



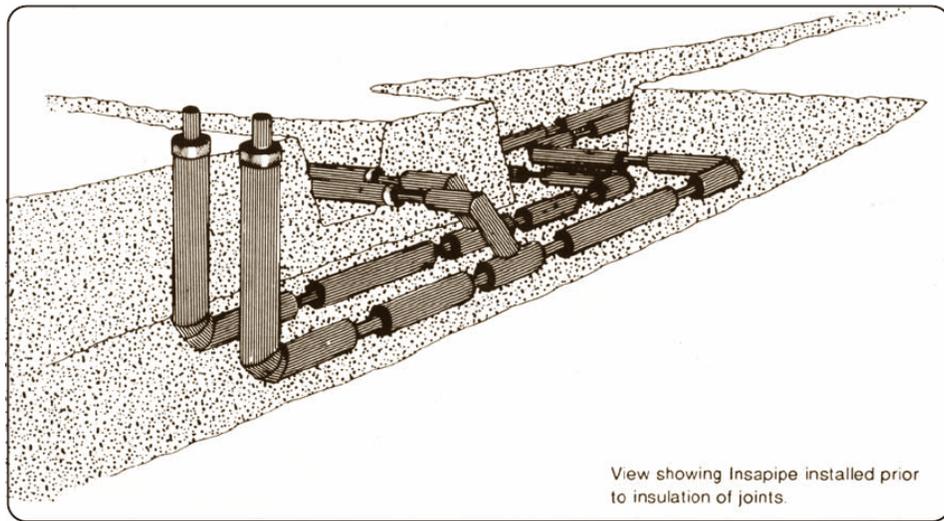
# Underground System

## Description

Insapipe is a factory fabricated and insulated Underground piping system designed for direct burial into an unlined trench. The product is manufactured generally to British Standard 4508 for Thermally Insulated Underground Piping Systems to Parts 3 and 4 being cased systems without air gap.

The system consists of any type of process pipe conveying hot or cold fluids centralised within a high density polyethylene outer casing. The annular space between pipe and casing is machine filled with polyurethane foam which expands and upon setting forms a totally uniform insulation around the pipe

Note particularly that all works installed to BS4508 Parts 3 and 4 must be fully pre-fabricated Straight joints are the only site work permitted As an option for chilled water and other non-cyclic applications kitsets for bends and tees are available for fabrication on-site or in your factory.



## Quality Control

The Underground environment is particularly harsh by virtue of the abundance of ground water and corrosive conditions. Preventive or regular maintenance is almost impossible therefore a product for use in this environment must be of the highest quality. Insapipe Underground has undergone much laboratory and experimental testing. Testing of raw materials as listed below together with typical water tightness data are available on request.

Non-destructive testing of steel pipe welds

Pressure testing of process pipe

Thermal conductivity of insulation

Thermal aging of insulation.

Mechanical properties of casing materials

Mechanical properties of completed foam system

Biological properties of foam system.

Physical properties of completed system.

Tests on typical field joints under cyclic thermal conditions

under external water pressure head.

System test in which a representative pipe circuit subjected

to cyclic thermal conditions under external water pressure head.

A strict regimen of quality control procedures is maintained to

ensure that every product made conforms to our minimum

standards and will thus meet the requirements of the British

Standard.

## Specification:

### Typical for cyclic systems

All thermally insulated underground pipework shall be Insapipe, process pipe in casing without air gap or approved equivalent, of the physical properties indicated below.

Insapipe must be installed strictly in accordance with the manufacturer's recommendation.

### Process Pipe

The pipe shall be suitable for the pressure service specified elsewhere.

All pipes shall have ends suitably prepared for field welding and shall be capped for transport and storage.

### Outer Casing

High density polyethylene Grade 5010 Type II carbon black stabilised, extruded in one piece.

