UTECH

SOLUTIONS FOR PIPES WITH THERMAL EXPANSION

GUIDE SUPPORT

FIXED POINT

FIXED POINT

PIVOT SUPPORT

SLIDER SUPPORT

During pipeline installation, besides weight loads, effects of thermal deformation should be taken into account. With UTECH fixed points and sliding elements, you can reliably control these thermal elongations. When designing pipeline systems, two causes of thermal movements should usually be taken into account. There are two causes of thermal movements: on the one hand, the temperature difference between the pipe and the environment causes the material to expand or contract. On the other hand, temperature differences between the transported liquid and the environment can also cause thermal deformations.

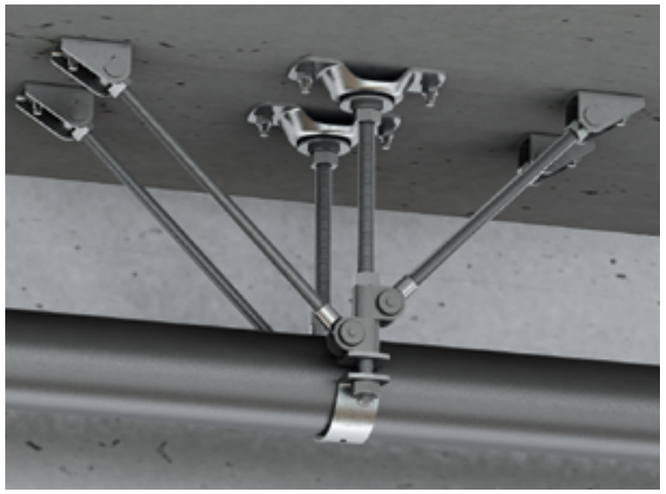
Both cases are good reasons why pipes should not be fixed rigidly but securely and flexibly with UTECH sliders.

UTECH sliders for the pipeline provide necessary freedom in the longitudinal direction. Thus, thermal movements are possible without additional load on the material.

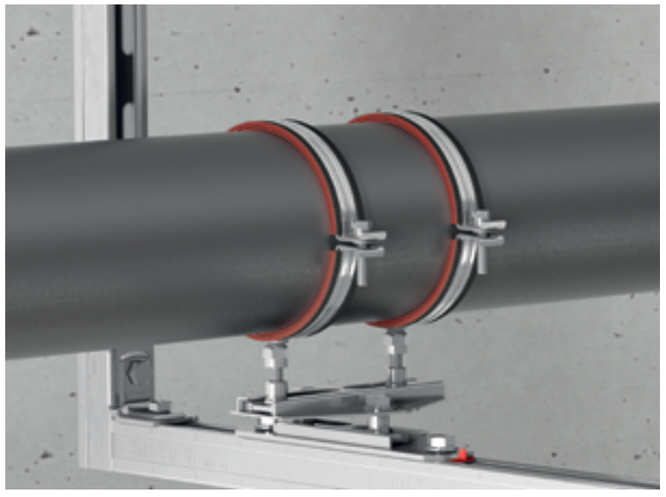
A suitable combination of UTECH sliders and fixed points can give the pipeline system an additional well-defined structure. This means that pipe movements are distributed evenly along the route. And the resulting forces are safely absorbed.

ADVANTAGES

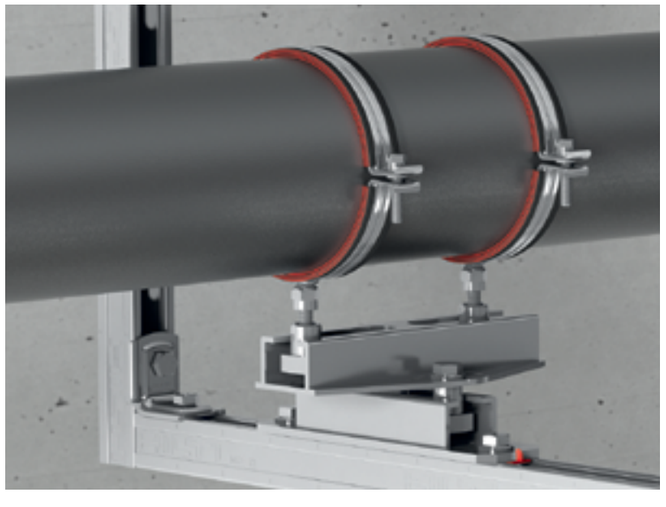
- UTECH sliders can easily be used for both horizontal and vertical pipelines.
- UTECH MSG and MRG transverse sliders allow the pipe to move in two directions in a controlled manner.
- UTECH fixed points are suitable for fixing the pipe at a distance 85 mm up to 2 m off the base material. Maximum load would be 36 kN.
- We offer you maximum flexibility in the positioning of the anchor holes to avoid hitting the reinforcement.



MFP fixed point Lightweight



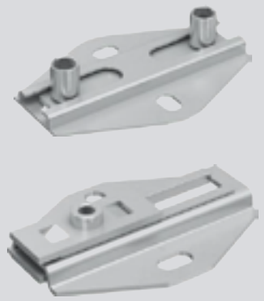
MSG slider



MRG slider

BASIC ELEMENTS

MSG SLIDERS

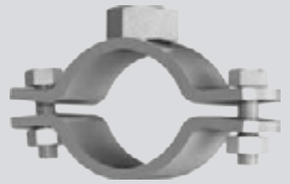


See section «Fix points and sliders»

SWIVEL HANGER MPH

See section «Fix points and sliders»

MFP CLAMPS



See section «Fix points and sliders»

MFP FIXED POINTS. COMPACT

See section «Fix points and sliders»

MFP FIXED POINTS. LIGHTWEIGHT

See section «Fix points and sliders»

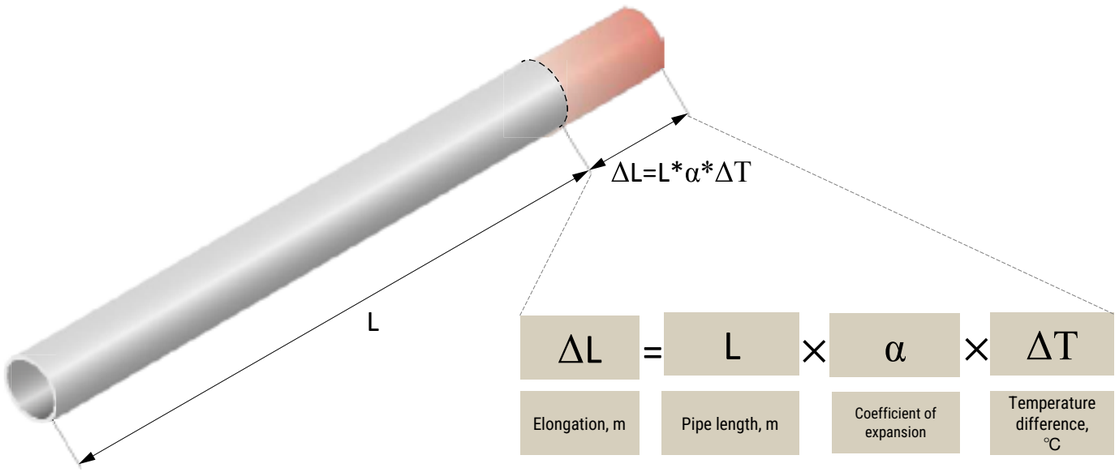
MFP FIXED POINTS. UNIVERSAL

See section «Fix points and sliders»

THERMAL EXPANSION

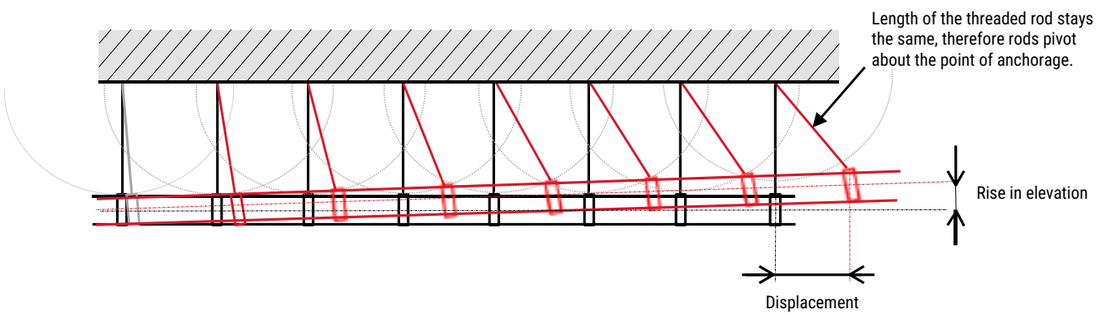
THE MAJOR CHALLENGE WHEN FASTENING HEATING PIPES IS THERMAL EXPANSION OF THE PIPE AND ITS IMPACT ON PIPE SUPPORTS AND THE SURROUNDINGS.

