

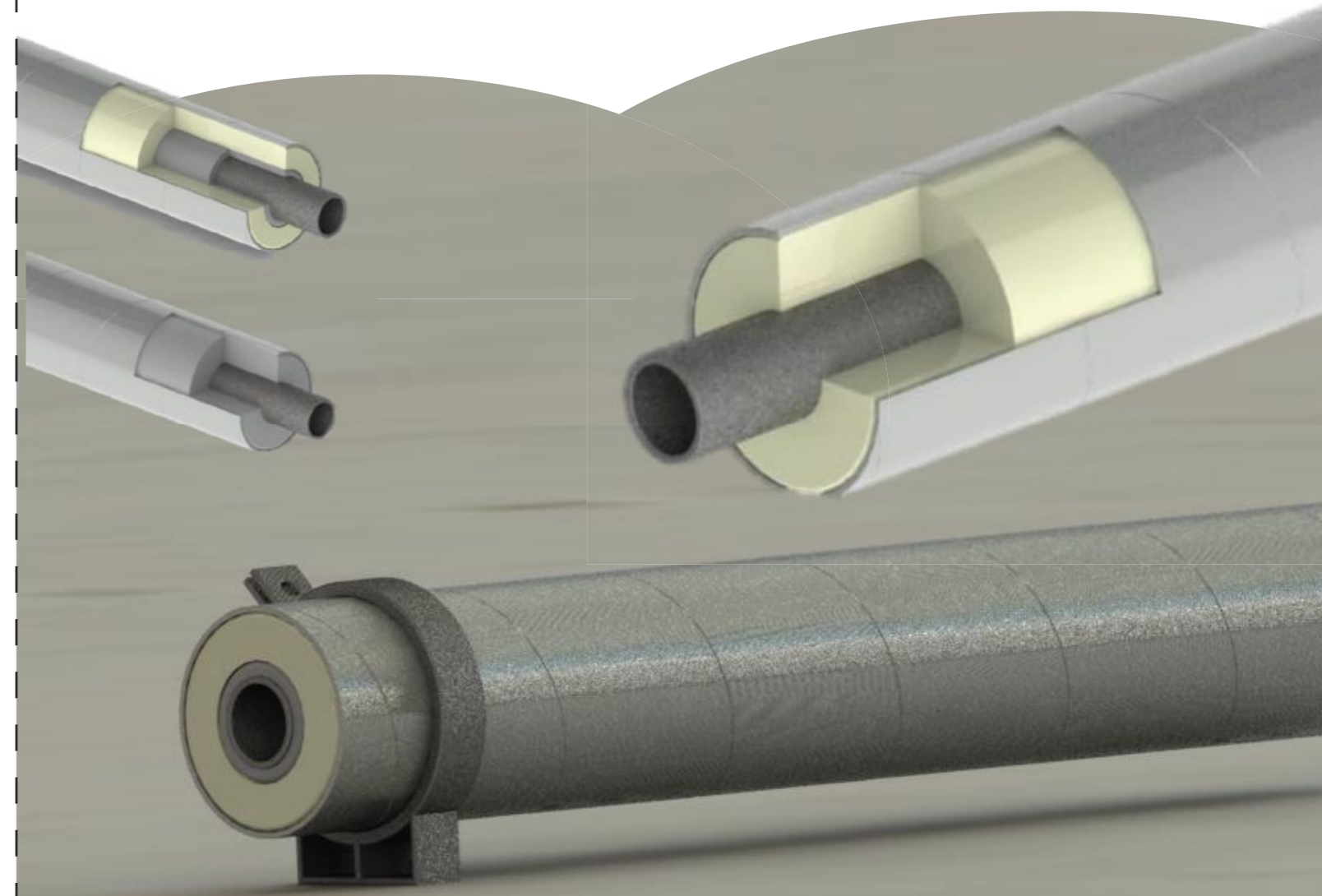
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# INSAPIPE ABOVE GROUND Catalogue