## Insulation

Insulation shall be methylene di-isocyanate (MDI) based rigid polyurethane foam machine injected into the annulus between the service pipe and outer casing by a one shot factory process and shall have the following properties:

1. **Density:** Nominal in situ 75 kg/m<sup>3</sup>
2. **Thermal conductivity:** k value .023 w/m<sup>2</sup>K at 20°C mean.
3. **Compressive strength:** 300 kPa at room temperature.
4. **Closed cell content:** 90% by volume minimum.
5. **Insulation thickness:** Unless otherwise specified insulation thicknesses shall be -

Pipes up to 32nb  
25mm nominal thickness

Pipes between 40 and 125nb  
32mm nominal thickness

Pipes between 150 to 200nb  
40mm nominal thickness

Pipes 250 and over  
50mm minimum thickness

## Fittings

All fittings shall be factory fabricated and insulated so that the only site insulation shall be the straight joints between the pre-insulated units unless otherwise specified.

1. The service pipe fabrication shall be in accordance with the welding specification specified elsewhere herein.
2. All casings for fittings shall be pre-fabricated from high density polyethylene (as specified above). Casing fabrication shall be effected by either hot plate, hot gas or extrusion welding processes

## Bulkheads

Bulkheads where required shall be the heat shrinkable modified cross linked polyethylene type, suitable for the service temperature specified elsewhere.

Where pre-insulated units are supplied exclusive of bulkheads, the exposed foam faces shall be coated with sealant factory applied.

## Joints

Only the straight joints between the pre-insulated units shall be site insulated. Straight Joints shall be site insulated using rigid polyurethane foam.

**The casing Joint shall be complete with a polyethylene wrap-around heat shrink sleeve.**

## Arrangement and Layout of Piping

The drawings indicate the designed and approximate positions and arrangement of all piping.

Contraction and expansion shall be accommodated by sufficient bends so that the system is sufficiently flexible to absorb the whole of its contraction or expansion, without developing excessive stresses in either the piping itself or the connection equipment.

In the contractor's illustration drawings which shall be submitted to the Engineer for his approval prior to installation, all pipework shall be positioned with due regard to these requirements and shall be in accordance with the manufacturer's recommendations.

Tenderers are expected to be fully conversant with the manufacturer's installation and handling recommendations. Published technical literature is available.

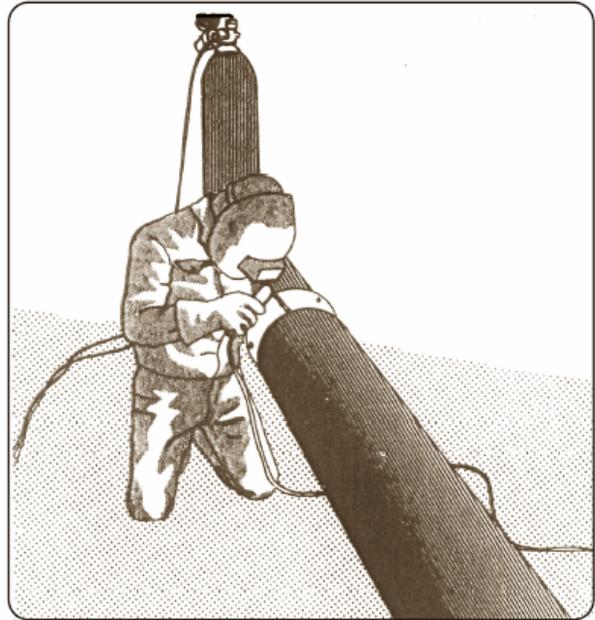
## Welding

Align pipe and weld to contract specifications. Welded joints are the only acceptable method of pipe jointing unless using valves, flanges and screw joints enclosed in a sealed access chamber. For further details see the design section of this catalogue.

It is essential to use shields or asbestos rope to protect the foam from burning and overheating, particularly if gas welding is used.

When welding mini bends, avoid welding both ends in succession as heat build-up can be too great for the insulation.

It is also necessary to avoid excessive heat build-up when welding the steel pipe in the proximity of a bulkhead. Excessive heat can cause further shrinkage of the bulkhead resulting in the bulkhead bursting or gassing. The area of the pipe at the bulkhead must be kept cool with wet sacking. Remember should any bulkheads be required to be fitted on site, ensure these are fitted prior to welding up the pipe lengths and note that if a bulkhead is damaged, either prior to or during welding, it cannot be replaced while the pipe is welded up.