Thermal expansion leads to pipeline elongation and depends on three basic parameters:



UNCONTROLLED EXPANSION

What can happen in the event of uncontrolled expansion? Let us explore the impact of expansion on pipe supports

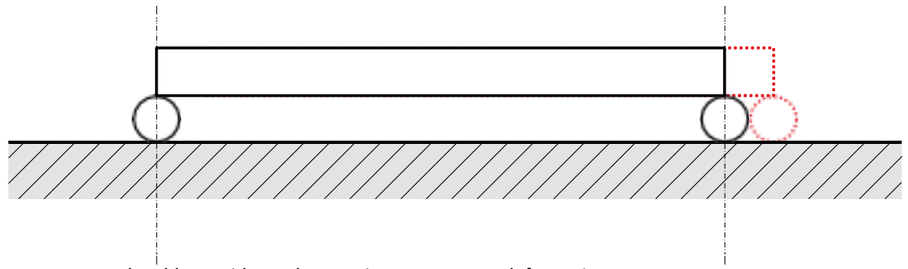


Uncontrolled expansion can lead to irreversible deformation, huge displacements, improper load redistribution and ultimately to chain reactions causing pipe collapse.

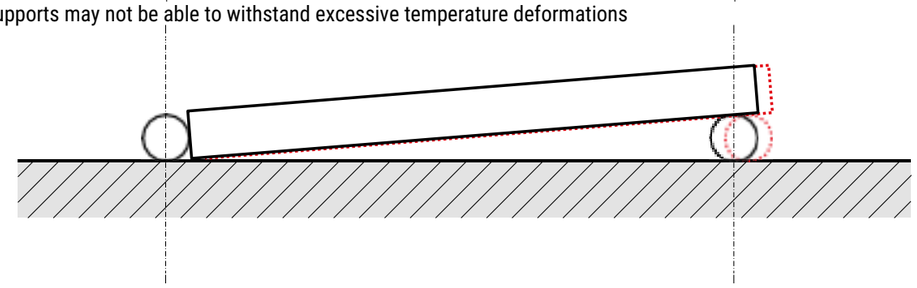
UNCONTROLLED EXPANSION - IMPACT ON SUPPORTS AND BUILDING STRUCTURES

What can happen in the event of uncontrolled expansion – the impact of expansion on pipe supports:

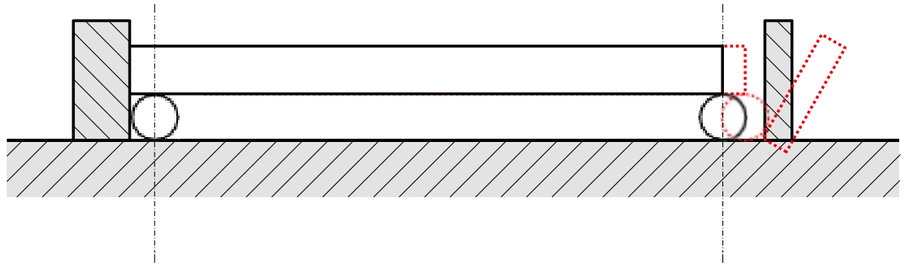
- With minor deformations, the structures can withstand movements without collapse



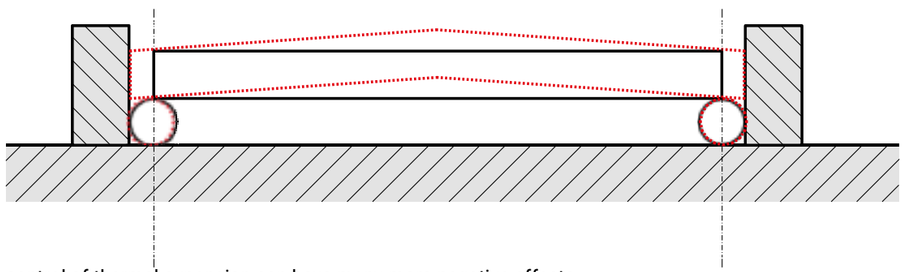
- Some supports may not be able to withstand excessive temperature deformations



- An expanding pipeline may exert pressure against the surrounding structure, which is not designed to carry these loads.



- The expanding pipeline exerts pressure between two rigid structures, thereby subjecting it to inner stress, possibly leading to breakage.



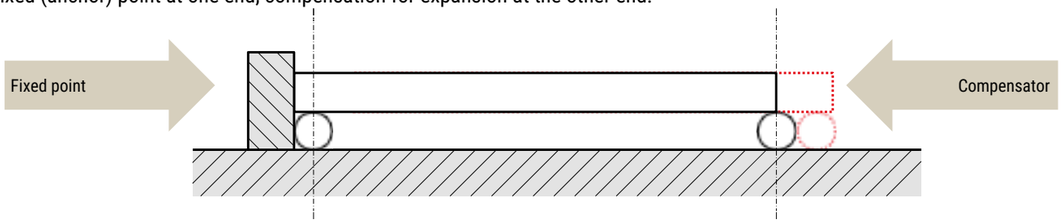
Ignoring the control of thermal expansion can have many more negative effects.

EXPANSION CONTROL

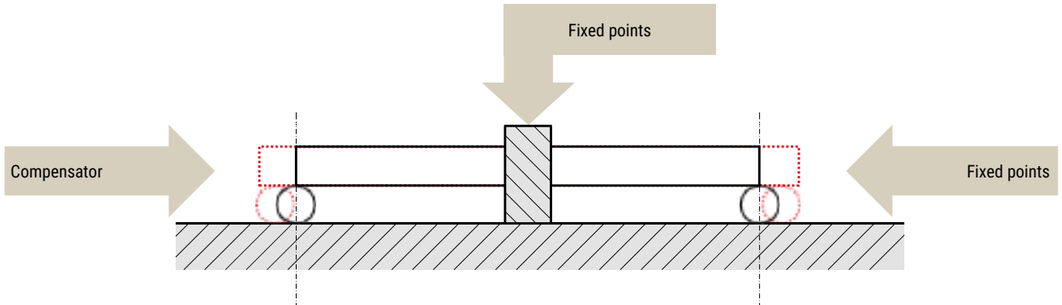
METHODS USED TO CONTROL EXPANSION METHODS USED TO CONTROL EXPANSION

The impact of expansion can be predicted and calculated. For this purpose, fixed (anchor) points and compensators are used.

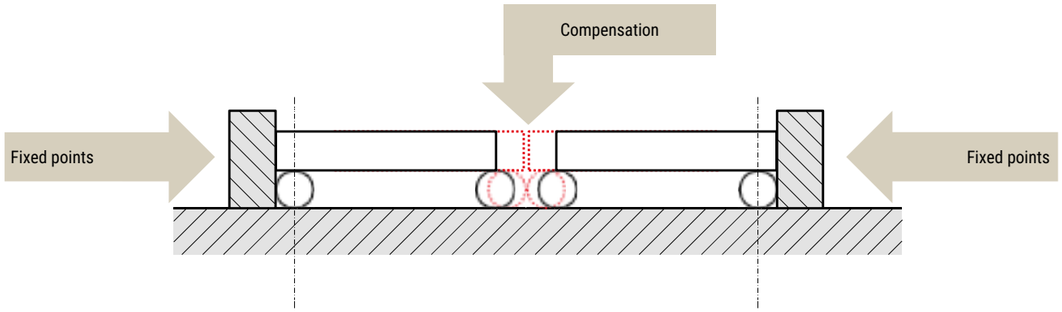
- Fixed (anchor) point at one end, compensation for expansion at the other end.



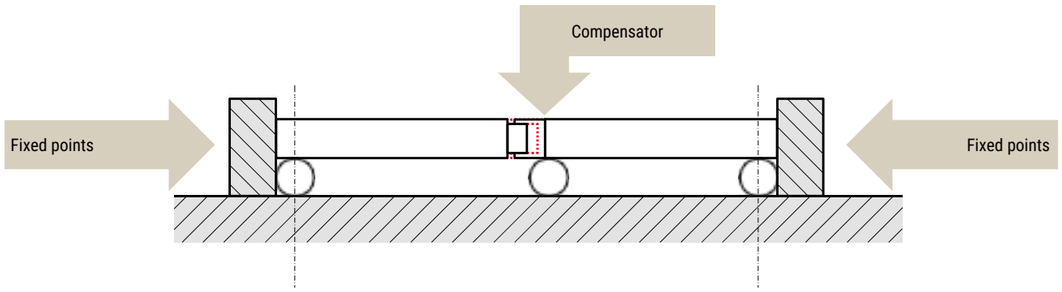
- Fixed (anchor) point in the middle, compensation for expansion at both ends.



- Fixed (anchor) points at the ends and space designed to provide compensation for expansion somewhere in between.



- Fixed (anchor) points at the ends and an axial compensation somewhere in between.