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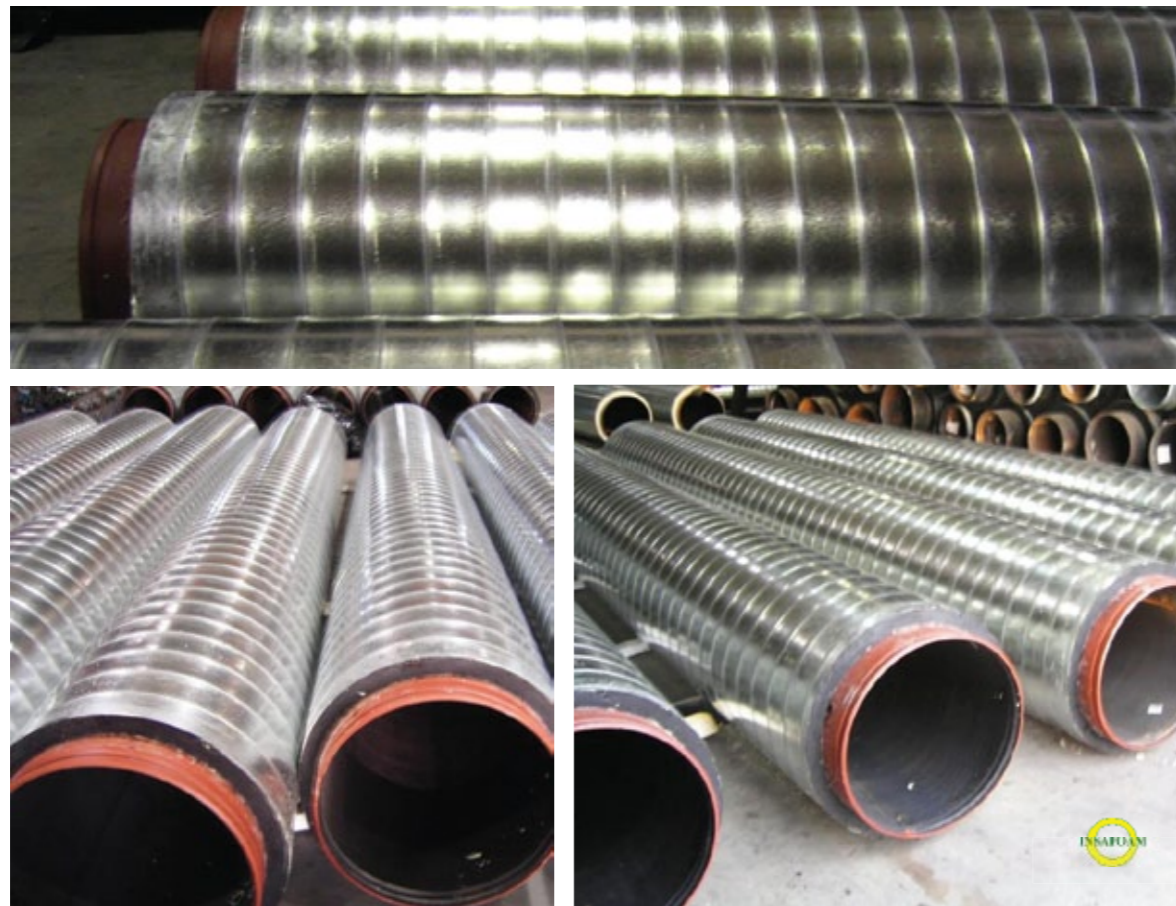
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## INSAPIPE Above Ground

INSAPIPE Above Ground is a range of pre-insulated pipes specifically designed for transporting hot or cold fluids for applications above ground level. INSAPIPE Above Ground consist of 3 main components; an internal carrier pipe, the insulation layer and jacket. Carrier pipes are usually made from steel.

INSAPIPE Above Ground is available in a range of thickness to suit the different performance requirements for the application. The jacket can be made from galvanised steel, stainless steel or aluminium and the thickness of the material can be modified to suit the application.

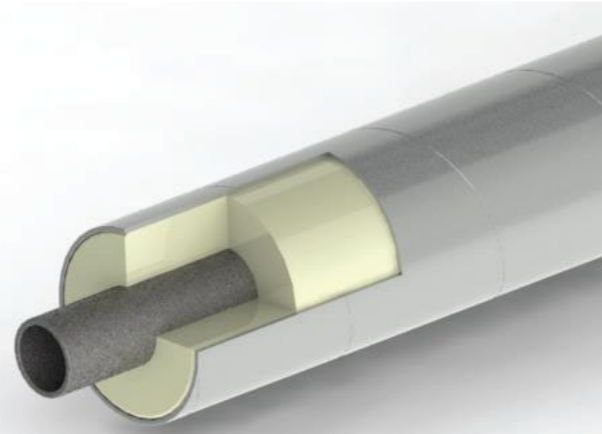


Polyurethane foam is the main insulator of choice for INSAFOAM. However, because the maximum operating temperature of polyurethane is 130°C, polyurethane should not come into direct contact with a surface of temperature higher than 110°C. Therefore, calcium silicate is included for higher fluid temperatures. The variation of the composition of the insulating layer with different fluid temperatures is shown below.

#### Low Temperatures

(Between 0°C and 110°C)

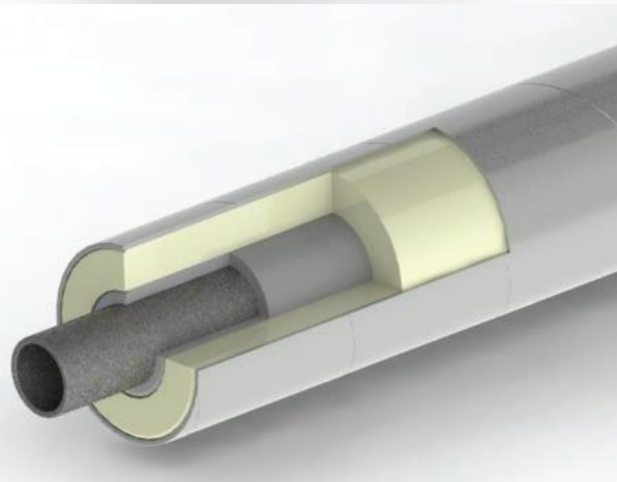
The insulation layer consists of only polyurethane.



#### Medium Temperatures

(Between 110°C and 500°C)

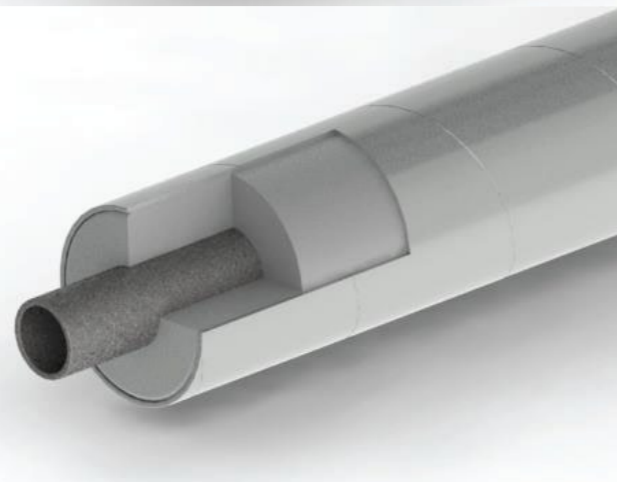
The insulation layer consists of a combination of polyurethane on the outer surface and calcium silicate on the inner.