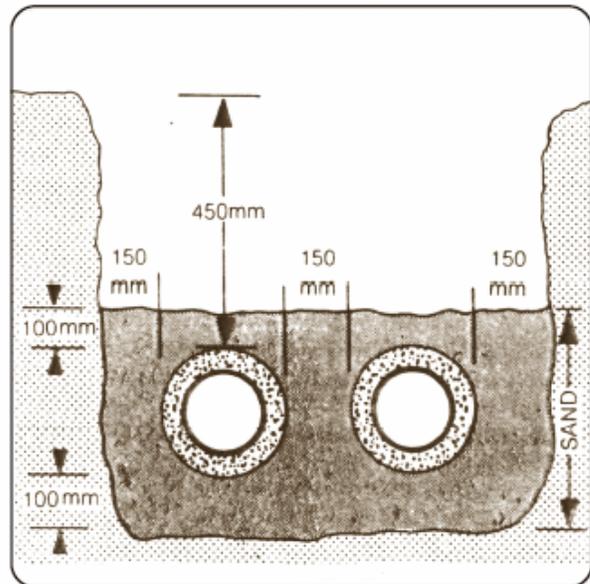
## Pressure Testing

All welded, pre-fabricated fittings are inspected prior to shop insulating. Should specific welding standards or tests be required please advise at the time of pricing and ordering. All site welds are the contractor's responsibility and should be tested in accordance with the contract specifications prior to insulating.

## Backfilling

No backfilling is to be carried out without the approval of the inspecting authority. Should it be desirable to backfill prior to the insulation of site joints, backfilling must not be within one metre either side of any joint, and the pipe spacing and clearances under 'trenches' must be adhered to.

Remove all trench or pipe supports before backfilling. Backfilling should first be carried out by hand using sand and be well tamped down, particularly around the pipe ensuring the cavity between pipes is filled. Hand-filling to continue until the pipe is covered by 100mm of sand "hereafter mechanical means may be utilised with the original trench material as backfill provided it does not contain any sharp objects, stones or foreign matter which could damage the outer casing. In particularly wet areas, or where the trench runs down a steep gradient, water flowing down the trench can cause migration of the sand fill. To prevent this occurring, periodically lay concrete across the width of the trench from the base of the trench to level with the bottom of the Insapipe. Note that pumice should not be used as a backfill material.





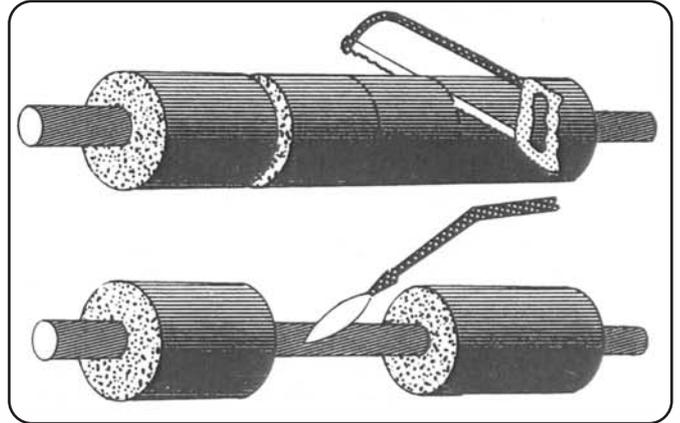
## Altering Units

The only items designed to be cut on site are unit lengths. If a unit length has been supplied with a bulkhead at one end only, cut to waste the opposite end to prevent the waste of a bulkhead.

The procedure to cut a unit length on site is as follows:

1. Mark end to end measurement on outer casing.
2. Mark casing 150mm either side of first mark and cut casing and foam through to process pipe at these points with a hacksaw taking care not to cut the process pipe.
3. Break or cut casing and foam away from process pipe and clean off.
4. Recheck overall measurement, mark and cut the process pipe.

When cutting unit lengths on site, it is important to note the maximum lengths of site straight joints, shown in Table 3, which can be insulated with standard jointing materials. To avoid over-length joints weld in a small section of Insapipe, thus making two joints of an acceptable length.



The outer sheathing of a straight joint consists of a polyethylene "heat shrink sleeve". Should the contract documents specify an alternative style of sleeve refer to your local dealer. Unless otherwise advised a "standard" type sleeve will be used.

