioners

H-AEJWT



Axial Expansion Joint with Weld Ends and Tensioners

H-UEJW



Universal Expansion Joint with Weld Ends

H-UEJF



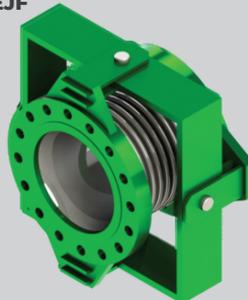
Universal Expansion Joint with Flanges

H-GEJW



Gimbal Expansion Joint with Welded Ends

H-GEJF



Gimbal Expansion Joint with Flanges

H-HEJW



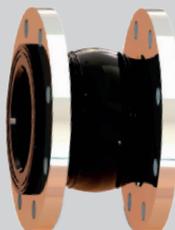
Hinge Expansion Joint with Welded Ends

H-GUEJF



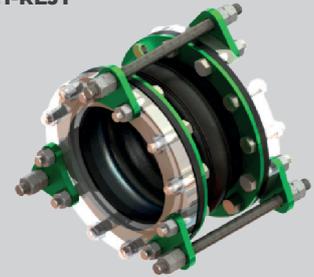
Gimbal Universal Expansion Joint with Flanges

H-REJ



Rubber Expansion Joint

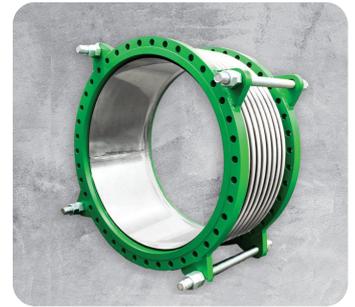
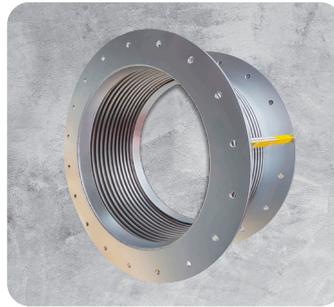
H-REJT



Rubber Expansion Joint with Tensioners

AXIAL EXPANSION JOINTS AND VIBRATION DAMPERS

Designed to absorb axial compression or extension movements in straight sections of piping. This model must be installed between fixed points with unidirectional axial guides, containing the effects of reaction force due to joint pressure. Composed of stainless steel bellows (flexible element), stainless steel internal guide, and carbon or stainless steel terminals. Our standard line includes the H-JEAP models - Axial Expansion Joint (PPS - weld-end terminals) and H-JEAF - Axial Expansion Joint with Flanges, fixed or loose.



NOMINAL DIAMETER (in.)	Ø ext. (mm)	L1 (mm)	L2 (mm)	MOVEMENTS		SPRING CONSTANT		AMPLITUDE FOR H-AVEJ LINE	
				AXIAL	LATERAL	AXIAL	LATERAL	AXIAL (X) (mm)	LATERAL (Y) (mm)
				X (mm)	Y (mm)	(kgf/mm)	(kgf/mm)		
2"	60,3	230	180	25	10	9	7	±1,5	±0,5
2.1/2"	73,0	230	180	38	18	13	11		
3"	88,9	260	205	38	13	9	7		
4"	114,3	340	255	50	22	14	9		
5"	141,3	340	280	50	20	16	14		
6"	168,3	345	270	50	17	17	30		
8"	219,1	350	290	50	14	28	62		
10"	273,0	370	300	50	11	33	119		
12"	323,8	370	315	50	11	39	161		
14"	355,6	330	260	50	11	40	318		
16"	406,4	330	265	50	7	46	461		
18"	457,0	330	270	50	7	51	644		
20"	508,0	330	275	50	6	73	57		

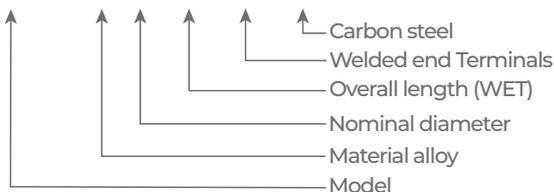
*OTHER DIAMETERS AND TECHNICAL CHARACTERISTICS AVAILABLE UPON REQUEST



The Axial Expansion Joint can also be designed to absorb small-amplitude mechanical vibrations, reducing or eliminating mechanical and sound vibrations from equipment such as suction and discharge pumps, turbine inlets and outlets, fans, motors, compressors, etc. Our standard line includes the H-VDEJW model - Vibration Damping Expansion Joint (WET - Welded end Terminals) and H-VDEJF model - Vibration Damping Expansion Joint with Flanges, fixed or loose. The joints can also be supplied with a tensioning structure in galvanized carbon steel or stainless steel.

