POLYTECH INSULATION SDN. BHD.

POLYTECH INSULATION

ISO9001:2008

UKAS MANAGEMENT SYSTEMS 127

SIRIM QAS INTERNATIONAL

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OUR MISSION & PHILOSOPHY

Mission Statement

"To sustain the position of being the most customer satisfied, profitable and respected premier pre-insulated piping system provider"

Company Philosophy

For its Customers

- By providing the most attentive and efficient service in every aspect of its business
- By providing the most advanced technology and quality controlled products
- By investing in the molding, spiral and injecting machines and having vast knowledge and experience in the production technology, we will continue to refine our quality, expand our capabilities and increase our efficiency

TEST REPORT

DAS CERTIFICATION

DAS CERTIFICATION

Quality Management System

Certificate of Approval

This is to certify that the QMS of

POLYTECH INSULATION SDN BHD

Lot 6971-A, Batu 12, Jalan Balakong
43300 Balakong, Selangor
Malaysia

Has been assessed and found to meet the requirements of

ISO 9001:2008

This certificate is valid for the following scope of operations:

Manufacture of Pre-insulated Polyurethane Pipes

NACE/EA: 25,29/34 Exclusion: 7.3 Design & development

Authorised by: Stan Wright
Chief Executive

Date of Certificate Issue: 8 April 2014
Certificate Valid until: 7 April 2017

Recertification audit before 7 February 2017. Certified since 8 April 2014. This certificate is the property of DAS Certification and remains valid subject to satisfactory annual surveillance audits.

DAS Certification Certificate Number: 69517/SG/Q/80464

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SIRIM QAS INTERNATIONAL

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(Company No. 810334-X)

TEST REPORT

REPORT NO.: 2009FE0197	PAGE 1 OF 4

This Test Report refers only to samples submitted by the applicant to SIRIM QAS International Sdn. Bhd. and tested by SIRIM QAS International Sdn. Bhd. This Test Report shall not be reproduced, except in full and shall not be used for advertising purposes by any means or forms without written approval from Managing Director of SIRIM QAS International Sdn. Bhd. Please refer overleaf for conditions in the use of Test Report.

Our Ref	:	SQAS / FPS / 15 / 1 - 6
Issued by	:	**Fire Protection Section**
Issued date	:	2 3 JUL 2009
Product	:	**POLYURETHANE FOAM ENCASED WITH GALVANIZED STEEL CASING**
Reference Standard/ Method of test	:	BS 476 : Part 7: 1997 Fire Test on Building Materials and Structures Part 7: Surface Spread of Flame Test.
Applicant	:	**POLYTECH INSULATION SDN. BHD.** No. 2190- J, Lot 42488, Kawasan Perindustrian Balakong Jaya, Sungai Ramal, 43300 Balakong, Selangor Darul Ehsan. **(Attn: Mr. Liew Chee Kit)**
Description of sample	:	6 pieces of Polyurethane Foam Encased with Galvanized Steel Casing. Size of Specimen : 250mm × 885mm × 48.1 mm (measured thickness) Brand : POLYPIPE Specific Weight : 14.2 kg/m³ Descriptions of sample as claimed by the submitter : refer to page 2. The specimens were tested with the Galvanized Steel Face side exposed to the specified heating condition of the fire test.
Date received	:	23.06.2009
Job No.	:	J2009 506 0178

FIRE PROTECTION SECTION TESTING SERVICES DEPARTMENT

KAMARULZAMAN MAT ZIN
Testing Executive

ZAINI AHMAD
Group Leader
Fire Protection Section
Testing Services Department
SIRIM QAS International Sdn. Bhd.

SIRIM QAS INTERNATIONAL

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TEST REPORT

REPORT NO.: 2009FE0204	PAGE 1 OF 5

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Our Ref	:	SQAS / FPS / 15 / 1 - 5
Issued by	:	**Fire Protection Section**
Issued date	:	2 4 JUL 2009
Product	:	**POLYURETHANE FOAM ENCASED WITH GALVANIZED STEEL CASING**
Reference Standard/ Method of test	:	BS 476: Part 6: 1989 Fire Test on Building Materials and Structures Part 6: Method of Test for Fire Propagation for Products.
Applicant	:	**POLYTECH INSULATION SDN. BHD.** No. 2190- J, Lot 42488, Kawasan Perindustrian Balakong Jaya, Sungai Ramal, 43300 Balakong, Selangor Darul Ehsan. **(Attn: Mr. Liew Chee Kit)**
Description of sample	:	3 pieces of Polyurethane Foam Encased with Galvanized Steel Casing. Size of Specimen : 225mm × 225mm × 48.3 mm (measured thickness) Brand : POLYPIPE Specific Weight : 17.3 kg/m³ Descriptions of sample as claimed by the submitter : refer to page 2. The specimens were tested with the Galvanized Steel Face side exposed to the specified heating condition of the fire test.
Date received	:	23.07.2009
Job No.	:	J2009 506 0177

FIRE PROTECTION SECTION TESTING SERVICES DEPARTMENT

KAMARULZAMAN MAT ZIN
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Testing Services Department
SIRIM QAS International Sdn. Bhd.