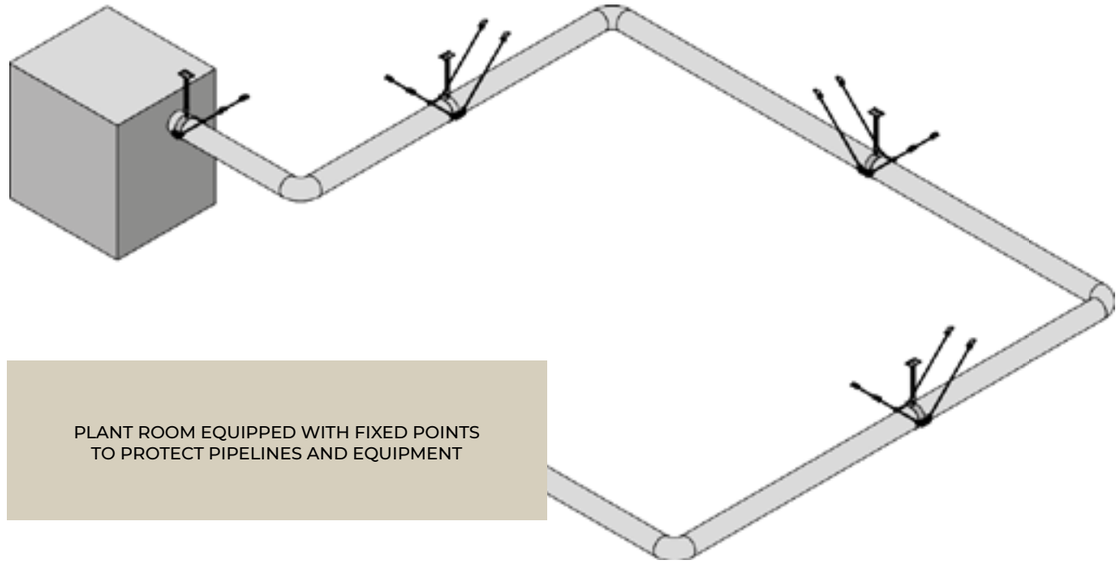


A system for controlling expansion always consists of a set of fixed points and compensator.

EXPANSION CONTROL

FIXED POINTS – PLACEMENT

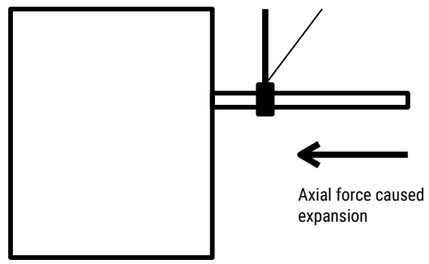
Generally, a good starting point is the following basic rule: For every straight section of pipe with a diameter of 50 mm or more and a length of 10 m or more, expansion should be controlled by a fixed point in the middle of the run.



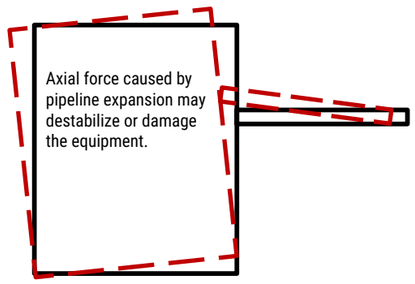
PLANT ROOM EQUIPPED WITH FIXED POINTS TO PROTECT PIPELINES AND EQUIPMENT

Some plant room equipment may be subject to a risk of destabilization or damage by pipe axial forces. Therefore, in some cases it is required to install a fixed point near the equipment.

PLANT ROOM EQUIPMEN WITH FIXED POINT PROTECTION



PLANT ROOM EQUIPMENT WITHOUT FIXED POINT PROTECTION



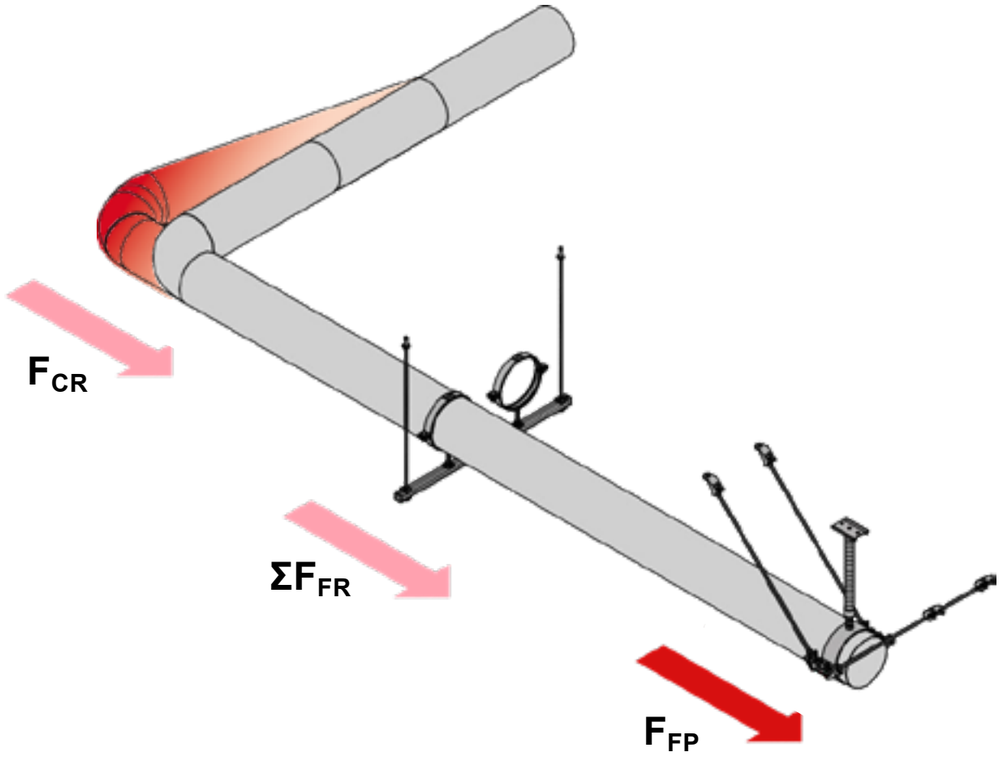
EXPANSION CONTROL

THE BASIC FUNCTION OF A FIXED POINT IS TO ANCHOR THE PIPE IN A PLACE WHERE LOAD GENERATED AT FIXED POINT BY THE COMPENSATOR THE BUILDING STRUCTURE IS DESIGNED TO CARRY LOADS GENERATED BY EXPANSION AND TO THUS ENSURE ZERO MOVEMENT OF THE PIPE. THIS CONTROL OF THE PIPE WILL GENERATE CERTAIN LOADS DUE TO FSR – LOAD GENERATED BY SPRING RATE OF THE COMPENSATOR SEVERAL FACTORS, DEPENDING ON THE TYPE OF COMPENSATION USED:

Loads generated at a fixed point by natural compensation:

F_{CR} – Resistance to compensation (L-shaped, U-bend)

ΣF_{FR} – Friction (resistance) at all pipe supports



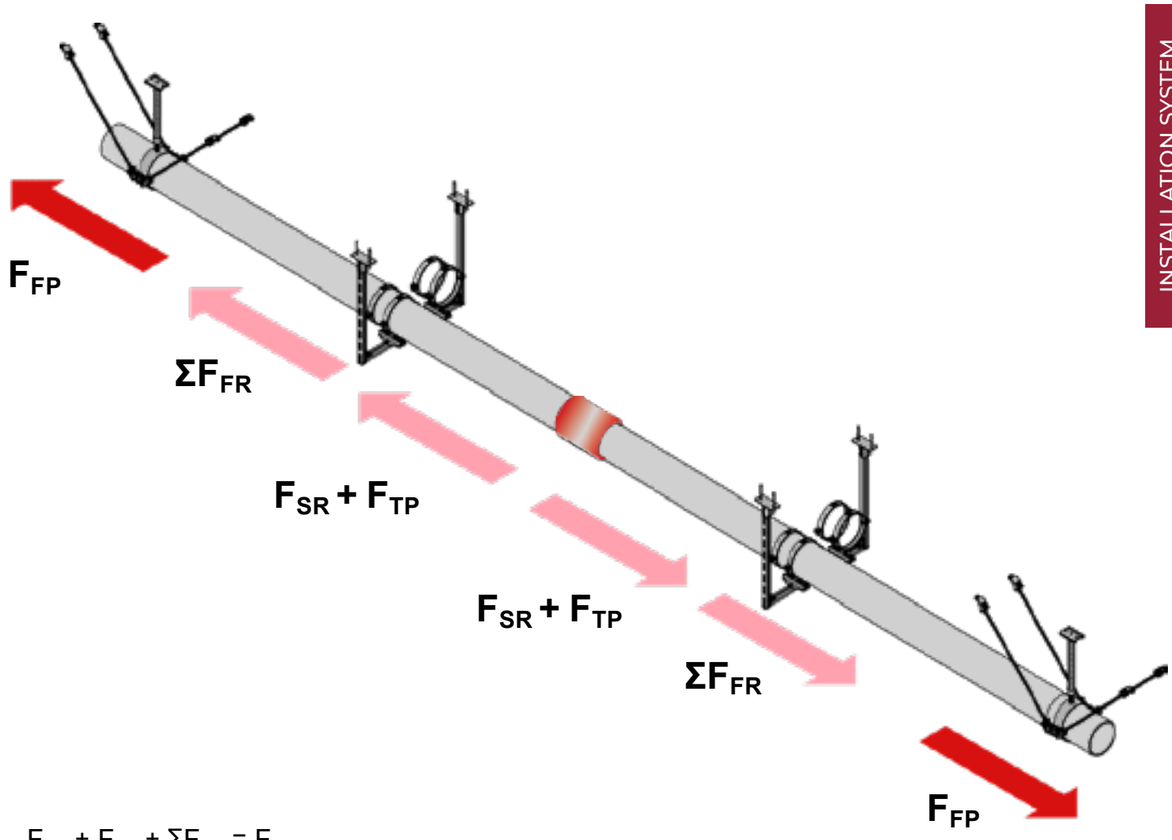
$F_{CR} + \Sigma F_{FR} = F_{FP}$

Loads generated at a fixed point by axial (bellows) compensation:

F_{SR} – Load generated by spring rate of the expansion joint

F_{TP} – Media pipe pressure

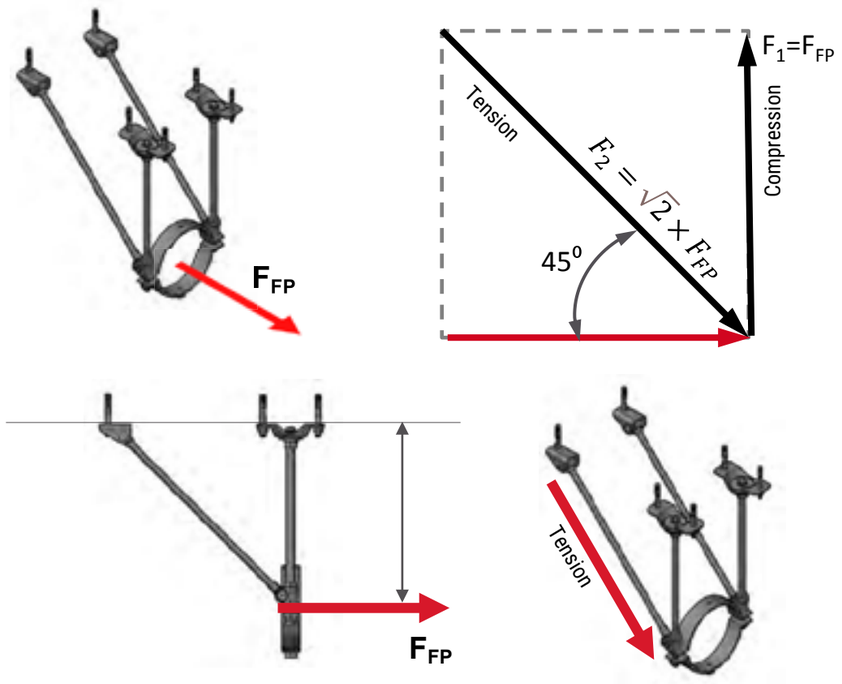
ΣF_{FR} – Sum of friction forces in sliders (guiding supports) on the design section



$F_{SR} + F_{TP} + \Sigma F_{FR} = F_{FP}$

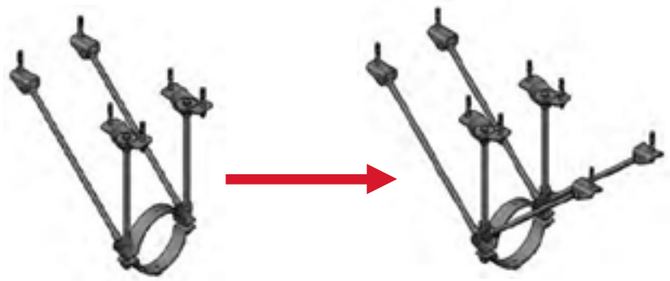
PRINCIPLES OF LOAD TRANSFER FROM THE FIXED POINT

Most of the UTECH fixed point sets work on the stand and brace principle, thereby splitting the load into two parts on a triangular principle.



Brace in UTECH fixed point sets are made from M16 threaded rods. The threaded rod must be subjected to tension only. The orientation of the brace should reflect this.

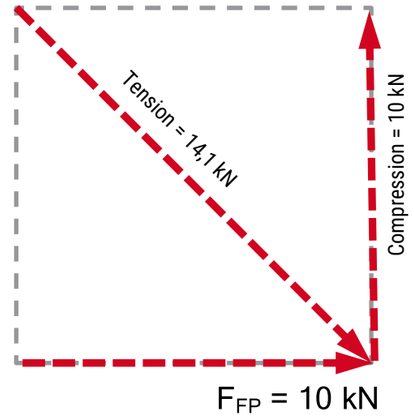
In cases where you are not sure, or the brace can be even temporarily subjected to opposite loads (when the system is heating up or cooling down), we recommend that braces are fitted on both sides.

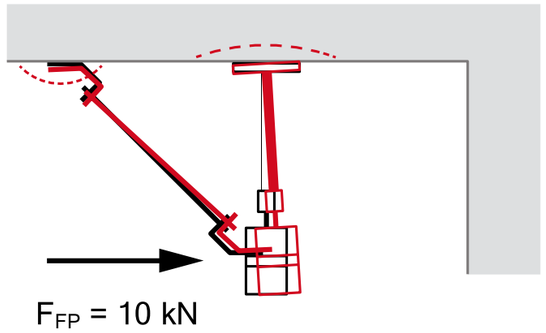


FIXED POINT AND BUILDING STRUCTURES

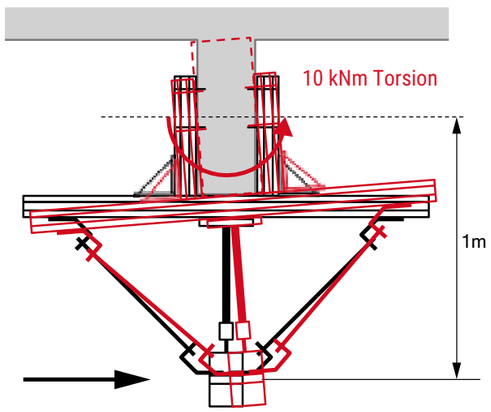
PLACEMENT OF FIXED POINTS SHOULD ALWAYS TAKE THE LOADING CAPACITY OF THE BUILDING STRUCTURE INTO ACCOUNT. THE STRUCTURAL ENGINEER RESPONSIBLE FOR THE STRUCTURE MUST ALWAYS BE CONSULTED ABOUT THE IMPACT OF THE FIXED POINT. THE CASES MENTIONED BELOW ARE EXAMPLES OF SITUATIONS THAT COULD PRESENT A RISK TO THE STABILITY OF THE BUILDING STRUCTURE OR ANY OTHER SUB-STRUCTURES.

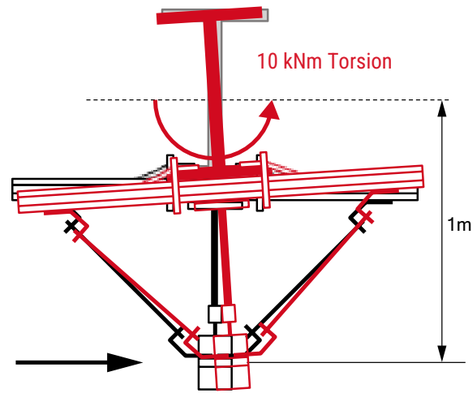
Placement of fixed points should always take the loading capacity of the building structure into account. The structural engineer responsible for the structure must always be consulted about the impact of the fixed point. The cases mentioned below are examples of situations that could present a risk to the stability of the building structure or any other sub-structures.





10 kN may exceed the spot loading capacity of a concrete slab and the loads acting in this way may pull out the entire anchor.





Load transfer to the girder may subject it to torsion or other mechanisms that could impact its stability or lead to its collapse.

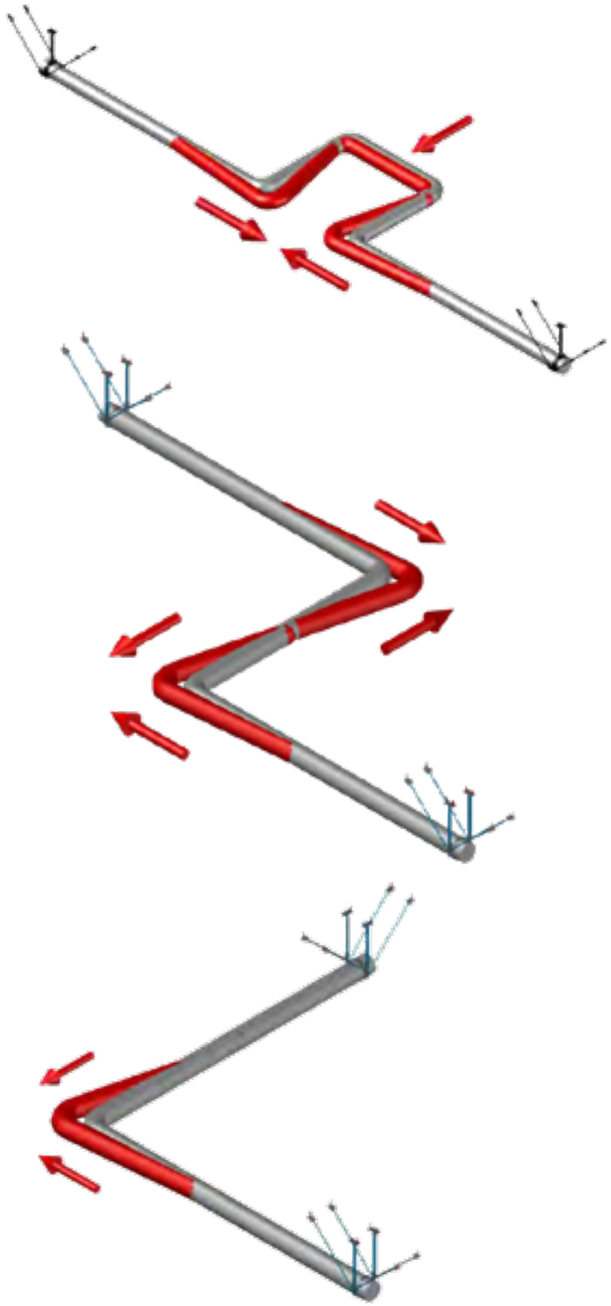
COMPENSATORS

Fixed points and compensators divide the pipeline into small sections, reducing the forces on fixed points and building structures and making movements controllable.

