# Installation and servicing instructions for stainless steel expansion joints

## 1. Introduction

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 vibrations which may occur at pumps, motors, compressors, or turbines.

Axial, lateral, or angular movements can be absorbed, acc.to the local situation. For choosing the most appropriate sort of expansion joint, we will be at your disposal consultatively any time.

**Stainless steel expansion joints are equipped with single-ply or multiply bellows.**

The tables with the standard types given in our general catalogue, will give you an overview of our product range, and might be helpful for your technical considerations.

In any case, we recommend to supply us with all necessary data, enabling us to take into account values of movement, pressure, temperature, etc. and thus to find the optimum technical and cost-saving solution.

The characteristics of an expansion joint are based on the flexibility of ist bellow. This flexibility results from the bellow´s shape and number of convolutions, the thickness of each single ply, and for multiply bellows from the number of plies and the material used.

ROTH – expansion joints are designed, manufactured and approved in accordance to:

EJMA-Standards (EXPANSION JOINTS MANUFACTURERS ASSOCIATION INC.),

CE **PED Pressure Equipment Directive 97/23/EG**

Permission of: TÜV SÜDWEST, Mannheim
**Manufacturing certified acc. ISO 9001**

### 1.1 Materials

The most commonly used materials for bellows, connecting components and tie-rod systems are shown in the table 1.

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**table 1**

| application | material no. | short name | DIN EN | AISI | ASTM |
|---|---|---|---|---|---|
| **bellows** | 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 | - | - |
| **internal sleeves** | 1.4541 | X6CrNiTi18-10 | 10088 | 321 | SA 240 TP 321 |
| | 1.4571 | X6CrNiMoTi17-12-2 | 10088 | 316Ti | SA 240 TP 316Ti |
| **connecting components** | 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** | 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 |
| **tie-rod system** | 1.0570 | S355J2G3 | 10025 | - | - |
| | 1.5415 | 16Mo3 | 10028 | - | A 204 Gr A |
| | 1.7335 | 13CrMo4-5 | 10028 | - | A 182-F11,F12 |

## 1.2 Pressure reduction factors by high operating temperatures

The pressure reduction factors given in table 2 must be obeyed.

**table 2**

| material | | temperature [°C] | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -200 / -20 | 20 | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 550 |
| | | factor **ft** | | | | | | | | | | | | |
| 1.4301 | X5CrNi18-10 | 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 | X2CrNi19-11 | 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 | X6CrNiTi18-10 | 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 | X5CrNiMo17-12-2 | 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 | X2CrNiMo17-12-2 | 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 | X6CrNiMoTi17-12-2 | 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 |

A = on request

The maximum permissible operating overpressure **p zul**. For an expension joint with norm pressure **PN** and the factor **ft** for higher operating temperature is :

$$p_{zul.} = PN \cdot ft$$

## 2. 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:

### 2.1 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. Presettings 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 acc.to the direction of flow. Transport supports, if any, must be removed after installation.

### 2.2 Checks before putting into service or before pressure test

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.

### 2.3 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.

### 2.4 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.**

### 2.5 Positioning of 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 **general katalogue**).

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

Intermediate fixed points do not have to bear the thrust from the internal pressure since they are used in cases where such thrusts are absorbed by the tie-rods, plates, etc., incorporated on the expansion joint itself.

## 3. 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.

### 3.1 Fixed point loads

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.

### 3.2 Notes on installation

- only one expansion joint between 2 fixed points expansion joint as possible.
- 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.

Axial expansion joints cannot withstand thrust from the internal pressure and must therefor always be fitted inbetween two principal fixed points.

## 4. 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 favourable 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.
In addition to the main direction of movement, expansion joints with tie-rod systems absorb movements in a circular plane.

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

## 5. Universal expansion joints

The 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.

## 6. 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.

☞ **Remark:**

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

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.

## 7. 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 turbinesor 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.