N.B. If tube type sleeves are required they must be positioned over the pipe casing prior to welding the Insapipe units together.

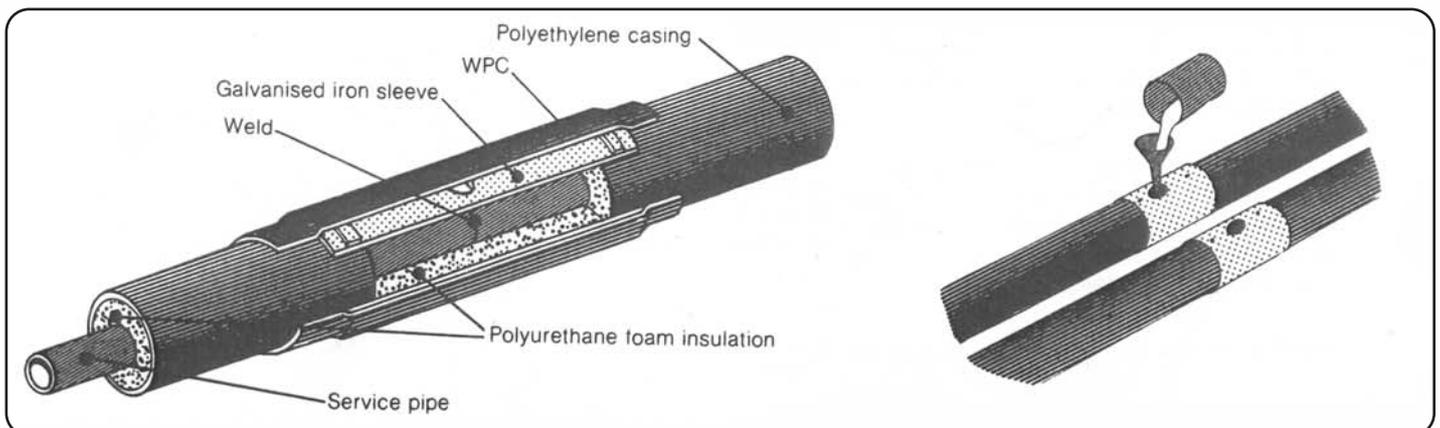
No. of Bulkheads	Up to 65mm diameter pipe	80 and 100mm diameter pipe
No bulkheads	420	420
1 bulkhead	370	350
2 bulkheads	320	300

## Site Insulation

To select the correct joint sleeves and patches refer to Jointing Sleeves and Patches.

The making good of thermal insulation between pre-insulated units, "jointing", is critical to the successful performance of the insulation system. The broad guide that follows details the key points involved. Jointing should not be attempted without some initial assistance and training from Insapipe Industries or their agent.

1. Clean joint area thoroughly.
2. Fit 400mm long PGI sleeve - pop rivet longitudinally only - do not damage casing.
3. Drill air release holes and pour hole.
4. Pour out and measure correct quantities of foam chemicals.
5. Thoroughly mix mechanically and pour into joint.
6. Clean off excess foam after rise.
7. Apply and heat shrink wraparound sleeve using propane torch.
8. Take care not to overheat or burn sleeve.
9. Inspect for flow of mastic around sleeve edges and under or over-heating.