#### High Temperatures

(500°C and above)

The insulation layer consists of only calcium silicate.

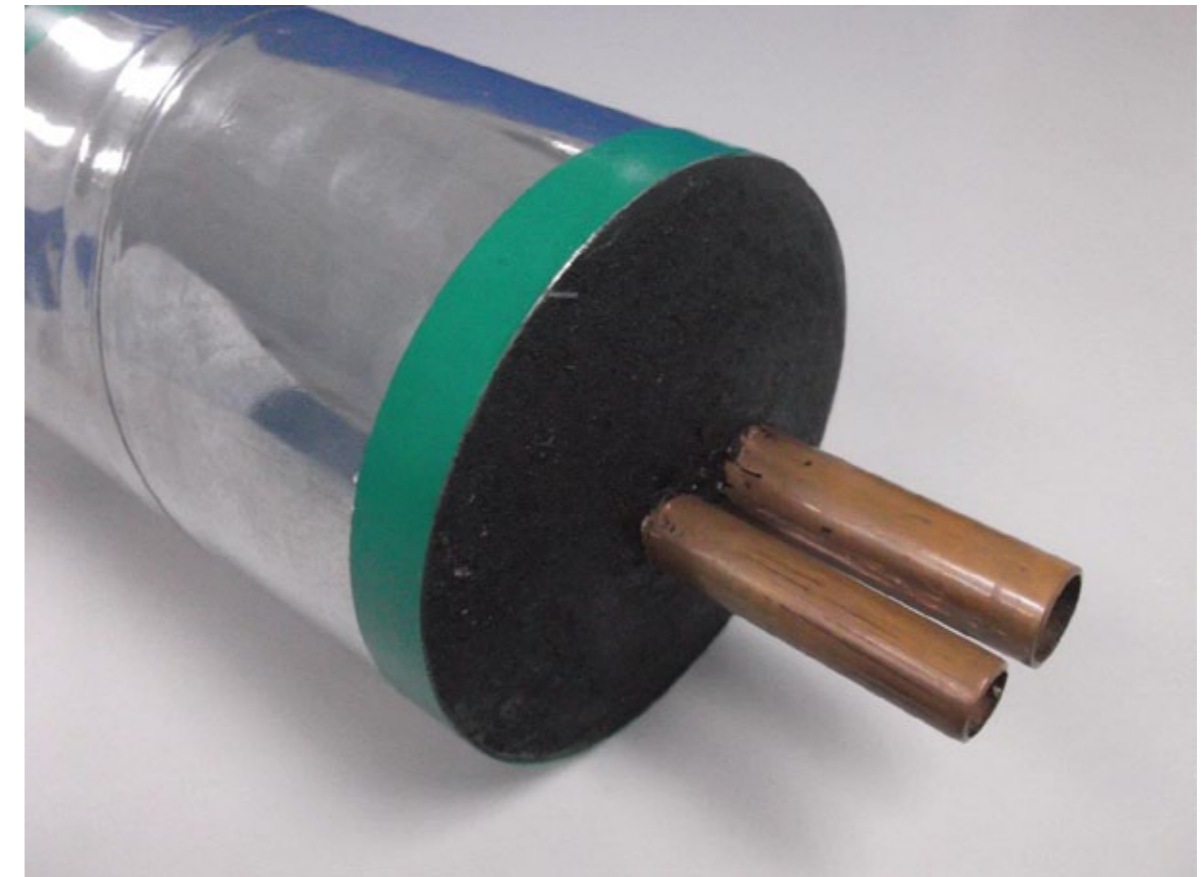


## Copper Pipes

Copper piping systems are often used for the distribution of domestic hot water and refrigerant gas lines. If the temperatures of the fluid in the pipes are to be maintained, the pipes need to be insulated.

In addition to steel pipes, INSAFOAM also pre-insulates these copper tubes using polyurethane to be ready to be installed on site. The jacket used can be made from galvanised steel, stainless steel or aluminium and the thickness of the material can be modified to suit the application.

INSAFOAM pre-insulated pipes can be made with multiple tubes within 1 jacket.





## Features & Benefits

### Zero Maintenance

The tight insulation provided by the polyurethane foam and the metal jacket ensures that the external face of the carrier pipe is not exposed to the environment. This makes certain that corrosion experienced by the external face of the carrier pipe is minimal.



### Superior Thermal Performance

Polyurethane foam is the main insulator of choice for INSAPIPE Above Ground. Polyurethane is one of the best insulating material commonly used and a thermal conductivity as low as 0.021 W/m K can be achieved. This means that the specified thermal performance can be provided with a thinner insulation.



Insulator thickness required to achieve the same thermal resistance of 4 m K/W.

Insulator	Thermal Conductivity (W/m K)	Thickness (mm)
Polyurethane Foam	0.021	84
Expanded Polystyrene	0.032	128
Rock Wool	0.038	152
Glass Fibre	0.045	180
Calcium Silicate	0.060	240

## Reduced Installation Time and Field Cost

INSAPIPE Above Ground pre-insulated pipes come ready for installation. This means that the only insulation that needs to be done on site is at the joints. Therefore, installation time can be significantly reduced. In addition, the insulating process is done in a factory-controlled environment, i.e. no damp insulations, no reliance on site skill, no reduction in quality due to site condition or remoteness and no weather delays.



## Moisture Resistant

The structure of the polyurethane foam consists of more than 92% closed cells. This makes it resistant to penetration of other fluids. The polyurethane foam also attaches very tightly to the carrier pipe, preventing water from seeping between the 2 materials.