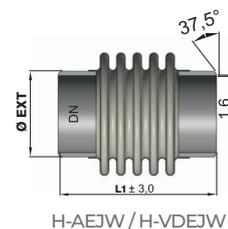


Haenke reference example: H-VDEJW-304-3X300-WET-CS

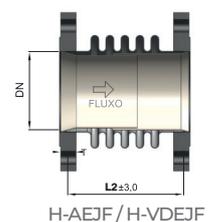


Design data (table):
 Pressure: 10 kgf/cm²
 Minimum service life at 25°C: 1000 cycles
 Maximum axial movement (see table)
 Maximum lateral movement (application without guide tube) (see table)

AXIAL EXPANSION JOINT WITH WELDED END TERMINALS



AXIAL EXPANSION JOINT WITH FLANGES



UNIVERSAL

Designed to absorb exclusively lateral and axial movements of the joint itself. Composed of two stainless steel bellows joined by an intermediate tube, internal stainless steel guide, and tensioning structure sized for low and medium working pressure, supporting the reaction effects of pressure released by the bellows. Universal Expansion Joints can be supplied with weld-on ends – H-UEJW or with flanges – H-UEJF.



***DIAMETERS AND TECHNICAL CHARACTERISTICS UPON REQUEST**



GIMBAL

Designed to absorb angular movements in space. Composed of a bellows and internal stainless steel guide and cardanic structure sized for low, medium, and high working pressures, withstanding the reaction effects of pressure released by the bellows. Gimbal Expansion Joints can be supplied with weld-on ends – H-GEJW or with flanges – H-GEJF.

The Gimbal Expansion Joint must always be installed in pairs, or two plus one Hinged Expansion Joint (H-HEJ). Replacing the Universal Expansion Joint (H-UEJ), which cannot absorb large lateral spatial movements.

***DIAMETERS AND TECHNICAL CHARACTERISTICS UPON REQUEST**

HINGE

Designed to absorb coplanar angular movements. Composed of a bellows and internal stainless steel guide and hinge structure sized for low, medium, and high working pressures, withstanding the reaction effects of pressure released by the bellows. Hinged Expansion Joints can be supplied with weld-on ends – H-HEJW or with flanges – H-HEJF.

***DIAMETERS AND TECHNICAL CHARACTERISTICS UPON REQUEST**



RUBBER

Designed to absorb axial, lateral, angular movements and vibrations. Composed of an elastomer body and flanged ends in carbon steel or stainless steel. Rubber Expansion Joints are sized to withstand working pressures of up to 300 PSI (21 kgf/cm²) and temperatures of up to 100°C.

***DIAMETERS AND TECHNICAL CHARACTERISTICS UPON REQUEST**

DESIGN CONCEPTS

DIAMETERS AND TECHNICAL CHARACTERISTICS UPON REQUEST

When we heat a body, increasing its thermal energy, we increase the state of agitation of the molecules that compose it. These molecules need more space and end up moving away from each other, increasing the volume of the body. This phenomenon is known as thermal expansion.

Thermal Expansion of Pipes

In solid bodies, expansion occurs in all directions, but this expansion can be predominant in only one direction, and when this happens, we have linear thermal expansion or, simply, axial thermal expansion.

Here, we will address the effects of axial thermal expansion on the pipe shown in Figure 1:

To calculate axial thermal expansion, we use the following formula: $\Delta L = L_0 \cdot \Delta T \cdot K$

Where:

ΔL : Axial Thermal Expansion (mm)

L_0 : Initial pipe length (mm)

ΔT : Maximum temperature differential (°C)

K : Unit thermal expansion coefficient (mm/m.°C)

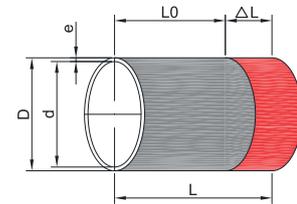


FIGURE 1

The following table shows the unit thermal expansion coefficients for carbon steel and 18 Cr 8Ni stainless steel materials and temperatures.