GENERAL PRODUCT INFORMATION

General

Polytech Insulation produce wide range of thermal insulation product specificly used for most high rise building, industrial, institution and community central heating and cooling system. The process pipe suitable for temperature between -50°C to +145°C in any piping system environment.

Polyurethane insulation products - Insulation of pipes with polyurethane can result in significant energy saving. Polypipe insulation is installed as a single layer which saves time and reduces labour cost. Polytech pre-insulated polyurethane pipe has an excellent thermal conductivity which means it need be only half as thick as its main competitors (thereby improving ease of installation in restricted spaces).

Polypipe, it is achieved by injecting polyurethane between the inner carrier pipe and outer shell pipe, casing. Conventional type of insulation used pipe manually covered with block polyurethane foam. Alternatively, pipes can simply be sprayed with polyurethane foam which is then covered within external coating.

We (Polytech) fabricated all types of insulated piping system product. This includes:
- Aboveground piping system
- Underground piping system
- Refrigeration piping system
- Spiral round duct piping system
- Prefabricated option
- Rigid polyurethane foam product
- All types of insulated pipe as specified

SPECIFICATION

Manufacturing process

Polypipe is manufactured from three basic component. A pressure tight jacket, the required carrier pipe and rigid polyurethane foam. The carrier pipe is centralised within the outer jacket and the annular space between the jacket and carrier pipe is machine injected with polyurethane foam. The polyurethane foam expands and, upon setting forms a dense homogenous insulation around the pipe.

Description of the following carrier pipe :

1) BS 1387 Standard Pipe.
2) JIS G3452 Standard Pipe.
3) API 5L Grade B Seamless and ERW Pipe.
4) ASTM A53/A106 Grade B Seamless and ERW Pipe.
5) Copper-tube (ASTM B280 / AS1571 / ASTM B-88 / BSEN 1057 class X & Y)

Description of casing material :

Aboveground system

- Internal / External Spiral Lockseam, Galvanised Steel
- Internal / External Spiral Lockseam, Aluminium
- Internal / External Spiral Lockseam, Epoxy Coated Steel
- Pvc

Underground system

- High Density Polyethylene, Spiral or one-piece extruded

Insulation of rigid polyurethane foam and physical properties :

1) Density : Minimum 45 kg/m^3 and 50 kg/m^3
2) Thermal conductivity : 0.018Kcal/m.h ˚C @ 20˚C
3) Compressive strength : 320 kPa min
4) Closed cell content : 90% minimum
5) Insulation thickness shall be determined taking into consideration condensation forming on the outer jacket under the following climatic condition.

Ambient Temp.	RH%	Fluid Temp.
35˚C	90	5˚C
30˚C	95	5˚C

Insulation thickness (minimum) :

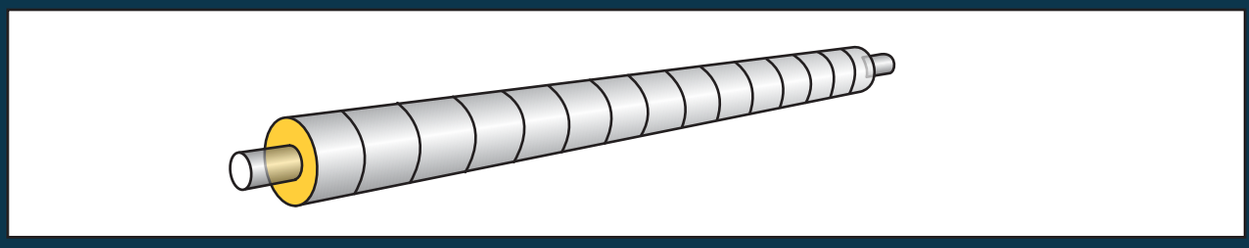
- Pipe size NB 100mm (4") and below: 38 mm (11/2")
- Pipe size NB 125 mm (5") and above : 50 mm (2")
- Specify carrier pipe and heavier density if required.

ABOVE GROUND PIPING SYSTEM

Polypipe is the thermal insulated piping system, factory manufactured stringent production and high quality condition. With our latest production machinery and quality control facilities, Polypipe is progressively developing new pre-insulated pipings range to serve the ever demanding industrial market.

