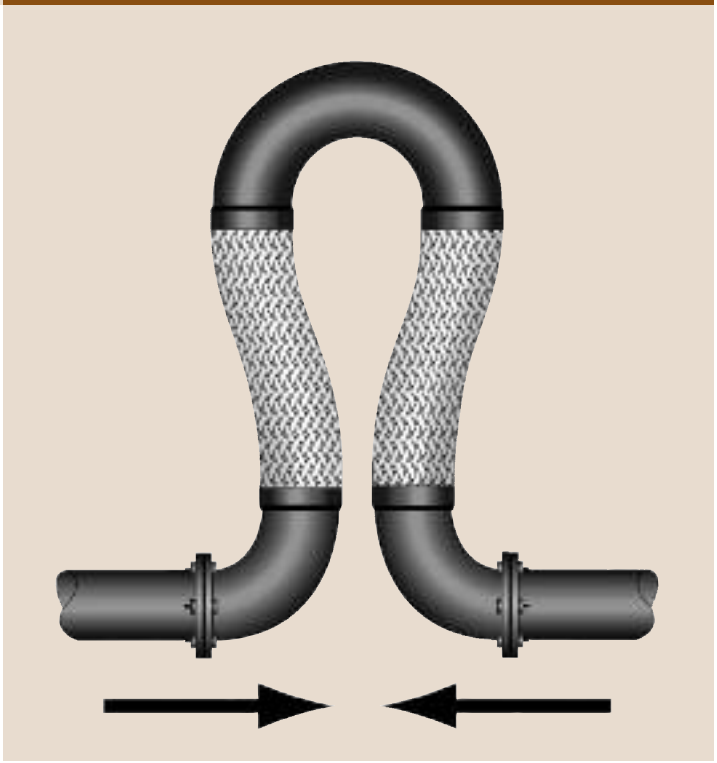
HOW THE METRALOOP WORKS

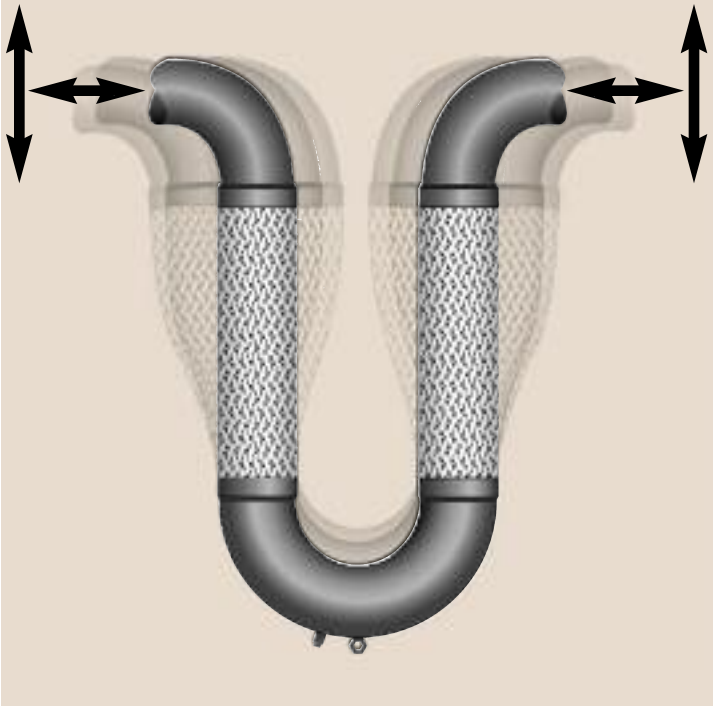
THERMAL EXPANSION: AXIAL MOVEMENT



THERMAL EXPANSION:

The MetraLoop is simply a flexible variation of the tradition hard pipe loop. For any given length of pipe and given temperature change, the amount of movement can be calculated and the appropriate MetraLoop can be designed. When installed in a pipe run the MetraLoop's legs simply bend laterally to compensate for the pipe's expansion or contraction. Unique to the loop is the incredibly low amount of force required to bend its legs, minimizing anchor loads, guiding and installation costs.