TYPES OF NATURAL COMPENSATORS

Natural compensators appear at a pipe turn

U – BEND



Z – BEND

L – BEND

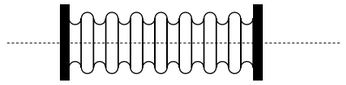
TYPES OF AXIAL COMPENSATORS

An axial compensator is a device that uses a flexible element (bellows) to compensate for deformations occurring during pipeline operation. It is designed to compensate for thermal expansion, prevent pipe fracture, and compensate for misalignment.

Important notice The expansion joint supplier must be consulted about placement of fixed points and the accommodation of expansion. His instructions regarding design and installation must be strictly followed.

AXIAL COMPENSATORS

They are designed to compensate for the thermal expansion of the pipeline. They work due to the movement of the bellows in the axial direction and are used in pipeline systems of various lengths and purposes. These compensators are popular due to their simplicity, reliability, and lack of maintenance.



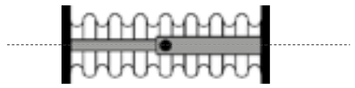
AXIAL COMPENSATORS AND FIXED POINTS

ANGULAR COMPENSATORS

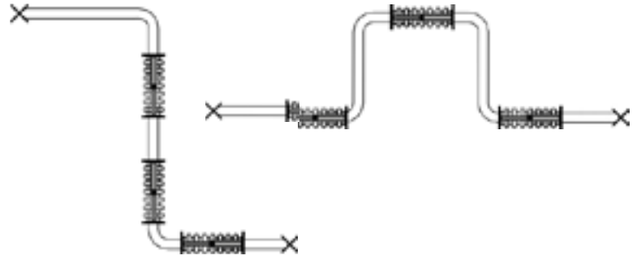
Angular compensators are installed on pipelines with elbows in different planes. They stabilise the system by compensating for changes in pipeline length caused by temperature fluctuations and media movement.

Types of angular compensators:

1. Planar – one axis of rotation
2. Spatial – gimbal



ANGULAR COMPENSATORS AND FIXED POINTS

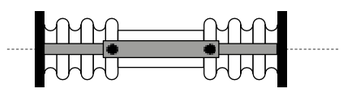


LATERAL COMPENSATORS

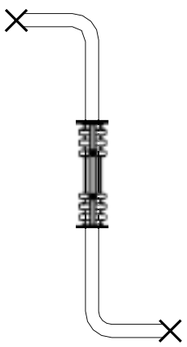
Lateral compensators are used on long sections of pipelines where slight misalignment of the pipe occurs due to the large number of elements and the impossibility of perfect installation. These compensators allow the spigots to be shifted in different planes while their axes are parallel due to the deformation of the bellows.

Types of transverse compensators:

1. Planar – one axis of rotation with own control of pipe pressure
2. Spatial (circular) – multidirectional with own control of pipe pressure able to absorb multidirectional lateral movement



LATERAL COMPENSATORS AND FIXED POINTS



INSTALLATION SYSTEM
UTECH

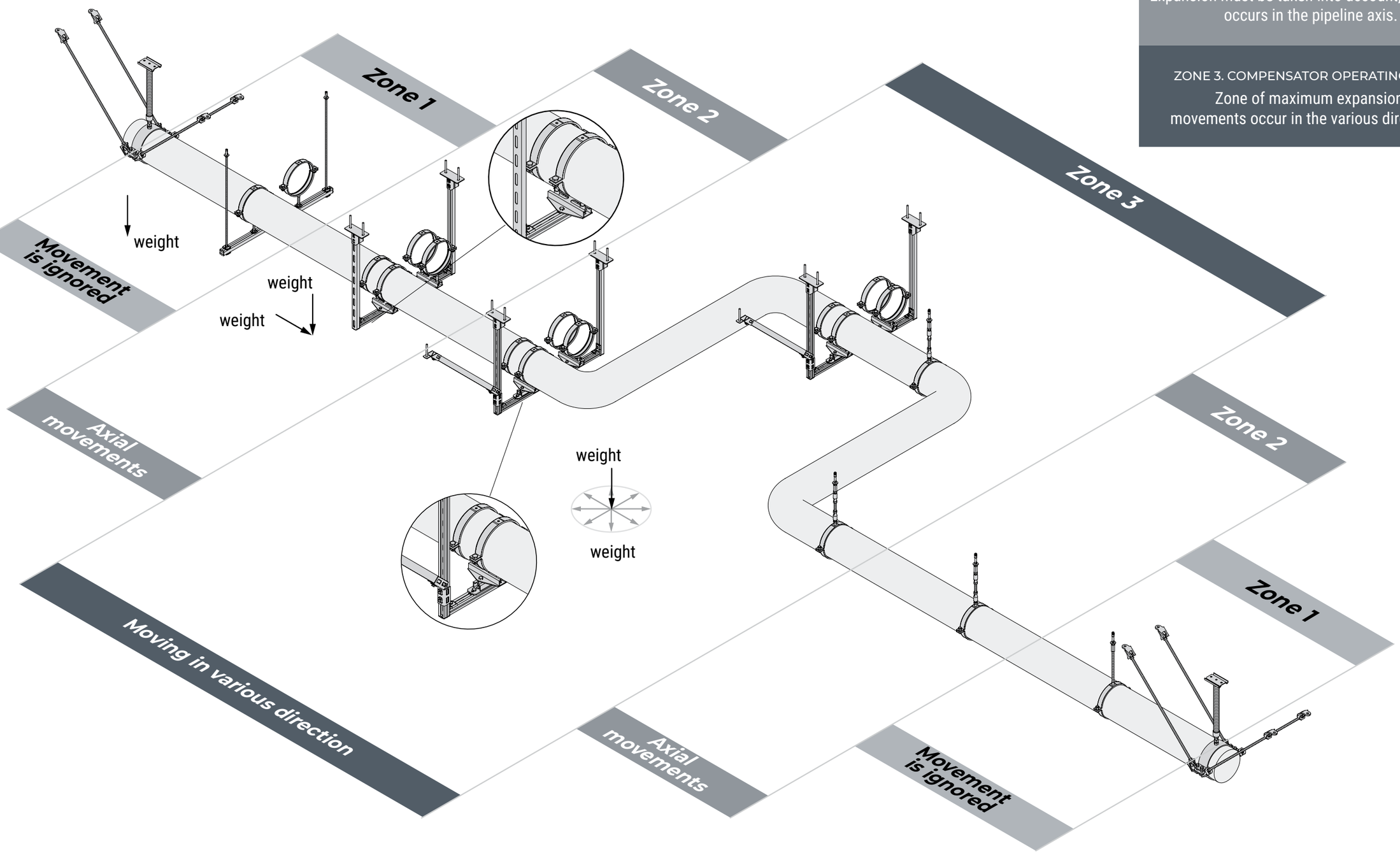
ZONES AND TYPICAL PIPELINE SUPPORTS

HORIZONTAL SECTIONS WITH NATURAL COMPENSATORS

ZONE 1. QUIET ZONE
The zone where the expansion is insignificant, immediately after the fixed point.

ZONE 2. EXPANSION ZONE
Expansion must be taken into account; expansion occurs in the pipeline axis.

ZONE 3. COMPENSATOR OPERATING ZONE
Zone of maximum expansion, movements occur in the various directions.