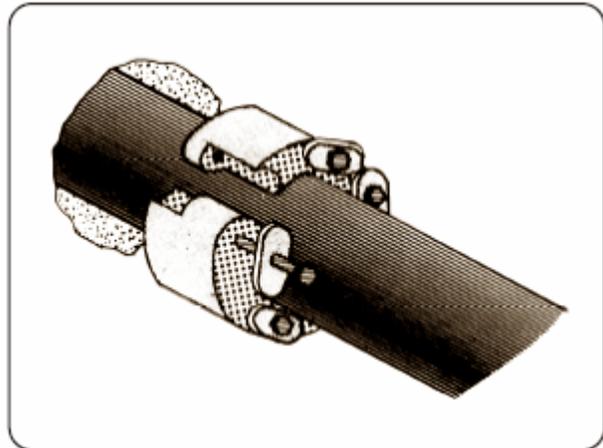




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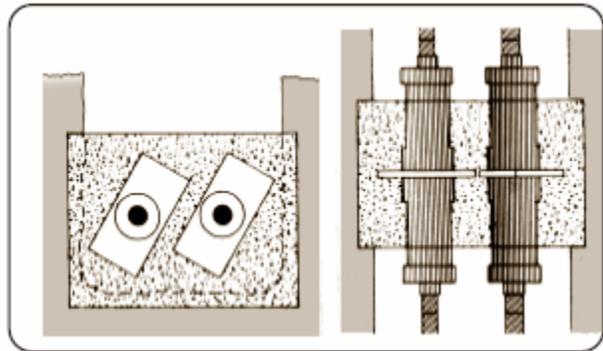
## Wall Penetrations and Chambers

When a valve or similar piece of equipment must be fitted in an underground pipeline the only acceptable method of achieving this is within an access chamber or pit. These chambers should be of a cast concrete construction minimum wall thickness of 75mm sealed and drained with a sump. The Insapipe must pass through the wall and terminate inside with a bulkhead. For penetrations of chamber walls or into underground plant rooms the only recommended method for sealing the casing to the wall is using linkseals. The hole may be cast in using a puddle flanged sleeve or drilled but in either case must be large enough to suit the Link Seal ©



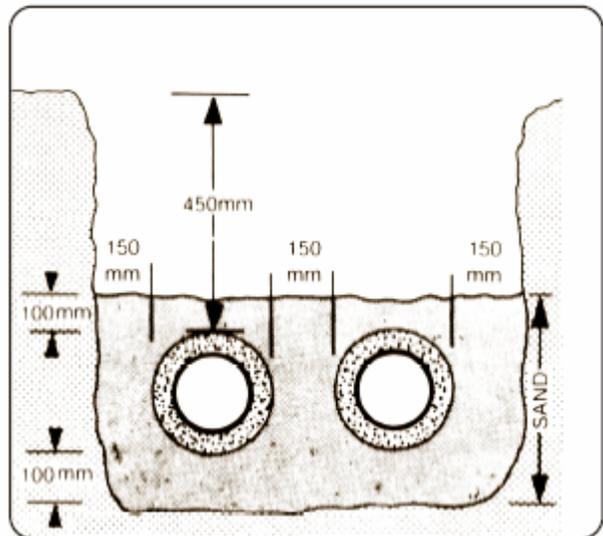
## Anchors

Pre-insulated anchors are the only acceptable method of underground Insapipe. The anchor is provided with steel plates welded to the steel pipe and sealed to the casing. The dimensions of the concrete anchor block are dependent on the local soil condition and must be calculated by a competent person. However the block should be wide enough to ensure it bears on virgin soil and short enough to ensure a good site joint can be made. A distance of 100mm between the edge of the block and the casing will be adequate.



## Trenches

The depth of the trench provides a degree of restraint and guides the plane of thermal movement, therefore, as pipe sizes increase depth of burial must increase. The trench can be excavated by mechanical means provided the bottom is hand-graded and has a 100mm thick layer of sand underneath the Insapipe. The width of the trench should be sufficient to enable the Insapipe to be installed with a minimum clearance of 150mm between pipe casing and also between casing and the sides of the trench. At the area of the straight joint between Insapipe units, ensure that there is also 150mm of clearance under the casing to enable the heat shrink sleeve to be applied to the joint. Use table to calculate minimum trench widths and depth.



Pipe NB	15	20	25	32	40	50	65	80	100	125	150	200	250	300
Casing diameter D	80	80	100	100	110	125	145	160	185	213	250	320	380	450