SEISMIC MOVEMENT: ALL DIRECTIONAL



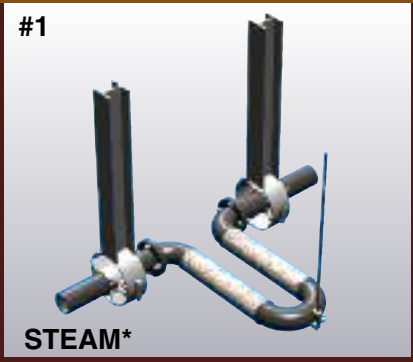
SEISMIC MOVEMENT:

The two flexible legs connected by an unrestrained return bend, will allow a predetermined amount of pipe movement in any direction. (Typical design movement is ±4 inches in any direction, however movement of several feet in any direction is possible). With the loops extreme flexibility and low force to move, the loop absorbs the seismic energy and imposes minimal loads on the adjacent pipe hangers, supports or nozzle loads on major equipment. See page 11 for more details.

TYPICAL INSTALLATIONS

Illustrated below are the typical orientations for the MetraLoop. No support is required for the 180° return bend for standard loops 2-1/2" diameter and smaller. However due to the weight of the return bend and the extreme flexibility of the loop, larger sizes require support to prevent the 180 from sagging in all orientations except when installed hanging down as shown in illustration #2. Guides are recommended but not always required see bottom of page 6 for more details. **Special Note** - For steam service minimizing the entrapment of condensate is crucial and loops should be installed as shown in illustration #1. Detailed installation considerations are noted on the following pages.

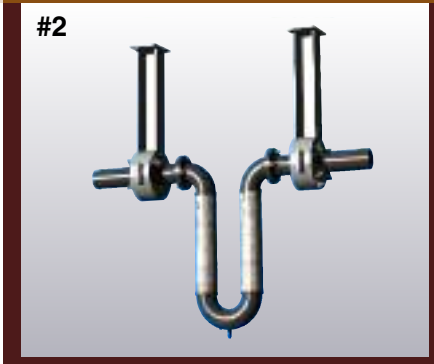
METRALOOP™ HORIZONTAL
– HORIZONTAL RUN –



SUPPORT MUST BE PROVIDED TO PREVENT THE LOOP FROM DROOPING OR TORQUING PIPE. SUPPORT MUST ALLOW THE 180° RETURN, TO MOVE HORIZONTALLY BACK AND FORTH 1/4", AS THE LOOP FLEXES.

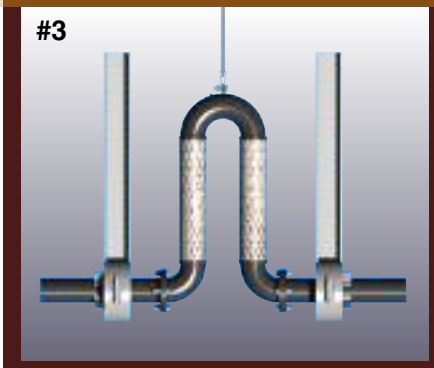
*RECOMMENDED INSTALLATION FOR STEAM. ANY OTHER ORIENTATION MAY CAUSE CONDENSATE TO COLLECT.

METRALOOP™ HANGING DOWN
– HORIZONTAL RUN –



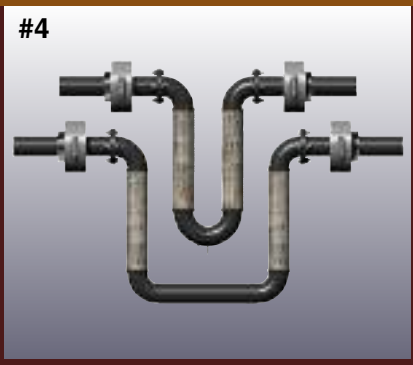
LOOP SHOULD HANG STRAIGHT DOWN AND BE FREE TO FLEX.

METRALOOP™ STRAIGHT UP
– HORIZONTAL RUN –



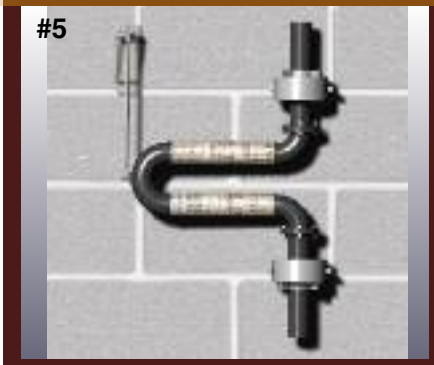
SUPPORT MUST BE PROVIDED TO PREVENT THE LOOP FROM LEANING. PIPE HANGER ROD SHOULD BE LOOSE ENOUGH TO ALLOW THE 180° RETURN TO MOVE UP OR DOWN, OR BACK AND FORTH, AS THE LOOP FLEXES.