INSTALLATION SYSTEM

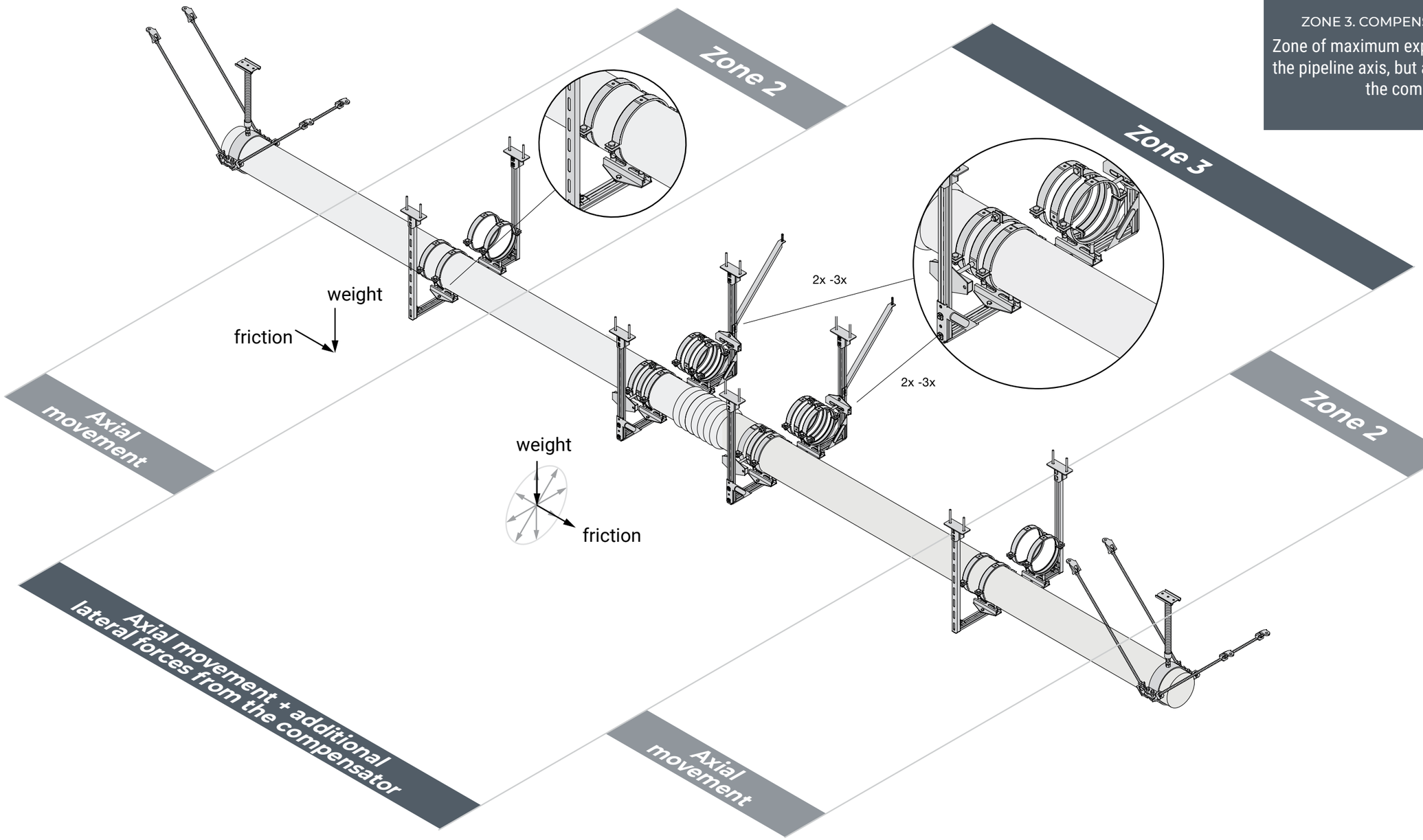
ZONES AND TYPICAL PIPELINE SUPPORTS

HORIZONTAL SECTIONS WITH AXIAL COMPENSATORS

ZONE 1. QUIET ZONE
Not available for pipelines with axial compensators.

ZONE 2. EXPANSION ZONE
Expansion must be taken into account; expansion occurs in the pipeline axis.

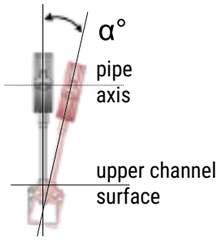
ZONE 3. COMPENSATOR OPERATING ZONE
Zone of maximum expansion, movement occurs in the pipeline axis, but additional lateral forces from the compensator occur.



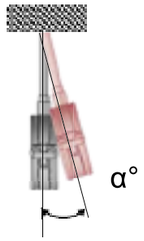
PIPE SUPPORTS

PIPE RUNS CAN BE DIVIDED INTO ZONES ACCORDING TO THE IMPACT OF EXPANSION ON THE PIPE SUPPORTS. THE ZONES ARE DEFINED DIFFERENTLY FOR PIPES ON STANDING SUPPORTS AND FOR SUSPENDED PIPES. THE MAIN FACTORS ARE EXPANSION ALONG THE PIPE AXIS AND DISTANCE FROM THE UPPER SURFACE OF THE CHANNEL (IN THE CASE OF PIPES ON STANDING SUPPORTS) AND EXPANSION ALONG THE PIPE AXIS AND DISTANCE FROM THE UNDERSIDE OF THE SUPPORTING STRUCTURE (IN THE CASE OF SUSPENDED PIPES).

SUPPORTED PIPES

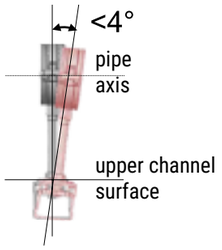


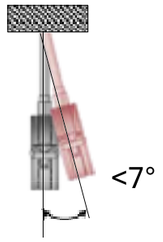
HANGED PIPES



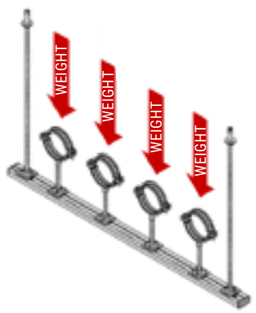
QUIET ZONE:

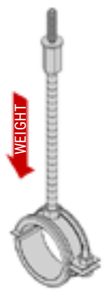
At this pipe zone the impact of expansion is negligible – no special measures arerequired.





The pipe supports must be designed to take up the vertical load resulting from the weight of the pipe section

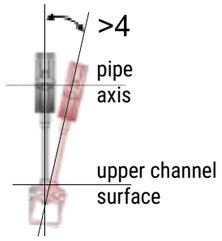




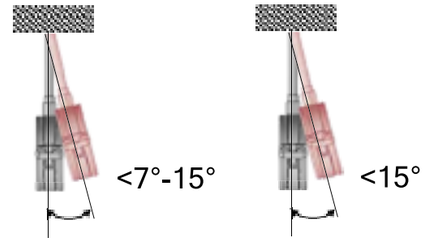
EXPANSION ZONE:

This is the zone in which expansion begins to have an impact in axial direction. Traditional methods of pipe installation begin to run out of options and use of special expansion elements becomes necessary. Ignoring expansion would result in torque moment in channels, significant displacement of threaded rods and irreversible deformation of several parts. All of these impacts could lead to a chain reaction and, in extreme cases, to collapse of the pipe support system.

SUPPORTED PIPES

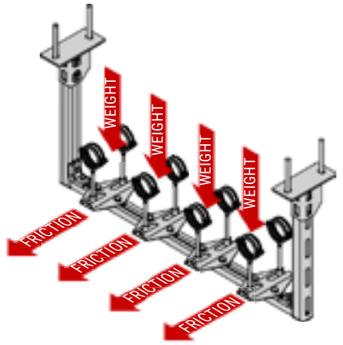


HANGED PIPES

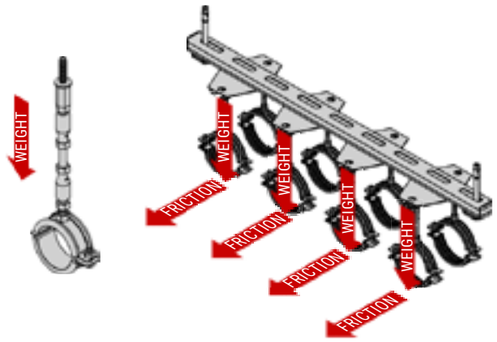


In the expansion zone it is necessary to make use of expansion elements that properly distribute expansion forces to the supporting structure. The pipe support must be designed according the loading scheme:

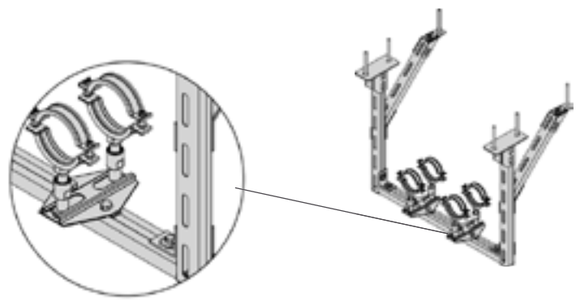
SWING HANGER



SLIDING ELEMETNTS



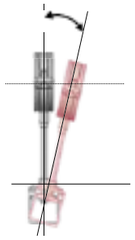
MOUNTING WITH LONGITUDINAL STRUTS
IN THE PIPE AXIS



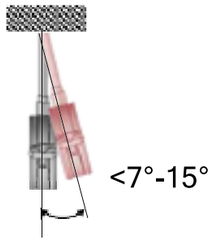
COMPENSATION ZONE:

In this zone, the expansion impact meets natural compensation achieved by the spring effect (resistance) of the system. Compensation tends to comprise movement in several directions during the heating-up or cooling-down phases. The pipe supports must therefore allow all of these movements and be able to transfer the loads properly to the supporting building structure.