## Environmentally Friendly

The polyurethane foam used by INSAFOAM is CFC/HCFC-free and non-fibrous. In addition, the gassing agent used to produce the foam has zero Ozone Depletion Potential (ODP) and low Global Warming Potential (GWP).



## Fire Resistant

INSAPIPE Above Ground has a 2 hour fire rating to enhance safety and is compliant to Class 'O' fire rating.



## No Heat Bridges

Heat bridges occur when the insulating layer of the pipe is interrupted by another material of lower heat resistance. This increases the heat gained by the fluid in the pipe by decreasing the overall heat resistance of the insulation. Condensation is also more likely to occur at the position of heat bridges because of the higher amount of heat conducted, leading to lower surface temperatures at those positions.



INSAPIPE Above Ground pre-insulated pipes avoid heat bridges by being supported outside the jacket. Therefore, there is no penetration through the insulator, avoiding the issues stated above.

## High Mechanical Strength

The metal jacket is a spiral tube with a 4-ply lock seam. The spiralling process and 4-ply lock seam produces a tube with high strength and rigidity. In addition, the metal jacket used is impact resistant. Also, the combined mechanical strength of polyurethane and the metal jacket is fairly significant and this makes pre-insulated pipe systems resistant to physical effects.



## Technical Data

### Insulator Properties

The insulator used is polyurethane foam and is available in multiple densities. The density controls the strength of polyurethane foam, its thermal properties and the percentage of closed cells in the foam. Within the range of densities offered, there is an inverse relationship between the mechanical strength of the polyurethane foam and its thermal conductivity.

Polyurethane foam is made by combining polyol and isocyanate with a blowing agent. The foam generated is homogeneous. The process used to produce the insulator is CFC/HCFC-free.

Density (kg/m <sup>3</sup> )	45	50	60
Compressive Strength (kPa)			
➤ Parallel	230	290	470
➤ Perpendicular	210	260	430
Shear Strength (kPa)	252	275	380
Thermal Conductivity (W/m K)	0.021	0.021	0.022
Closed Cell (%)	91%	93%	96%

## Calculations

### Maximum Heat Transfer

A conservative estimate for the heat transfer to the fluid in the pipe can be made by ignoring several negligible resistances to heat transfer. These include the thermal contact resistance between the layers, thermal resistance from convection in the pipe and thermal resistance from the pipe. This simplifies the calculation and the formula to calculate the maximum heat transfer is shown below.

$$Q' = \frac{(T_{atmosphere} - T_{fluid})}{R + R_{convection}}$$

where<sup>†</sup>,

$Q'$  = Heat transfer per unit length

$T_{atmosphere}$  = Atmospheric temperature

$T_{fluid}$  = Temperature of the fluid in the pipe

$R$  = Thermal resistance provided by the insulating layer

$R_{convection}$  = Thermal resistance provided by convection away from surface

### Thermal Resistance of Insulation

The heat transfer across the insulating layer is determined by the temperature difference across the layer and the thermal resistance provided by the insulating layer. The thermal resistance of an insulating layer acts as a measure independent of the operating conditions. This can be calculated using the equation below.

$$R = \frac{\ln\left(\frac{D_{jacket}}{OD}\right)}{2\pi k}$$

where<sup>†</sup>,

$R$  = Thermal resistance provided by the insulating layer

$k$  = Thermal conductivity of insulator

$D_{jacket}$  = Diameter of the metal jacket

$OD$  = Outer diameter of pipe

## Thermal Resistance from convection

The jacket surface is not at atmospheric temperature. This is because of the thermal resistance due to the convection of air. This resistance can be calculated using the equation below.

$$R_{convection} = \frac{1}{\pi D_{Jacket} \times h}$$

where<sup>†</sup>,

- $R_{convection}$  = Thermal resistance provided by convection away from surface
- $D_{Jacket}$  = Diameter of the metal jacket
- $h$  = Thermal convection coefficient of air

## Maximum Temperature after L m

The maximum temperature can be estimated by assuming the temperature change of the fluid inside the pipe is small. This is given by the equation below.

$$T_{max} = \frac{Q' \times L}{\dot{m}C} + T_{fluid}$$

where<sup>†</sup>,

- $Q'$  = Heat transfer per unit area
- $L$  = Pipe length
- $T_{fluid}$  = Initial temperature of the fluid in the pipe
- $\dot{m}$  = Mass flow rate
- $C$  = Specific Heat

## Check for Condensation

To check that no condensation occurs at on the surface, we must first find out the temperature at which the condensation can happen (dew point) and compare with the surface temperature calculated from the heat flow across the insulation. The dew point can be found from the table or psychrometric chart shown in the appendix.

The surface temperature can be calculated using the equation below.

$$T_{surf} = \frac{R \times T_{atmosphere} + R_{convection} \times T_{fluid}}{R + R_{convection}}$$

where,

- $T_{surf}$  = Surface temperature of insulation
- $T_{atmosphere}$  = Atmospheric temperature
- $T_{fluid}$  = Temperature of the fluid in the pipe
- $k$  = Thermal conductivity of insulator
- $D_{Jacket}$  = Diameter of the metal jacket
- $OD$  = Outer diameter of pipe

If the surface temperature is above the dew point, condensation will not occur.