METRALOOP™
– NESTED –



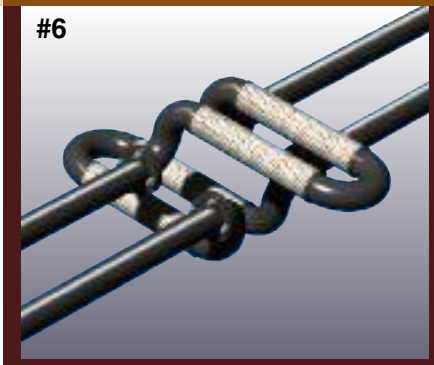
FOR TIGHT PIPE RUNS, ANY SIZE OR NUMBER OF LOOPS CAN BE DESIGNED TO NEST INSIDE ONE ANOTHER. TO ORDER, SPECIFY SEQUENCE OF PIPE DIAMETERS AND CORRESPONDING DISTANCES BETWEEN PIPE CENTERLINES.

METRALOOP™
– VERTICAL RUN –



LOOP MUST BE SUPPORTED TO ALLOW THE 180° RETURN TO MOVE HORIZONTALLY BACK AND FORTH, AND UP OR DOWN, AS THE LOOP FLEXES.

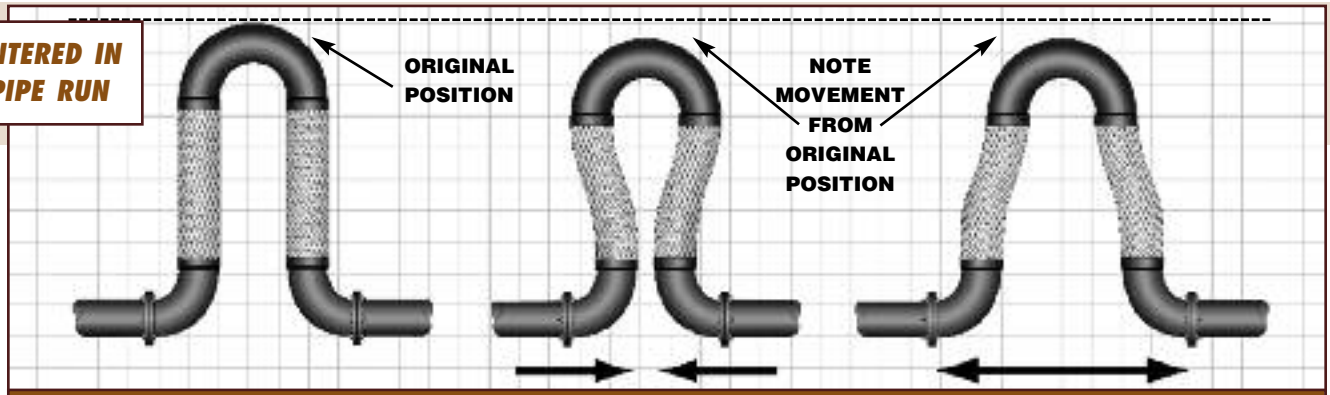
METRALOOP™
– OVER/UNDER –



THE METRALOOP EXPANSION LOOP CAN BE MANUFACTURED IN THIS CONFIGURATION TO BE AS COMPACT AS POSSIBLE. MULTIPLE OVER-UNDER LOOPS CAN ALSO BE INSTALLED IN NESTED CLUSTERS TO FURTHER TAKE ADVANTAGE OF THIS COMPACT ARRANGEMENT.