SUPPORTED PIPES

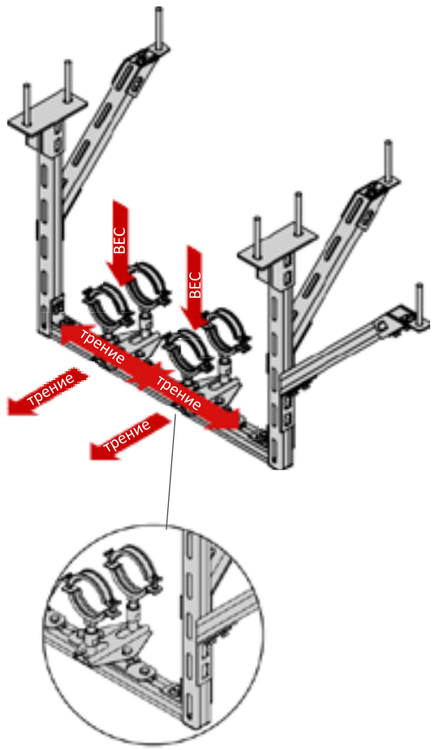


HANGED PIPES

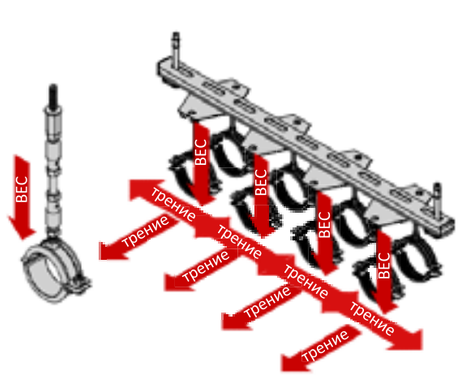


Elements that allow the pipe to move in two perpendicular planes must be used in the compensation zone. The pipe support must be designed according to the loading scheme:

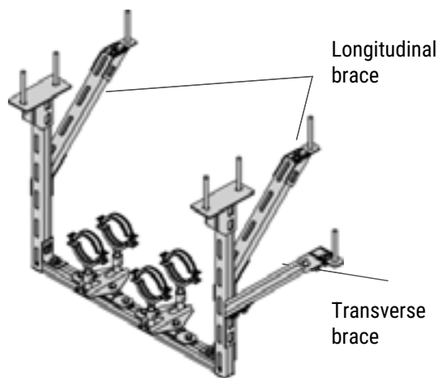
HINGED SUSPENSION



SLIDING ELEMENTS

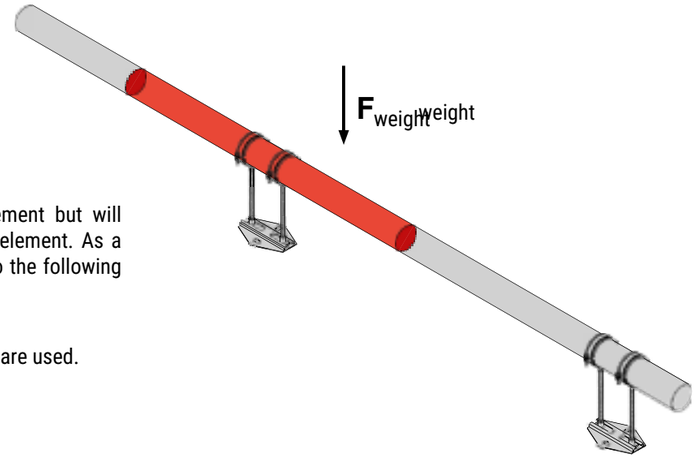


MOUNTING WITH BRACES



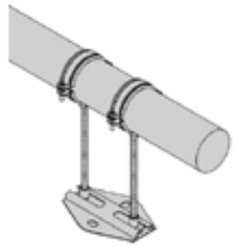
FRICTION

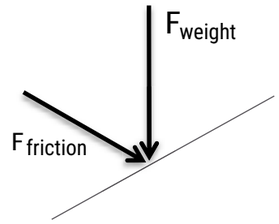
F_{weight} = weight of filled pipe x length of load
$F_{friction} = F_{weight} \times \mu$
μ = coefficient of friction of the roller or slider



Every expansion element will allow pipe movement but will generate horizontal force due to friction in the element. As a consequence, the pipe supports are subjected to the following loads:

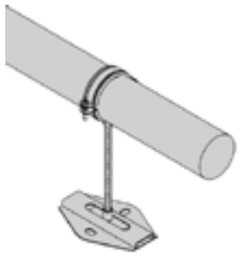
Two loads where double sliding/rolling elements are used.

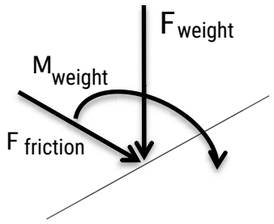




The use of a sliding element with two pipe attachment points creates a rigid structure that prevents torque from occurring.

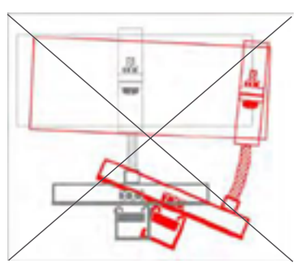
The use of a sliding element with one fixing point, the weight of the pipe generates torque

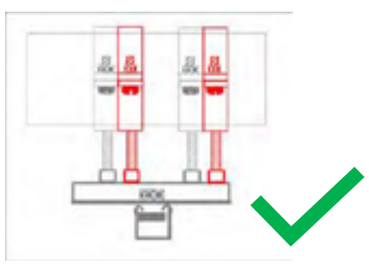




When using a sliding element with a single fixing, the support structure is subjected to torque due to the eccentricity caused by the sliding connection to the pipe clamp.

RECOMMENDATION:
Always use double sliding/rolling elements for open-section MT profiles.



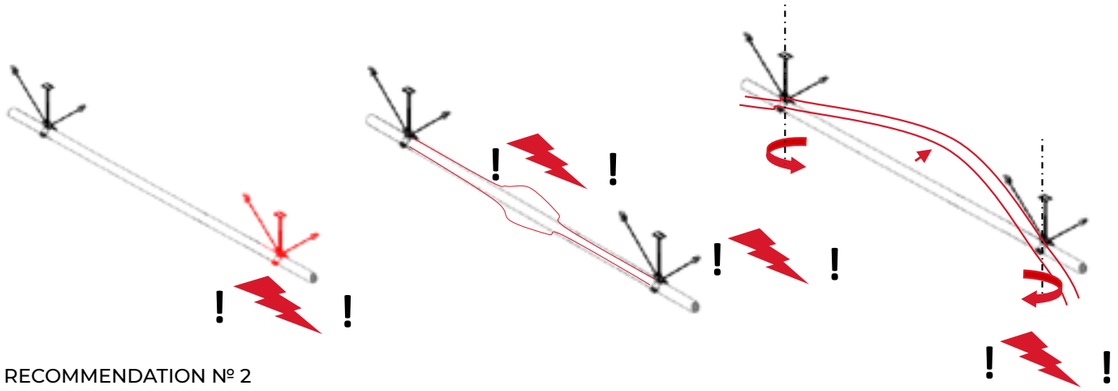


RECOMMENDATIONS FOR FIXED POINTS IN SECTIONS WITH NATURAL COMPENSATORS

RULES TO FOLLOW FOR SAFE DESIGN AND CONTROL OF THE EXPANSION

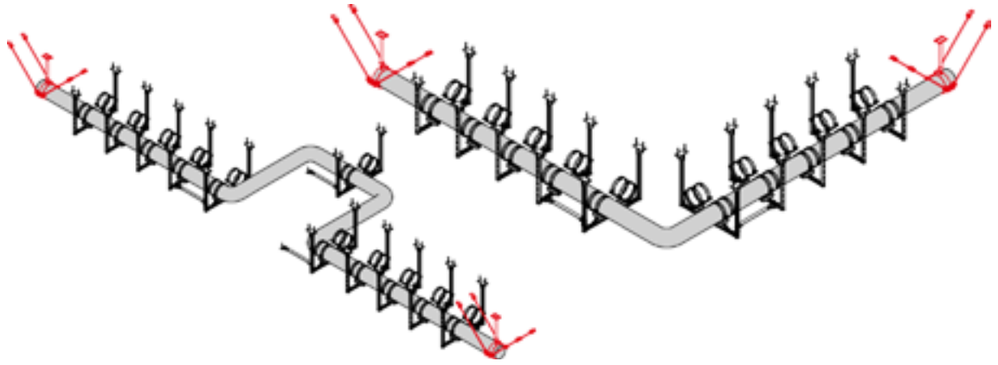
RECOMMENDATION №. 1

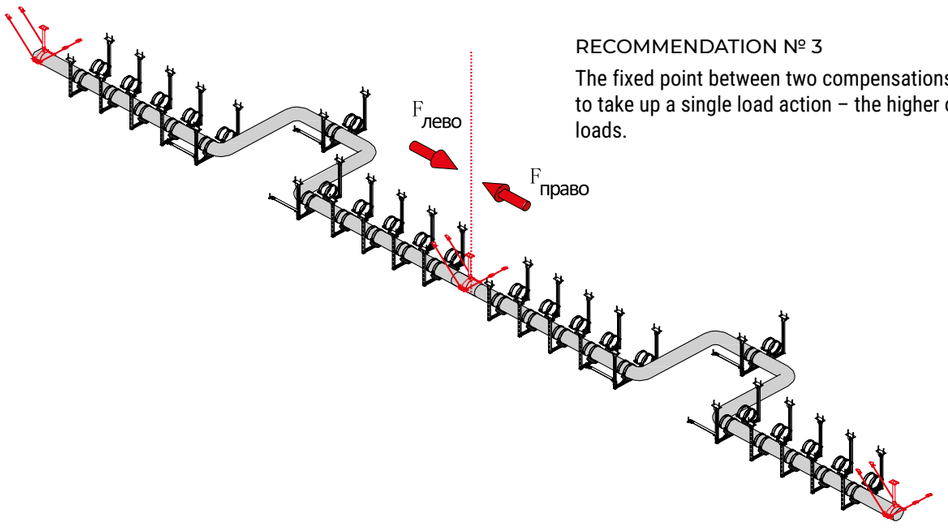
Never two fixed points on the same pipe without compensation between.



RECOMMENDATION № 2

Every compensation must be accompanied by one fixed point on each side.