COEFFICIENTS OF LINEAR THERMAL EXPANSION K (mm/m.°C)						
MATERIAL	100	200	300	400	500	600
	°C					
CARBON STEEL	0,0120	0,0126	0,0131	0,0136	0,0141	0,0147
STAINLESS STEEL 18 Cr 8 Ni	0,0168	0,0175	0,0180	0,0184	0,0188	0,0191

Example of axial thermal expansion calculation: $\Delta L = L_0 \cdot \Delta T \cdot K$

Consider a carbon steel pipe with an initial length of 30 m, installed at 20°C. What will be the thermal expansion of the pipe when the system operates at 200°C?

Applying the equation:

$L_0 = 30\text{m}$

$\Delta T = 200^\circ\text{C} - 20 = 180^\circ\text{C}$

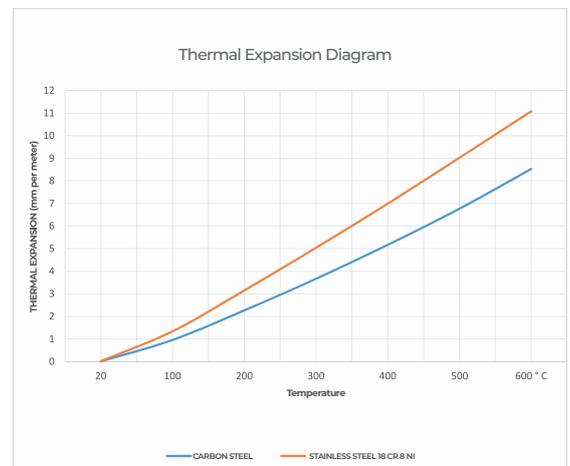
$K = 0,0126 \text{ mm/m.}^\circ\text{C}$ (extracted from the table)

Replacing:

$\Delta L = 30 \times 180 \times 0,0126 = 0,06804\text{m}$

Therefore, at operating temperature, the pipe will measure 30.068 m.

The figure on the right shows a thermal expansion diagram, where we can graphically find the value of axial thermal expansion without using the equation.



FORCES CAUSED BY AXIAL THERMAL EXPANSION

Analyzing a straight pipe, fixed at both ends and subject to temperature variation, it will transmit a thrust force to the fixings due to its expansion.

As a consequence of Hooke's law, force F is equal to: $F = A \cdot E \cdot K \cdot \Delta T / 1.000.000$

Where:

F: Thrust force on fixed points (Ton)

A: Effective cross-sectional area of the pipe (cm²)

E: Modulus of elasticity (Young's modulus) of the material at the temperature considered (kgf/cm²)

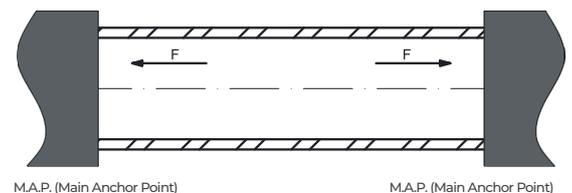
Example:

Consider a DN 8" SCH80 carbon steel pipe fixed as shown in the previous figure and subjected to a temperature of 300°C.

For this case, we have the following values:

A: 82,35cm²

F = 82,35 x 1.850.000 x 0,0131 x 280 / 1.000.000 = 558,8 tons



DESIGN CONCEPTS

As we can see, this value is too high to be transmitted to any anchorage or equipment. Even if the points could be dimensioned to withstand such thrust force, extremely high internal stresses would arise in the pipe material.

If we calculate the resulting stress from the previous formula, we have:

$$\delta = F/A$$

$$\delta = 558810,6 \text{ kgf} / 82,35 \text{ cm}^2 = 6785,789 \text{ kgf/cm}^2$$

To avoid the transmission of these extremely high loads, and to protect the piping material from the equally high stresses generated by thermal expansion, it is essential to carefully analyze the pipeline design so that it complies with the required anchoring conditions and meets applicable regulatory stress standards.

Main efforts conveyed by the Expansion Boards

Pressure Reaction Force (PRF)

For the correct application of expansion joints, we must take into account the FRP (Reaction Force due to Pressure). This force is released by the expansion joints (Figure 2), which we can illustrate according to Pascal's principle, where pressure exerted on the seal of a liquid is transmitted with equal intensity in all directions. We can calculate this force using the formula:

$$FRP = P \times A$$

Where:

FRP: Reaction force due to pressure (kgf)

P: Internal pressure (kgf/cm²)