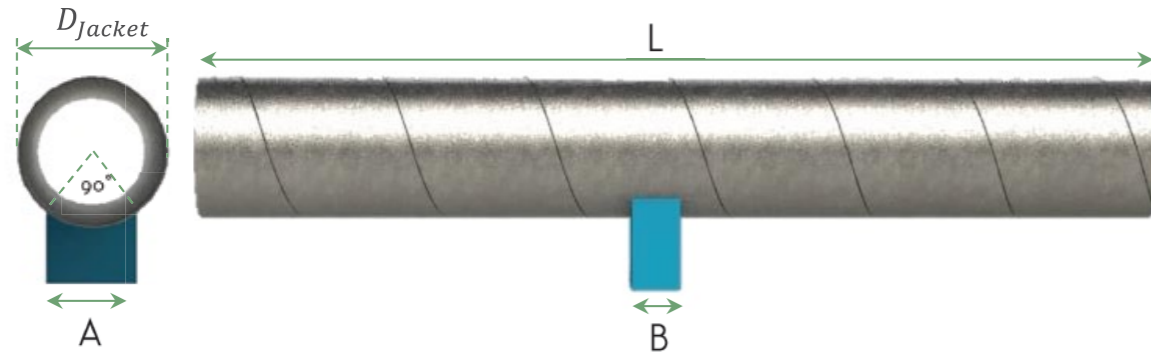
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<sup>†</sup> All variables are in S.I. units unless stated otherwise



## Support Length and Span

INSAPIPE Above Ground is supported outside the jacket. This avoids heat bridges through the insulation. However, polyurethane foam has limited compressive strength. Therefore, there is a limit to the span of pipe it is able to support without damaging the polyurethane foam given a certain support length.



- $D_{Jacket}$  = Jacket diameter
- A = Support width
- B = Support length
- L = Span

The support width is determined by the jacket diameter as shown in equation below.

$$A = \frac{D_{Jacket}}{\sqrt{2}}$$

The support length and span are chosen based on the load on the column of polyurethane. The maximum allowable span and the support length are related by the equation below.

$$L = \frac{\sigma \times A \times B}{w}$$

where,

- $\sigma$  = Compressive strength of polyurethane
- $w$  = Weight per unit length

The weight per unit length is determined by the size, thickness and density of the pipe, polyurethane foam and jacket and the area the fluid the pipe is carrying is able to occupy.

$$w = \frac{\pi \rho_{fluid} (OD - 2t_{pipe})^2}{4} + \frac{\pi \rho_{pipe} (OD^2 - (OD - 2t_{pipe})^2)}{4} + \frac{\pi \rho_{PU} (D_{Jacket}^2 - OD^2)}{4} + \pi \rho_{Jacket} D_{Jacket} t_{Jacket}$$

where<sup>†</sup>,

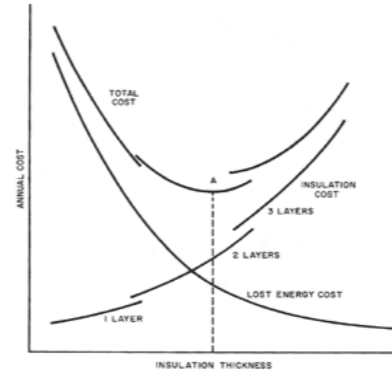
- $D_{Jacket}$  = Diameter of the metal jacket
- OD = Outer diameter of pipe
- $t_{pipe}$  = Pipe thickness
- $t_{Jacket}$  = Jacket thickness
- $\rho_{pipe}$  = Density of pipe
- $\rho_{PU}$  = Density of polyurethane
- $\rho_{Jacket}$  = Density of metal jacket
- $\rho_{fluid}$  = Density of fluid

<sup>†</sup> All variables are in S.I. units unless stated otherwise

## Product Classes

### - Specifying Insulation Thickness

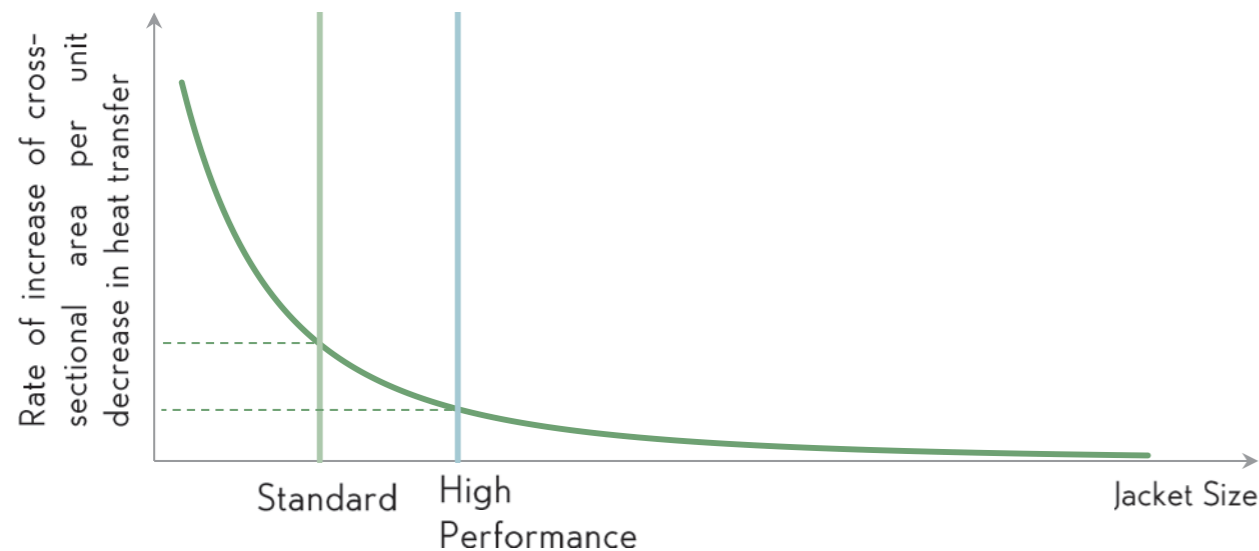
As the insulation thickness increase, the energy lost from heat gained from the surrounding decreases but at a decreasing rate. The insulation cost, however, increases with an increasing rate as the insulation thickness increases.