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## Road Crossing

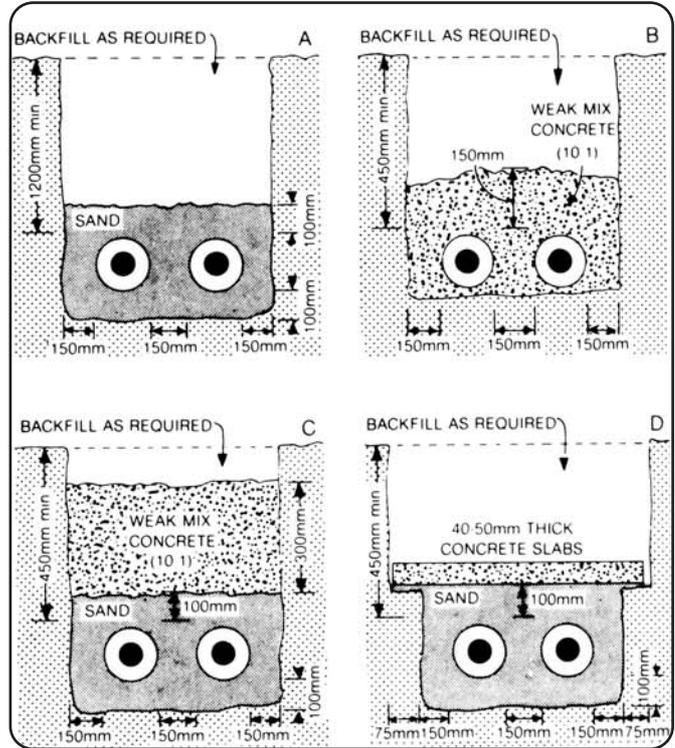
Where Insapipe is to be laid beneath a roadway, precautions are required to allow for traffic loading.

Either of the following four alternative methods of installation are recommended

- A. Insapipe should be buried in a trench deep enough to give a minimum of 1.2 metres of cover above the top of the casing.
- B. Insapipe surrounded by a minimum of 150mm of weak-mix (10.1) concrete 15mm aggregate with the Insapipe supported on firm compacted hand-graded soil.
- C. Insapipe surrounded by 100mm cover of sand and then backfilled with a minimum cover of 300mm weak-mix concrete. The Insapipe to be supported on a 100mm layer of sand.
- D. Insapipe covered with approximately 100mm of sand backfill and 40/50mm thick reinforced concrete slab, then backfilled as required.

In all instances, clearances between pipe and trench sides to be as per dimensions shown under Trenches.

Note that we recommend that bulkheads be applied to the Insapipe at both sides of the road crossing.

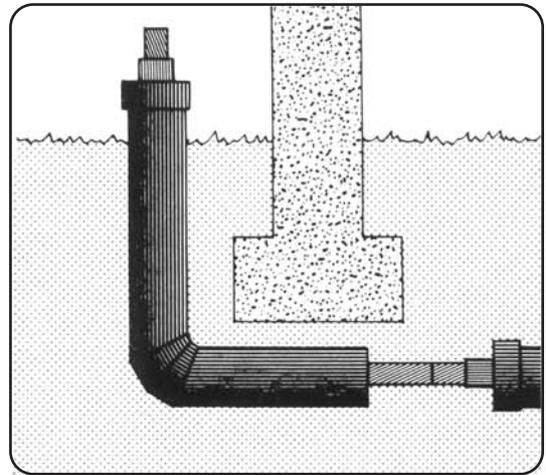


## Risers

When possible, use Expansion Bends as risers making sure at least 150mm of Insapipe is extended above ground level. If the area is liable to flooding increase this dimension further.

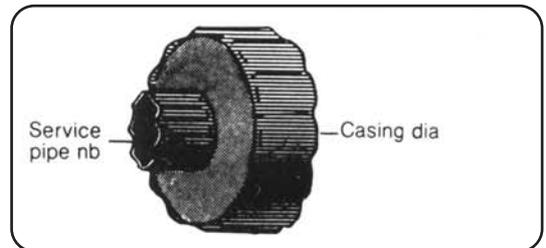
We recommend that all pipe run terminations be fitted with a bulkhead, whether the termination is above ground or in an access chamber or duct.

If pipe risers are external to a building, Insapipe Above Ground pre-insulated pipe should be used to ensure that the total line is sealed against the ingress of moisture.



## Bulkheads

Bulkheads can be supplied either loose or affixed in position upon request.



### SPECIFICATION

Bulkheads are a purpose-made unit manufactured from modified cross linked polyethylene, and are shrunk on to the pipes by the application of heat. The inside of the bulkhead is coated with a mastic ensuring a complete bond and seal against the ingress of moisture between it, the service pipe and the outer casing.