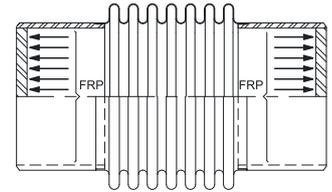


FIGURE 2

For expansion joints, the reaction force per pressure released by the bellows (FRP) according to the equation (Figure 3):

$$FRP = P \times \pi / 4 \times \varnothing m^2 = P \times \pi / 4 \times (\varnothing d + h)^2$$

We have:

FRP= Reaction force due to pressure (kgf)

P= Internal pressure (kgf/cm²)

Øm= Average bellows diameter (cm)

Ød= Internal diameter of bellows (cm)

H= Bellows wave height (cm)

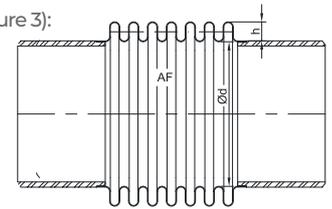


FIGURE 3

This force is released by joints that do not have a self-supporting external structure like the models H-AEJW, H-AEJF.

Therefore, for the correct installation of expansion joints in the dimensioning of fixed points and stresses when installed near equipment sensitive to this stress, there are several ways to avoid the transmission of reaction force by pressure:

- Use expansion joints with a tensioning structure (universal, hinge, gimbal). In this case, the force is contained by the structure itself, freeing the fixed points and/or equipment from this considerable stress.
- Secure the ends of the pipe section where the joint is installed with fixed points capable of withstanding the reaction of this force.
- Use self-compensating expansion joints, whose construction system allows the effects of force to be compensated for by using a compensating bellows.

Spring constant (axial, lateral, angular)

The spring constant is the force or moment required to compress, stretch, or deflect laterally or angularly the bellows of an expansion joint, serving as a key parameter in determining its flexibility and overall performance.

The spring constant is calculated based on the dimensional characteristics of the bellows and the elastic behavior of the materials used at different temperatures.

To obtain total axial and lateral spring constant values, multiply the spring constant by the total movement to be absorbed.

Axial movement

$$FX = Kx \cdot X$$

We have:

FX= Total axial spring force (kgf)

KX= Axial spring constant (kgf/mm) - See table according to the product

X= Total axial movement (mm)

Sideways movement

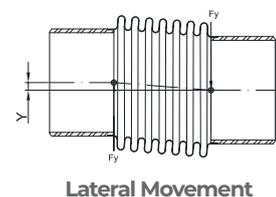
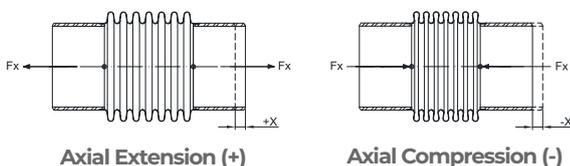
$$FY = ky \cdot Y$$

Where:

FY= Lateral spring force (kgf)

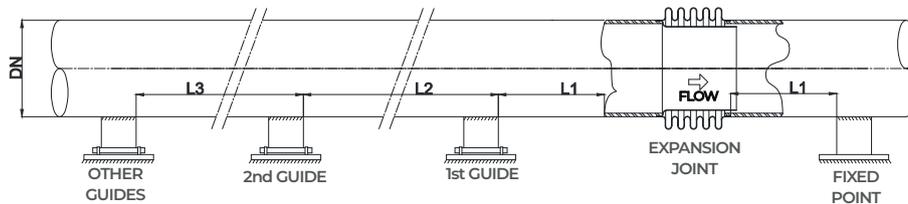
Ky= Lateral spring constant (kgf/mm) - See table according to the product

Y= Lateral movement (mm)



INSTALLATION RECOMMENDATIONS

- ▶ The installation site must be prepared for the installation of the Expansion Joint, following the specifications and design drawings.
- ▶ Changing the installation length of the Expansion Joint will result in additional movements, reducing its movement capacity during operation.
- ▶ Any axial, lateral, or angular pre-tension indicated in the drawing must be strictly observed when installing the expansion joint at the installation site.
- ▶ Do not use Expansion Joints to absorb movements greater than specified/designed.
- ▶ Install the expansion joints respecting the direction of flow, identified on the identification plate where applicable.
- ▶ Strictly observe the maximum permissible temperatures and pressures.
- ▶ Strictly follow all instructions contained in the corresponding drawings and specifications.
- ▶ Remove all shipping locks (when applicable) identified and painted yellow or red, only after complete installation of the Expansion Joint and before final testing of the line.
- ▶ The transport locks are designed to keep the expansion joint at the correct installation length, but they are not designed to withstand reaction forces due to internal pressure.
- ▶ Do not exceed the hydrostatic test pressure of 1.5 times the specified design pressure.
- ▶ To clean the system with steam, use the reel in the Expansion Joint position, replacing the joint after cleaning is complete. Follow this procedure if it is not specified at the time of specifying the Expansion Joint.
- ▶ Ensure that the fixed points of the piping where the Expansion Joints will be installed are properly sized.
- ▶ Next to the Expansion Joint, there should be axial guides according to the spacing indicated in the drawing and table below:

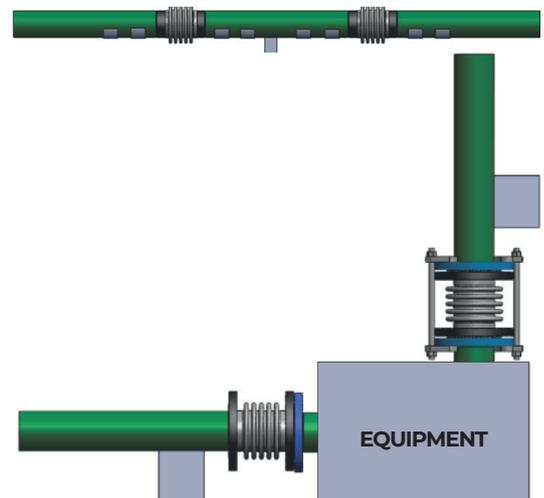


DN (In.)	Maximum Spaces - mm		Maximum Spaces - mm
	From Expansion Joint to 1st Guide	Between 1st Guide and 2nd Guide	From 2nd Guide onwards
1	100	350	3000
1 1/4	130	450	3400
1 1/2	160	600	4300
2	200	700	4900
2 1/2	250	900	6000
3	300	1200	6700
4	400	1500	9144
5	520	1800	7100
6	500	3000	12200
8	800	3000	15200
10	1000	3100	18900
12	1200	3100	20100
14	1400	4900	21300
16	1600	5500	23800
18	1850	6400	25900
20	2050	7000	28300
24	2450	8500	31100

*OTHER DIAMETERS AND TECHNICAL CHARACTERISTICS AVAILABLE UPON REQUEST

INSTALLATION EXAMPLES

AXIAL EXPANSION JOINTS (H-AEJW)



Install only one expansion joint between two fixed points. If several expansion joints must be installed in the same straight section of piping, distribute intermediate fixed points in the section, maintaining one joint between two fixed points.

For expansion joints with stroke limiters, when applicable, they must be locked in their final position, according to the dimensions specified in the design drawings in the last assembly stage prior to the hydrostatic testing of the line.

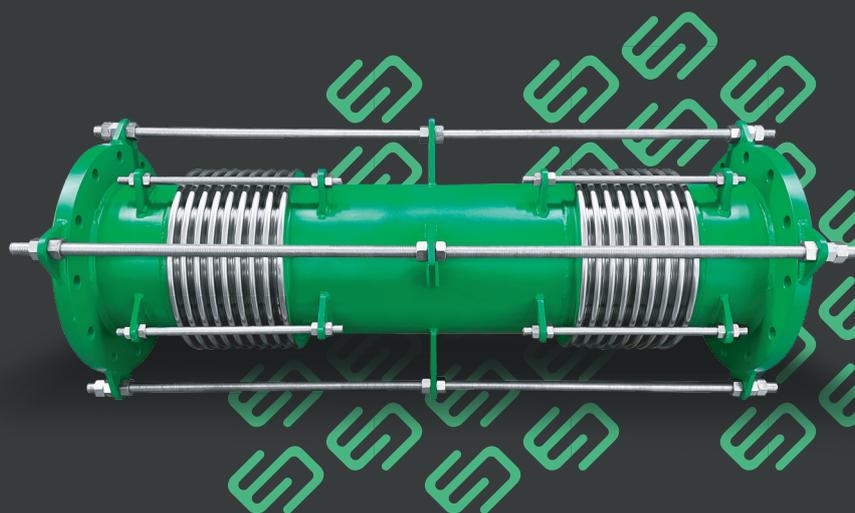
For connecting expansion joints for vibration, crimp the piping immediately after the expansion joint.

For the installation of Double and Anchored Expansion Joints (with self-supporting structures), strictly follow the pipe axes in accordance with the specified/designed movements of the Expansion Joint.



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