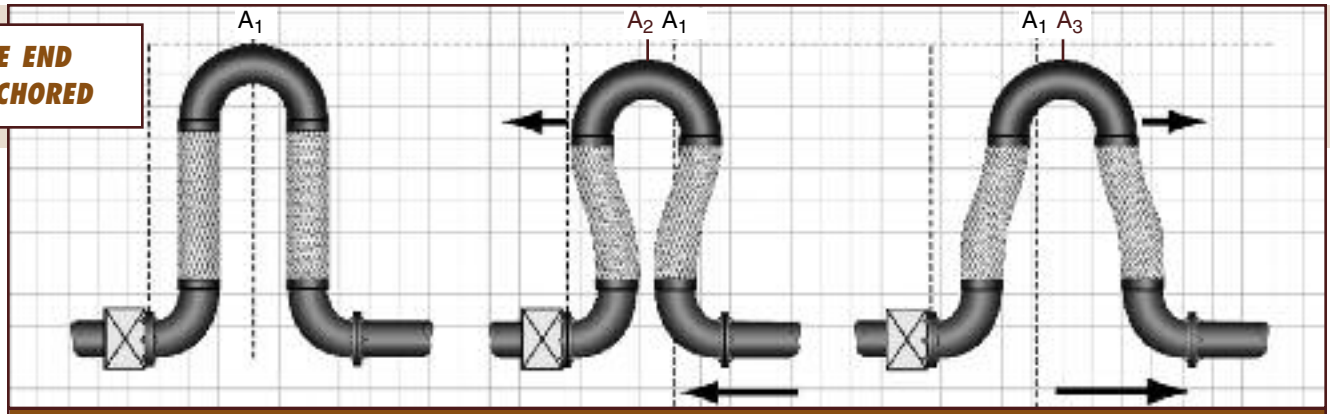
INSTALLATION/GUIDING CONSIDERATIONS

CENTERED IN A PIPE RUN



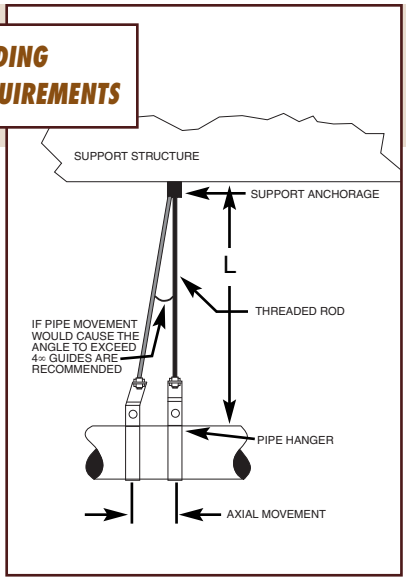
Centered in a pipe run: when the loop is installed in the middle of a pipe run, the loop will flex symmetrically and the 180 will move toward and away from the pipe. The 180 support should be designed with enough slack to allow the 180 to move 10% of the loops designed movement. For example a loop designed for ± 4 inches of axial movement will see the 180 return bend move 4 tenths (0.4") of an inch.

ONE END ANCHORED



One end anchored: When installed at or near an anchor the 180 will have a lateral component to its movement, in addition to the movement shown above ("Centered in a pipe run"). The lateral movement will be 50% of the thermal expansion or contraction and it will be in the same direction as the pipe movement. Again a sufficiently slack hanger rod or slide support is all that is required.

GUIDING REQUIREMENTS



MINIMUM 'L' REQUIRED TO ELIMINATE GUIDES	
AXIAL MOVEMENT	ROD 'L' LENGTH
1"	14"
2"	28"
4"	57"
6"	85"

Guiding Requirements: Thermal Movement - Being the most flexible component of your piping system, the MetraLoop is the path of least resistance. And unlike other expansion joint devises, bellows, hard pipe loops, ball or slip type joints, the loop will absorb any thermal expansion before your pipe develops a tendency to bow out of position. As long as the loops design parameters are not exceeded the loop does not need guides.

However, the Mechanical Contractors Association of America "Guidelines for Quality Piping Installations" section 3 Pipe Hangers and Supports, suggests to ensure movement is directed as expected and if your piping is supported on pipe hangers that will swing more than 4 degrees from vertical when the pipe moves it is recommended that a pipe guide be installed anywhere within 15 pipe diameters on each side of the MetraLoop. Loops anchored on one side need only one guide on the traveling side.

Guiding Requirements - Seismic Movement - When spanning a buildings seismic expansion joint, guides are not required. See page 11.

APPLICATIONS

NESTED METRALOOPS:

Nested MetraLoops can be used in parallel pipe runs to keep all the expansion or seismic devices at one location. MetraLoops can be nested in any sequence, large inside of smaller diameters or small inside of large and any number of pipes can be made in a nest.