The bulkhead has been satisfactorily tested to comply with BS4508 Part 4 reference Section 3.2.3.4.(a) (c).

Further use of bulkheads is primarily dependent on site conditions and each contract should be considered individually and the use of bulkheads evaluated on an economic basis in relation to:

- (a) The replacement cost of the section of pipeline isolated between bulkheads.
- (b) The consequential financial, health or special cost of any interruption to the service provided by the piping system.



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## Thermal Movement and Flexibility

Consideration must be given in design and installation for the pipeline's ability to accept movement due to thermal expansion and contraction.

On long or cross country pipelines where the duty is non cyclic, reliance can be placed on ground friction and restraint to control the pipeline through the outer casing and insulation. Calculations can be made using the following formulae:

$$F = 2(HdLD+W)g \times \mu$$

Where

- F = friction restraint N
- H = depth burial M
- d = density of ground cover kg/m<sup>3</sup>
- g = gravitational acceleration m/s<sup>2</sup>
- L = length of pipeline m
- D = outside diameter of casing m
- W = Mass of pipe kg
- μ = coefficient of friction

Note the coefficient of friction varies considerably from site to site and as a general guide the coefficient can be taken as varying between 0.1 and 0.7

Where cyclic conditions apply such as in a heating system or for shorter pipelines it is recommended that flexibility is built into the system by installing bends to cater for this movement, as offsets rather than loops. Calculations show that if thermal movement is limited to 20mm in any part of a system then neither the pipe insulation, casing or joint are overstressed. Therefore, if no natural flexibility exists in a pipe route an offset should be installed to limit movement.

The length of an offset must vary with pipe sizes to keep stresses to an acceptable level. Bends are supplied ex factory with leg lengths of 1000 x 600 mm smaller sizes and 1000 x 1500 mm over 125mm diameter. The table details the minimum offset dimension achieved by placing two bends together in a Z shape.

It is equally important when determining positions of tees and branch lines from a main to consider their effect on the MAINS THERMAL MOVEMENT. When a tee is directly buried it tends to act as a restraint and could force more than allowable movement into an offset. Therefore tees and branches should be placed as close as possible to midway between offsets or bends.

If allowance for thermal movement is made in this way anchors are not required. However, if it is not possible to place tees or slight changes of direction midway between offsets then an anchor is recommended to protect the branch line and force the movement towards the offset.

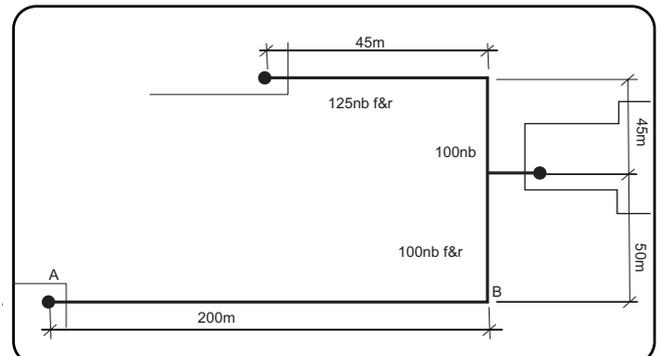
Material	Coefficient of linear expansion
Steel	12 x 10 <sup>-6</sup>
Copper	17 x 10 <sup>-6</sup>
PVC	8 x 10 <sup>-5</sup>

Pipe Size	Offset Distance	Leg Orientation
up to 50	1200	short to short
65 and 80	1600	short to long
100	2000	long to long
125 to 200	2500	short to long
250 and over	special case refer to Insapipe Industries Ltd	

## Stage 1

Shows the general layout of the pipeline shown with due regard to site contours, buildings and other services.

**Example:**  
Steel pipe BS 1387 (AS1074) medium weight operating at 6°C and installed in a 30°C ambient.





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## Stage 2

Check thermal movement to ensure that no more than 20mm movement can occur at any bend or change of direction.

$$\text{Change in length} = 200\text{m} \times (30^{\circ}\text{C}) \times 12\text{m/m}^{\circ}\text{C} \times 10^{-6} \\ = 57.6\text{mm}$$

Therefore movement expected at bends A and B is 28.8mm each which is greater than the allowed 20mm.