There is an optimum insulation thickness that minimises the total cost of the system. This optimal thickness differs for each application and pipe size.

INSAFOAM looks to cater to as many applications as possible and we do this through our product classes. 2 product classes are available (standard and high-performance) and the classes correspond to a selected jacket size for each pipe size.

The graph below acts as a guide to accommodate the trade-off between the increasing rate of the cost of insulation and decreasing effect of increasing the insulation when selecting the jacket sizes. As the jacket size increases for the same pipe size, the ratio of the rate of increase in cross-sectional area and the rate of decrease in heat transfer decreases. Selection of the appropriate ration depends on the budgetary and performance requirements.



## Standard

Pipe Detail		Jacket Size	Thermal Resistance	Insulation Thickness	Weight		
Standard	NB	OD	Dia	R	w/o water	w water	
	(mm)	(mm)	(mm)	(m K/W)	(mm)	(kg/m)	
BS 1387 C	15	21.3	80	10.029	29.35	2.62	2.80
BS 1387 C	20	26.7	100	10.008	36.65	3.42	3.73
BS 1387 C	25	33.4	100	8.311	33.3	4.47	4.96
BS 1387 C	32	42.2	115	7.598	36.4	5.62	6.42
BS 1387 C	40	48.3	125	7.207	38.35	6.38	7.64
BS 1387 C	50	60.3	142	6.491	40.85	8.54	10.51
BS 1387 C	65	73	150	5.458	38.5	10.40	13.72
BS 1387 C	80	88.9	178	5.262	44.55	13.37	18.40
BS 1387 C	90	101.6	178	4.25	38.2	14.01	20.37
BS 1387 C	100	114.3	200	4.24	42.85	18.01	25.87
BS 1387 C	125	141.3	228	3.626	43.35	21.98	34.26
BS 1387 C	150	168.3	250	2.999	40.85	25.78	43.46
JIS G3452 Std	200	219.1	320	2.871	50.45	36.26	67.68
JIS G3452 Std	250	273.1	381	2.523	53.95	50.06	99.15
JIS G3452 Std	300	323.9	431	2.165	53.55	63.02	133.72
JIS G3452 Std	350	355.6	458	1.918	51.2	77.80	174.02
API 5L 7.9mm	400	406.4	508	1.691	50.8	88.85	214.53
API 5L 7.9mm	450	457.2	559	1.524	50.9	99.96	259.02
API 5L 7.9mm	500	508	610	1.387	51	111.11	307.48
API 5L 7.9mm	550	558.8	660	1.261	50.6	122.19	359.81
API 5L 7.9mm	600	609.6	711	1.166	50.7	133.36	416.14
API 5L 9.5mm	650	660.4	762	1.085	50.8	169.69	501.56
API 5L 9.5mm	700	711.2	812	1.005	50.4	185.21	570.11
API 5L 9.5mm	750	762	863	0.943	50.5	198.56	640.40
API 5L 9.5mm	800	812.8	914	0.889	50.6	211.91	714.63
API 5L 9.5mm	850	863.6	965	0.841	50.7	225.27	792.79
API 5L 9.5mm	900	914.4	1016	0.799	50.8	244.52	880.78
API 5L 9.5mm	950	965.2	1066	0.753	50.4	258.00	966.91
API 5L 12.7mm	1000	1016	1117	0.718	50.5	350.11	1,135.61

## High Performance

Pipe Detail			Jacket Size	Thermal Resistance	Insulation Thickness	Weight	
Standard	NB	OD	Jacket Dia	R		w/o water	w water
	(mm)	(mm)	(mm)	(m K/W)	(mm)	(kg/m)	(kg/m)
BS 1387 C	15	21.3	100	11.72	39.35	3.00	3.17
BS 1387 C	20	26.7	115	11.067	44.15	3.72	4.03
BS 1387 C	25	33.4	125	10.002	45.8	4.98	5.47
BS 1387 C	32	42.2	135	8.813	46.4	6.04	6.85
BS 1387 C	40	48.3	150	8.588	50.85	6.94	8.20
BS 1387 C	50	60.3	160	7.396	49.85	8.96	10.93
BS 1387 C	65	73	178	6.755	52.5	11.08	14.40
BS 1387 C	80	88.9	200	6.145	55.55	13.95	18.97
BS 1387 C	90	101.6	228	6.126	63.2	15.37	21.73
BS 1387 C	100	114.3	228	5.233	56.85	18.80	26.65
BS 1387 C	125	141.3	250	4.324	54.35	22.64	34.92
BS 1387 C	150	168.3	279	3.831	55.35	26.71	44.38
JIS G3452 Std	200	219.1	350	3.55	65.45	37.38	68.80
JIS G3452 Std	250	273.1	400	2.892	63.45	50.84	99.94
JIS G3452 Std	300	323.9	458	2.626	67.05	64.33	135.03
JIS G3452 Std	350	355.6	508	2.703	76.2	80.38	176.60
API 5L 7.9mm	400	406.4	559	2.416	76.3	91.67	217.35
API 5L 7.9mm	450	457.2	610	2.185	76.4	102.98	262.04
API 5L 7.9mm	500	508	660	1.984	76	114.26	310.63
API 5L 7.9mm	550	558.8	711	1.826	76.1	125.61	363.22
API 5L 7.9mm	600	609.6	762	1.691	76.2	136.97	419.75
API 5L 9.5mm	650	660.4	812	1.566	75.8	173.42	505.29
API 5L 9.5mm	700	711.2	863	1.466	75.9	189.36	574.26
API 5L 9.5mm	750	762	914	1.378	76	202.91	644.75
API 5L 9.5mm	800	812.8	965	1.301	76.1	216.46	719.18
API 5L 9.5mm	850	863.6	1016	1.232	76.2	230.01	797.53
API 5L 9.5mm	900	914.4	1066	1.163	75.8	249.66	885.91
API 5L 9.5mm	950	965.2	1117	1.107	75.9	263.43	972.35
API 5L 12.7mm	1000	1016	1168	1.057	76	355.74	1,141.24