C.S.A./A.G.A. GAS LOOPS:

Selected sizes, designs and materials of construction for the MetraLoops have been tested and certified by C.S.A./A.G.A. for use on gas pipe lines. These MetraLoops are being used primarily in commercial and industrial facilities located in seismic zones to minimize the possibility of gas line ruptures. Fires caused by broken gas lines are the major cause of damage after earthquakes.

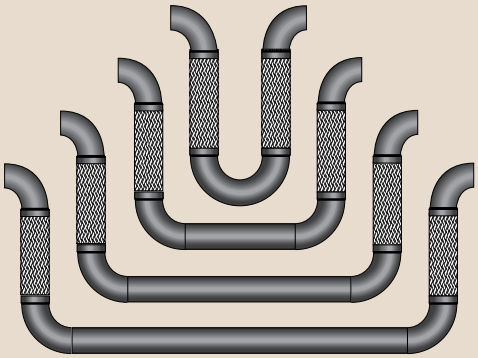
MEDICAL LOOPS:

Many healthcare facilities, especially in seismically rated areas, require flexibility in all piping systems. Optional cleaning, capping, and certifying, for all medical gas applications including medical oxygen, vacuum, and compressed air. For sealed systems, such as oxygen service, loops are supplied without drain/air release plugs. The Metraloop is accepted by the California Office of Statewide Health Planning and Development (OSHPD) for use in hospitals.

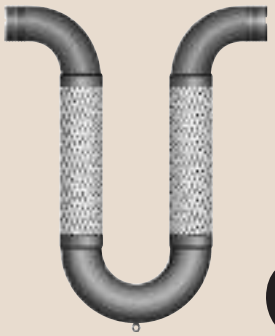
SPRINKLER SEISMIC LOOP:

Historically, seismic flexibility in fire sprinkler lines has been accomplished using a complex series of couplings. The UL listed Fireloop is a pre-tested factory warranted seismic expansion joint that is compact and can be oriented in any direction. The Fireloop meets NFPA-13 standards A-6-4.1 & 4.2 for seismic joints in fire sprinkler systems. See catalog Fireloop or www.metraflex.com for complete information.

MULTIPLE PIPE RUNS

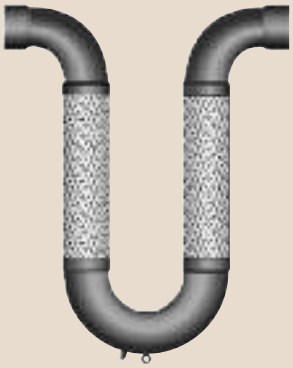


NATURAL GAS LINES

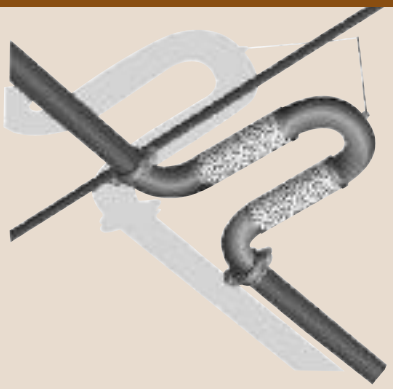


Certified by the AMERICAN GAS ASSOCIATION for use on gas pipe lines.

MEDICAL GASES



FIRE SPRINKLERS



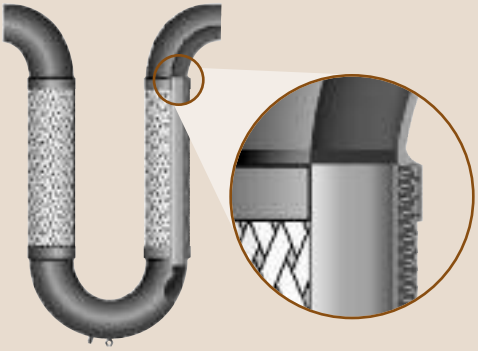
APPLICATIONS

ONE LOOP FOR TWO RUNS

CORNER LOOPS:

One Metraloop simultaneously absorbs the thermal expansion of two pipe runs. Space-saving inside corner Metraloop eliminates the need for an anchor at the corner. Support must be provided to prevent Metraloop from drooping or torquing pipe and must allow for sufficient movement.