Solution: Install a "Z offset" midway between A and B thereby creating two new bends. We then have 4 bends between point A and point B each taking 14.4mm movement.

All other bends in the system would take less than 20mm contraction.

## Stage 3

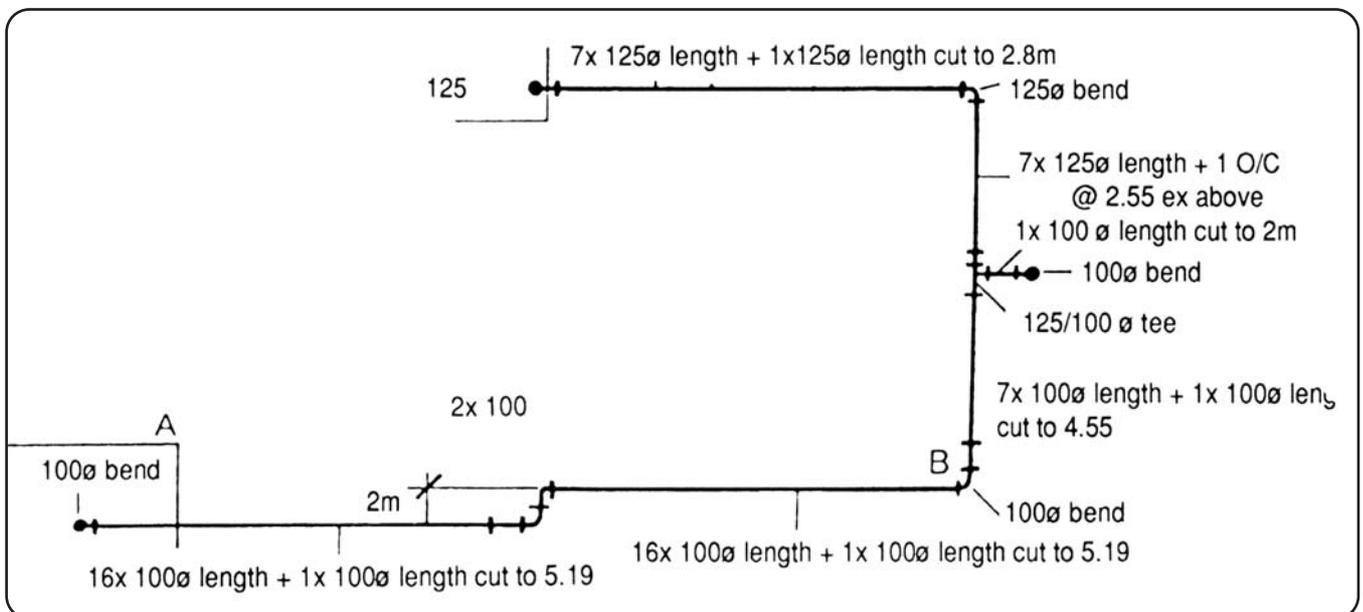
Determine the offset dimension of the "Z offset". This is determined by the pipe diameter. In this case the pipe is 100 nb therefore the minimum offset dimension is 2m.

## Stage 4

Redraw the pipeline including the offset and check the position of branches. In this case the branch line is close enough to midway between two bends to be of no concern.

## Stage 5

Draw to scale and arrive at a schedule of quantities.



## Schedule of Quantities

125 φ length x 30	125 joints	x	36
125 φ bend x 4	100 φ length	x	68
125/100 φ tee x 2	100 φ bend	x	10
	100 joints	x	78

## Ordering

Establish the schedule of Insapipe units required for your order, including full delivery requirements, with a name and telephone number for the carrier to contact at the point of delivery. Specify steel, domestic copper or other type of process pipe required.

The insulation system used in the standard Insapipe is suitable for temperatures from -50°C to + 130°C. It is important that when ordering, the working temperature of the system is stated.

It is also necessary to ensure that the outer casing temperature does not exceed 30°C and, therefore, any special soil properties should be noted (i.e. particularly dry soil, or soil of a high insulation value such as pumice).

For systems operating at temperatures greater than 100°C and/or buried in soil of high insulation properties, there is every possibility that the insulation thickness will have to be increased to keep the casing temperatures below 30°C.