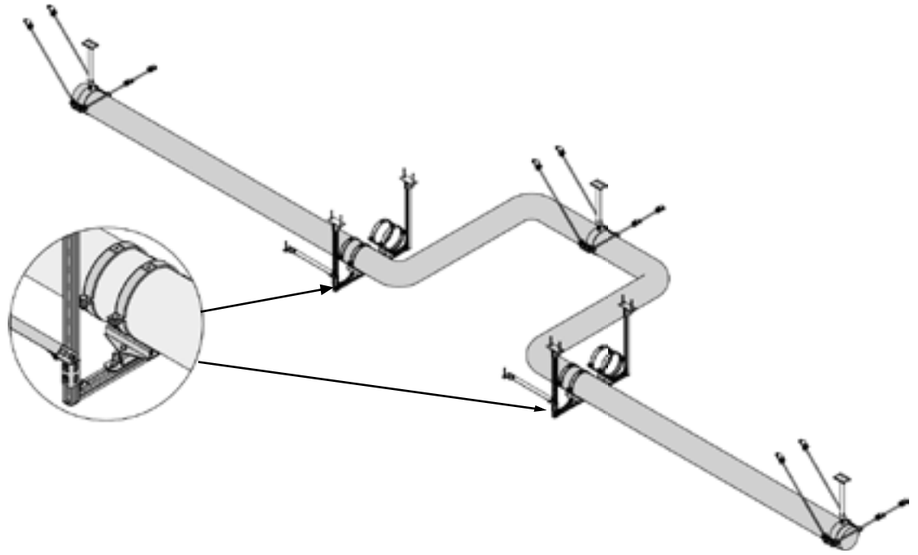
RECOMMENDATION № 3

The fixed point between two compensations must be designed to take up a single load action – the higher of the two potential loads.

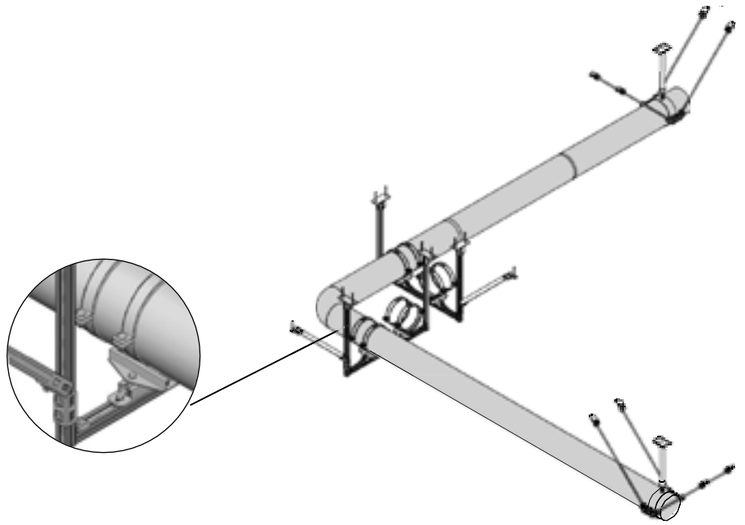
SPECIAL CASES FOR PIPES WITH NATURAL COMPENSATORS

Mainly in the industrial segment, the preferred method of achieving even more control of expansion involves placement of a fixed point at the U-bend arm.

The only difference here is that the last support and all supports up to the point of zero rotation must have cross sliding/rolling elements to allow lateral compensation.



In situations where the pipe support has to be placed very close to the elbow (between the point of zero rotation and the elbow) due to exceeding the max. spacing or loading capacity limits, the pipe supports must allow multidirectional movement and the entire frame structure must be designed to carry these vertical, axial and lateral loads. Cross sliding elements with sufficient traveling capacity must be used.

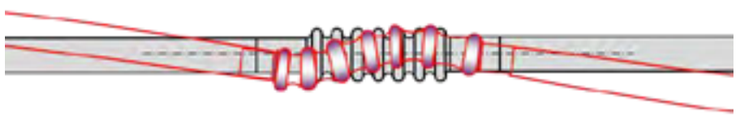


AXIAL COMPENSATORS

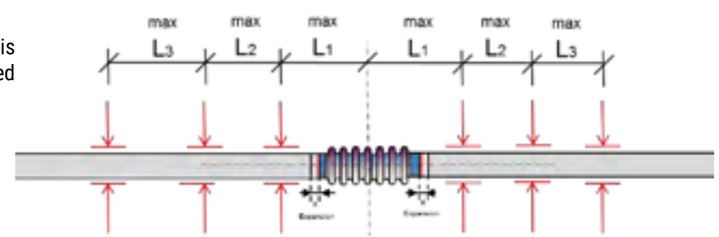
COMPENSATION ZONE:

In this zone, the expansion impact meets technical compensation and its resistance. Technical compensation (axial) behaves like a spring under pressure. This leads to unpredictability regarding the direction of the spring-back effect. An uncontrolled springback effect would lead to irreversible deformation of the expansion joint and would subject the pipe supports to unpredictable loads in unpredictable directions. The expansion joint must therefore be controlled by fitting suitably engineered axial guides at exactly the required distance from the expansion joint and at both sides of the joint.

Uncontrolled expansion leads to irreversible deformation and in many cases to collapse of the pipe system.

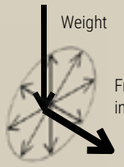


The way to control the technical compensation is to place correctly designed axial guides placed at the required distances.

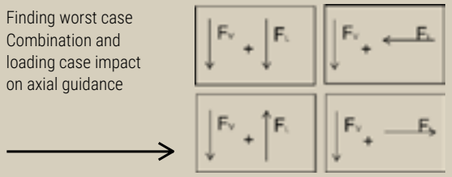


Loading scheme

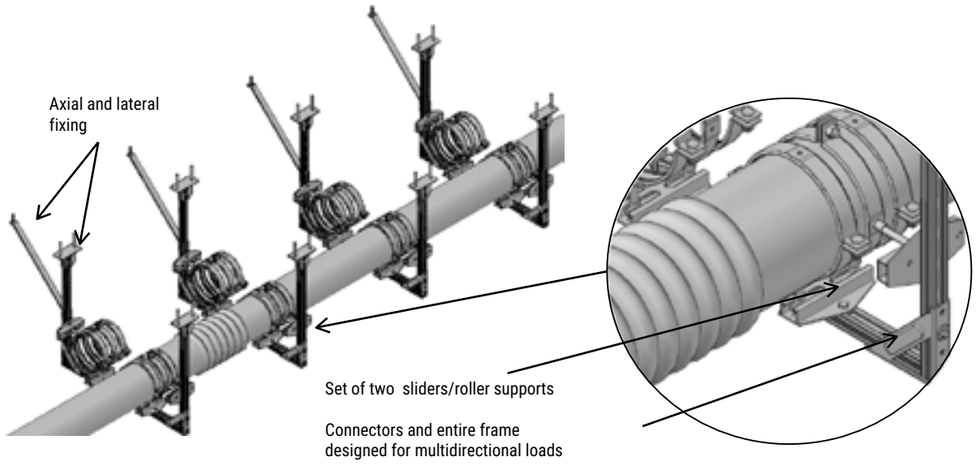
Resistance to deformation



Finding worst case Combination and loading case impact on axial guidance



The guiding supports are solutions that limit the pipe movements in two perpendicular planes. Depending on the recommendations of the compensator manufacturer, such fixed points shall be placed at the required distance on both sides of the compensator.

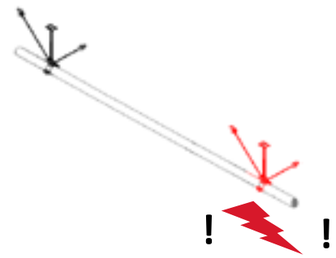


RECOMMENDATIONS FOR FIXED POINTS IN SECTIONS WITH AXIAL COMPENSATORS

Rules to follow for safe design and control of the expansion

RECOMMENDATION №. 1

Never use two fixing points on the same pipe without an compensator between them.



RECOMMENDATION №. 2

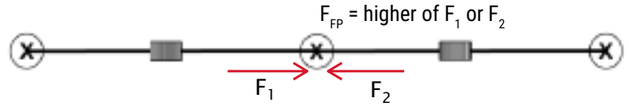
Every compensation must be accompanied by two fixed points – one on each side.

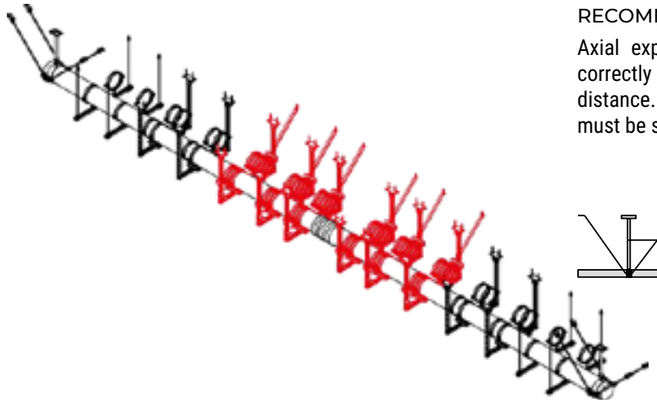
RECOMMENDATION №. 3

Every fixed point must be braced on both sides.

RECOMMENDATION №. 4

The fixed point between two compensations must be designed to take up a single load action – the higher of the two potential loads.





RECOMMENDATION №. 5

Axial expansion must be accommodated by *two or three correctly engineered axial guides on both sides at the proper distance. The instructions of the compensator manufacturer must be strictly observed.