HI VELOCITY SYSTEMS

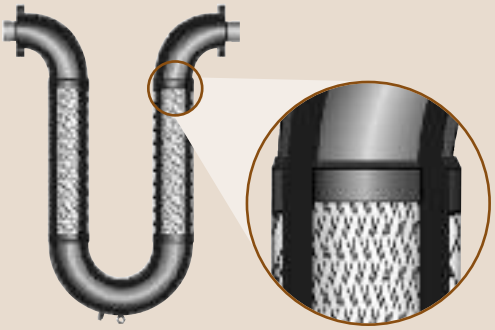


LINED METRALOOPS:

Liners are used when flow velocity exceeds 25 ft/sec. through the hose assembly or when the fluid is erosive.

A liner will reduce turbulence and pressure drop if this is critical to the application. Spiral wound interlocked flexible hose is commonly used for the liner.

CONTAINMENT OR STEAM JACKETED PIPING

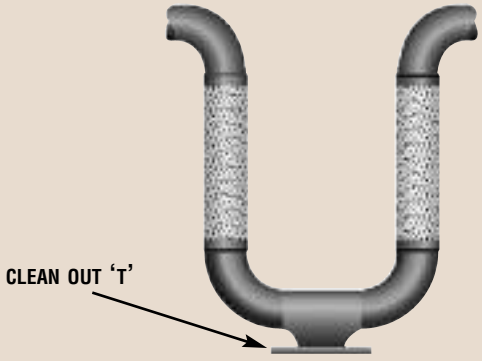


CONTAINMENT LOOPS OR STEAM JACKETED PIPING:

Containment MetraLoops for hazardous media can be built of almost any compatible material. A large inspection port in the return bend is a common option. Containment loops can be designed for thermal expansion, seismic, tank settling, nozzle loading requirements, etc. . .

Steam jacketed loops are used to heat or reheat media and at the same time absorb or compensate for thermal movement. Steam connections can be made anywhere except in the flexible legs.

SEWAGE SYSTEMS



SEWAGE (POOP) LOOP:

Lined to minimize sediment collection, these loops are designed with a clean out "T" to facilitate servicing and to comply with most code requirements. The loops are installed in the sewage lines as they exit a building foundation to allow for building settlement. They are also used in and outside the building to accommodate seismic movement.

APPLICATIONS

NOZZLE LOAD LOOPS:

Pipe stress and nozzle loading due to settlement can be eliminated. Use Metraloops on storage tanks, building separations, or any large equipment where stress relief is required. One assembly may be used to simultaneously absorb seismic, thermal, and settlement movements.

ROOF LOOPS:

Due to their large forces, most rooftop thermal expansion devices require penetration of the roof to anchor and support the piping. Metraloops permit the use of wooden sleepers or other similar supports that maintain the integrity of the roofing material.

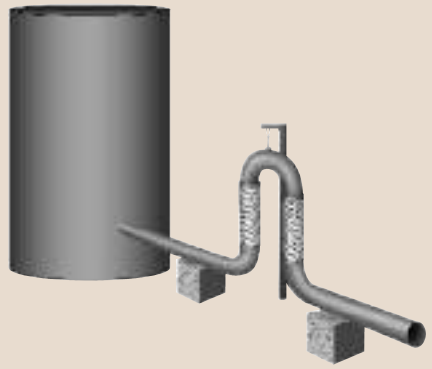
BURIED LOOPS:

All of the benefits of using The Metraloop for above ground systems can be applied to buried systems as well. The Metraloop will virtually eliminate all anchor loads from the system reducing anchor plate and thrust block requirements. The Metraloop will take up 75% less space than conventional hard pipe loops lowering excavation cost, and can be incorporated into the design of conduit systems. The Metraloop will provide an additional benefit of protecting the piping system and equipment from the effects of building settling and soil shifting.

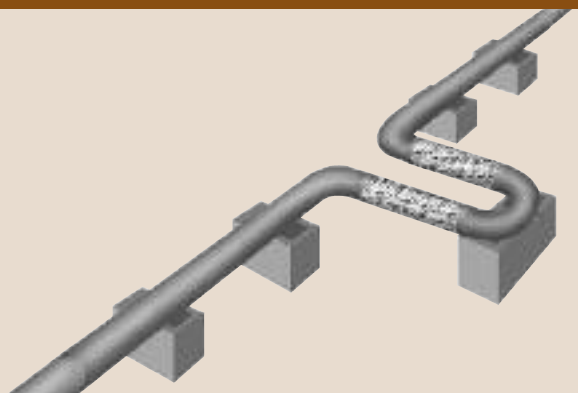
TRENCH BOX SYSTEM:

Requiring a fraction of the space of hard pipe loops, excavation and dirt disposal are minimized using the Metraloop. Rack supports using pipe rollers or slide supports are ideal for the pipe runs.