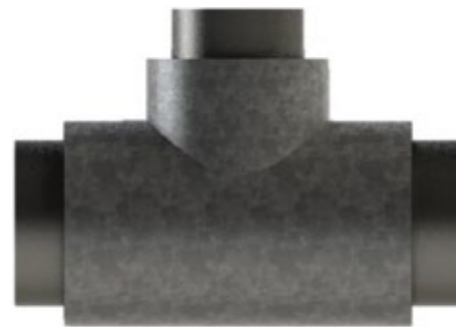
## Fittings

In addition to straight length units, INSAPIPE Above Ground comes with the following fittings. They are all available pre-insulated and ready to be installed on site.

L Bends



Straight Tees



Reducers



MiniBends

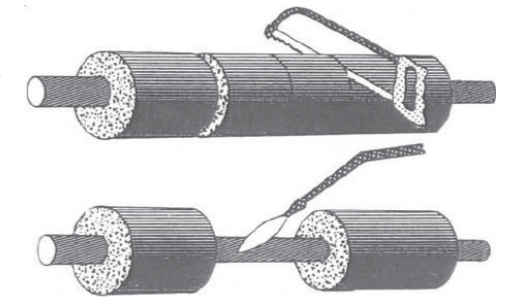


## Installation

To install INSAPIPE Above Ground, pipes need to be cut to size and joined and finally, the joints need to be insulated. Some points regarding installation are shown here to provide an idea of how INSAPIPE Above Ground will be installed. A detailed manual for installing INSAPIPE Above Ground is available in the appendix.

### Cutting

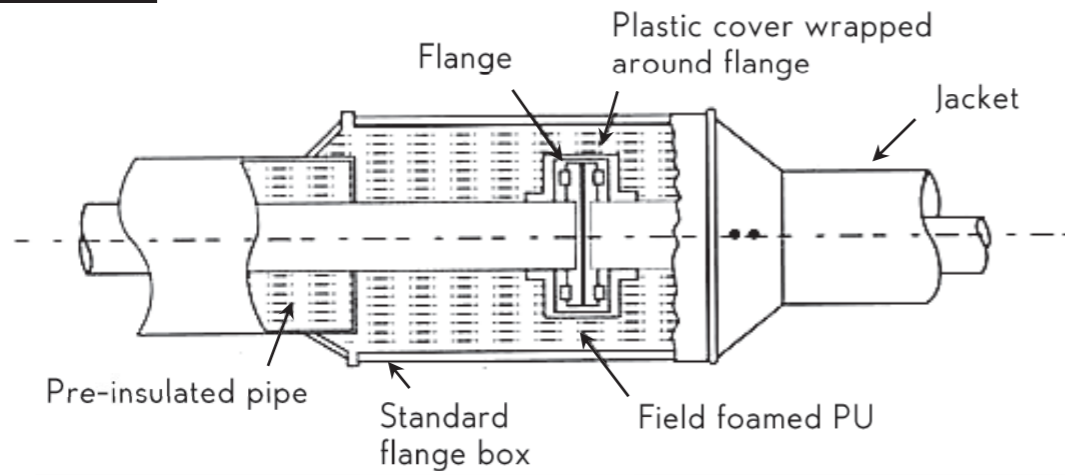
Piping units may need to be cut to field dimensions. A knife, hand saw, or power saw can be used to cut the insulation jacket and insulation. After the insulation has been removed, the service pipe can then be cut and the end preparation restored.



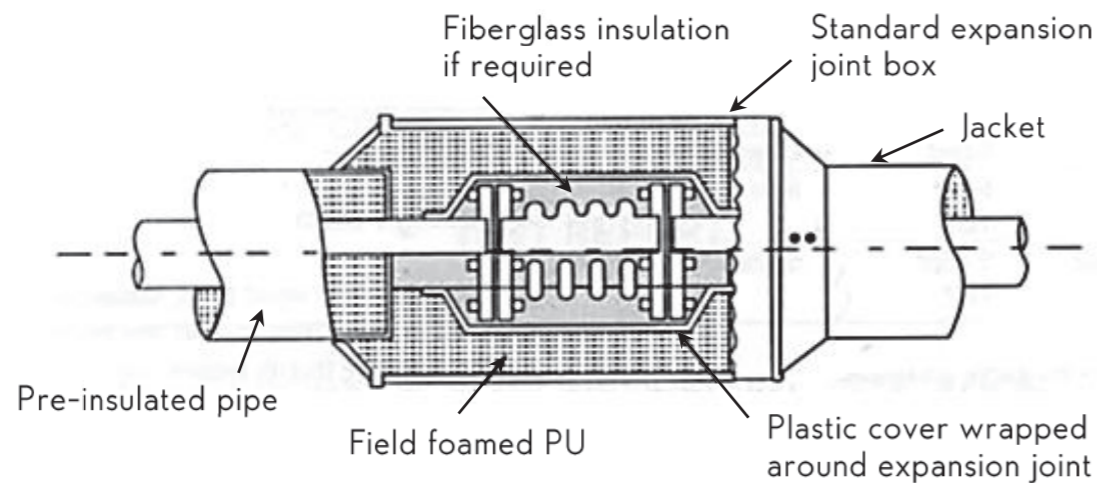
### Joining

When joining two pipes together, mechanical couplings such as a flange, expansion joint or a valve joint are often used. These components need to be insulated in the field after installation. This can be done using standard joint boxes. The parts of standard joint boxes are shown on the next page.