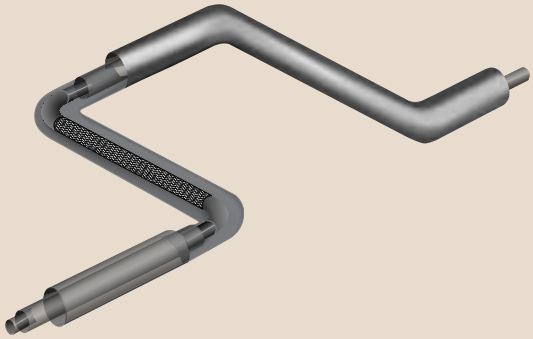
STORAGE TANKS



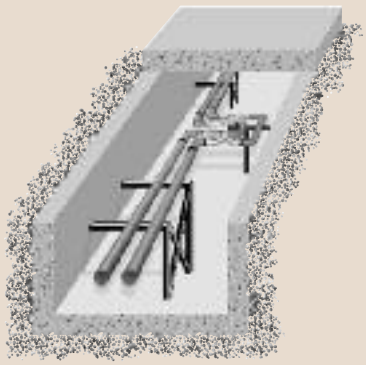
ROOF TOP PIPING



UNDERGROUND PIPING



TRENCH BOX SYSTEMS

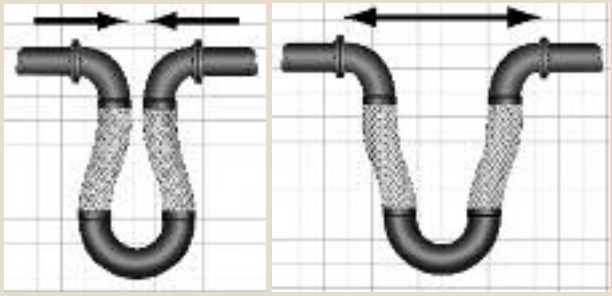


THERMAL EXPANSION APPLICATIONS

Flexible stainless steel hose and braid is an excellent product for absorbing lateral offset and angular movement. It is not well suited for axial compression, or torque. Under axial compression the braid is relaxed which lowers the pressure rating, and torque introduces complex stresses that quickly fatigue the hose.

With the above in mind, if hose and braid is to be used as the stress relieving, movement compensating component of a piping system it must be installed in a configuration that minimizes the axial compression of the hose and braid.

METRALOOP



EXPANSION CONTRACTION

APPLICATIONS

Metraloops can be used in any thermal expansion application. Virtually any amount of movement is available.

Steel Pipe - Metraloops are available in flanged, weld, or grooved or any combination to suit the system requirements.

Stainless Steel Pipe - For corrosive or seawater applications, all stainless steel construction is available.

Copper Pipe - The column strength of small diameter copper pipe is very low. Bellows type copper compensators require many pipe guides to maintain column strength. Metraloops exert no pressure thrust on the pipe reducing this requirement.

Plastic Pipe- Typically has much greater coefficients of expansion than either copper or steel and is more brittle. Again, the Metraloop with its low spring rate is ideal.

DESIGN CONSIDERATIONS

The best configuration to accommodate thermal expansion is the Metraloop. When the loop is installed in a pipe run that is expanding or contracting axially, the flexible legs, being perpendicular to the movement vector, are flexed laterally. As long as the legs are designed with sufficient live length the offset amount never exceeds the elastic limit of the hose and it will flex indefinitely.

In hot and cold water systems, Metraloops may be installed in any orientation relative to the piping and at any location along the pipe run. The pipes expansion or contraction will find it's way to the Metraloop. Due to the loops ability to accommodate large amounts of movement, it should be located in such a way as to limit stress on branch lines.

In steam systems, care must be taken to prevent condensate build up that could be harmful to other components downstream of the loop. For this reason we require steam Metraloops to be oriented horizontally. (See page 3, Illustration #1). Vertical steam risers do not apply. As an additional safety precaution all steam loops are double braided. Please specify service when ordering.

BENEFITS

The Metraloop is an inexpensive alternative to other methods of designing for thermal expansion such as bellows-type expansion joints, slip-type (packed) expansion joints or hard-pipe loops.

System costs are reduced because the Metraloop exerts only a fraction of the anchor loads of all other type expansion joints. And, due to it's natural flexibility, the Metraloop requires far fewer pipe guides than are required for bellows expansion joints and takes up less space than a hard-pipe loop. (See inside front cover for anchor load and space comparisons.)

Metraloops reduce the entire cost of the system in three ways:

* Reduce Anchor Costs - Smaller anchor loads means smaller, less expensive anchors. No expensive thrust blocks or heavy-duty main anchors are required.

* Reduce Guiding Costs - Only two pipe guides are required per Metraloop. Compared to the stringent requirements of other expansion joints, this can add up to a considerable savings.

* Reduce Construction Material Costs - Metraloops require much less space than hard pipe loops. That means smaller vaults when digging steam trenches, less concrete and less dirt for removal.

For a video demonstration of the MetraLoop, contact your local Metraflex representative, or call 800-621-4347.

SEISMIC APPLICATIONS

BENEFITS

The Metraloop is a better alternative to other methods of designing for seismic movement such as dual-tied bellows expansion joints, or ball-joints.

System costs are reduced because the Metraloop exerts only a fraction of the anchor loads of a ball-joint or a bellows expansion joint. That means no expensive thrust blocks or heavy-duty anchors are required. (See Inside Front Cover for anchor load comparison)

The extreme flexibility of the Metraloop also makes it ideal as a seismic connector to equipment such as boilers, chillers, and fan-coil units. Metraloops minimize equipment nozzle loading conditions.

DESIGN CONSIDERATIONS

FIGURE 1

The randomness of the movement in an earthquake requires that seismic expansion joints be capable of movement in any direction. Of all the six possible directions ±X, ±Y, ±Z (Figure 1) the Metraloop is the optimal configuration as compared with other type of flexible hose and braid seismic connectors. By design, flexible hose and braid connectors are limited to angular motion and lateral offset. Axial, compressive, or torsional movement is not possible. By fabricating an assembly with two sections of hose parallel to each other, and allowing the 180° return bend to move freely, the Metraloop minimizes the likelihood of compressive movement.

For movement in the +X, -X & planes (expansion & contraction), the Metraloop uses hose offset motion to achieve this movement. Also for movement in the +Z, -Z planes (front & back), the Metraloop uses hose offset motion. Movement in the +Y, -Y Plane (up-down), the legs of the Metraloop use hose angular motion for this movement.

Note: The use of assemblies with flexible hose sections oriented at 90° relative to each other can result in axial compression or torque of the hose. This may result in failure or shorter service life of the assembly. A non-structural disadvantage of these types of configurations is the cost and logistics of the necessary offsets in the pipe runs or additional supports required.

APPLICATIONS

Metraloops can be used in all types of systems including steam, hot or chilled water, medical gas, natural gas (See A.G.A./C.S.A. certified drawing, page 16), fire sprinklers, sewage, chemical, and petroleum products. Special applications requiring lined hose for high velocity, double-braid for high pressures, and all stainless steel construction for media compatibility are available (See pages 7-9 for a few of these special applications.

SEISMIC INSTALLATION

Figures 2 thru 4 show typical installations of Metraloops for seismic service. These drawings, along with detailed installation instructions for seismic applications can be found on our website and by contacting your local Metraflex representative.

FIGURE 2 - CROSSING A BUILDING SEISMIC JOINT - HORIZONTAL

FIGURE 3 - CROSSING A BUILDING SEISMIC JOINT - VERTICAL

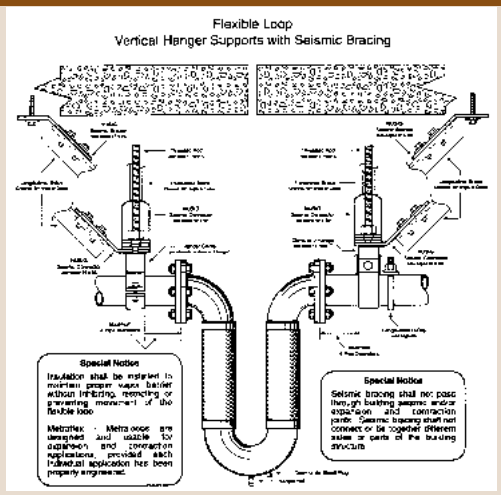


FIGURE 4 - RISER APPLICATION