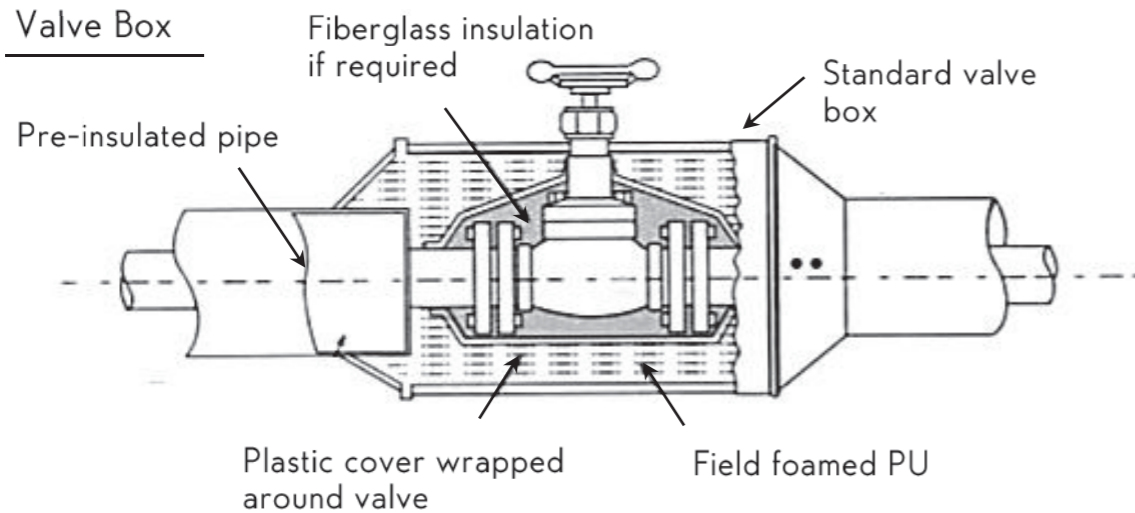
Flange Box



Expansion Joint Box



Valve Box



**Specification - Recommended**

**GENERAL**

All piping systems for service reaching a maximum temperature of 110°C installed aboveground as shown on plans shall be a Insapipe preinsulated and prefabricated piping system with all necessary fittings, expansion loops and accessories, etc., as specified.

The preinsulated pipe manufacturer shall be with ISO certification and SIRIM product certification. The supplier shall have been manufacturing of preinsulated pipes for at least 10 years.

**SERVICE PIPE**

The service pipe shall be in either of the following standard:

1. Steel Pipe in BS 1387 / EN10255 in Medium or Heavy Grade.
2. Carbon Steel Pipe in JIS G3452.
3. Carbon Steel Pipe in API 5L Gr B / ASTM A53 Gr B (ERW / LSAW / SSAW).
4. Carbon Steel Pipe in ASTM A106 (Seamless).
5. HDPE (High Density Polyethylene) Pipe in MS 1058 / ISO 4427 / DIN8074
6. ABS (Acrylonitrile-Butadiene-Styrene) Pipe
7. PPR (Polypropylene) Pipe

**JACKET**

The jacket material shall be pre-fabricated with internal spiral lockseam in either of the following material:

1. Galvanised Steel

Pipe Size	Minimum Thickness
100mm and below	0.4 mm

101 to 400mm	0.5 mm
401mm and above	0.6 mm

2. Aluminium

Pipe Size	Minimum Thickness
400mm and below	0.7 mm
401mm and above	0.9 mm

## INSULATION

Polyurethane foam shall be environmental friendly with zero ODP. The applied blowing agent shall be either cyclo-pentene or HFC 245fa. The polyurethane foam shall be applied by moulding onto the pipe by injection of the polyurethane foam into the annulus between the service pipe and the jacket.

Physical properties of polyurethane foam shall be as follows:

- Density: Minimum : 45 kg/m<sup>3</sup>
- Thermal Conductivity : Max 0.024 W/moK at 24oC mean
- Compressive Strength : Min 200 kPa
- Closed Cell Content : Min 90% by volume

## FITTINGS

Prefabricated and preinsulated elbows, reducers and tees shall be furnished and installed where shown on plans and shall consist of pipe, insulation and jacket conforming to the same specifications as specified for straight runs.

## FIELD JOINT INSULATION

Field Joints shall be insulated with a Two part liquid polyurethane foam, protected by an galvanized jacket. The manufacturer shall supply the field joint kit which inclusive of two part liquid polyurethane chemical and heat shrink sleeve.

The field foaming will be performed by the installing contractor under the instruction of a certified manufacturer's field service technician. To ensure proper and complete expansion of the two part polyurethane foam mix, the installer shall be trained by the manufacturer.

## Project Locations



- |                 |                  |                      |
|-----------------|------------------|----------------------|
| 01. Singapore   | 07. Bangladesh   | 13. Hongkong         |
| 02. Philippines | 08. Doha – Qatar | 14. Brunei           |
| 03. Vietnam     | 09. Pakistan     | 15. India            |
| 04. Myanmar     | 10. Bahrain      | 16. Saudi            |
| 05. China       | 11. Thailand     | 17. Papua New Guinea |
| 06. Cambodia    | 12. UAE          | 18. Indonesia        |
|                 |                  | 19. Maurities        |