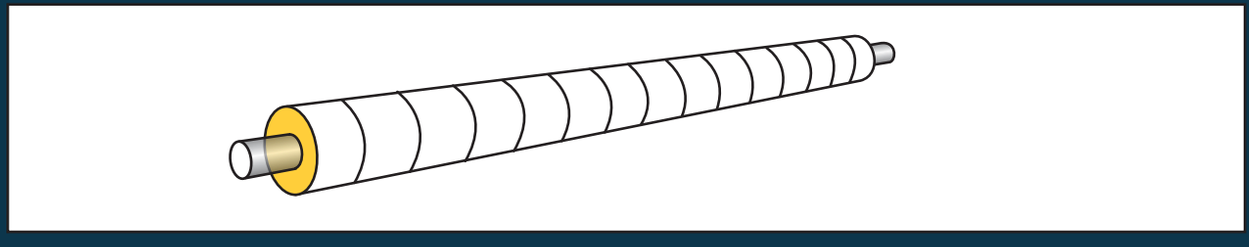
The following selection enables a casing to be chosen which will be functional, aesthetically pleasing and most suited to the environment.

a) Metal spiral internal/external lockseam casing.
Material: Galvanised steel, Stainless steel, Aluminium or others.



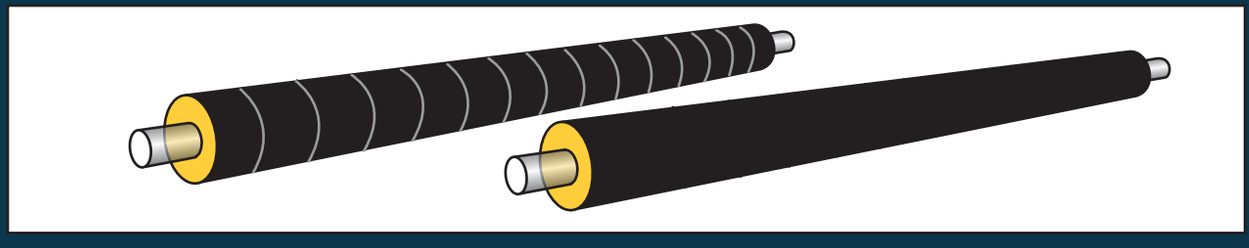
Casing Adventages: Vapour barrier, Corrosion resistance

b) Metal casing with epoxy coated white, this casing provides a tough durable high gloss surface abrasions. This system incorporates a protective sleeving to guard againts damage during installation. It is recommended that this sleeving be left in place until completion and site insulation.



Casing Adventages: Vapour barrier, Resistance to sunlight, Corrosion resistance

c) HDPE (High Density Polyethylene) pipe Spiral or One Piece Extruded Black in color. Customarily recognised as an underground casing, but HDPE is equally suitable for aboveground systems.



Casing Adventages: Vapour barrier, Resistance to sunlight, Corrosion resistance,
Resistance to mechanical damage.

*Alternative casing available upon request

ABOVE GROUND PIPING SYSTEM

Alternative Casing

Polypipe can be supplied in the following components : Straight lengths, L Bends, T Straights, T Crossovers, Anchors and Mini Bends. All are available prefabricated, or as kitsets to be assemble on site or in your own factory. This provides for three basic systems :

Site System

Supplied in preinsulated straight lengths. Bend, tee and straight joint casing are supplied in kitset form and fitted as the pipeline is installed. The on-site insulation of these fittings being carried out after pressure testing.

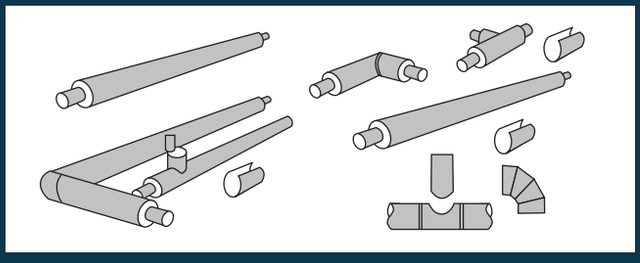
Unitised System

Supplied in preinsulated straight lengths, bends and tees of standard dimensions. The only site insulation required is the straight joints between units.

Prefabricated System

Supplied in preinsulated pipe lengths, branch offtakes and bends to specific dimensions and configurations, custom manufactured to individual requirements.

This system dramatically reduces on-site installation costs and reduces site installation to straight joints between prefabricated unit.



Access

Sufficient access is required to enable on-site insulation. To facilitate this function the minimum space required surrounding the item to be insulated is shown in insert alongside.

Expansion

Where the expansion is to be taken into the bends, normal expansion criteria should be used to ensure that the service pipe is not overstressed at the bends

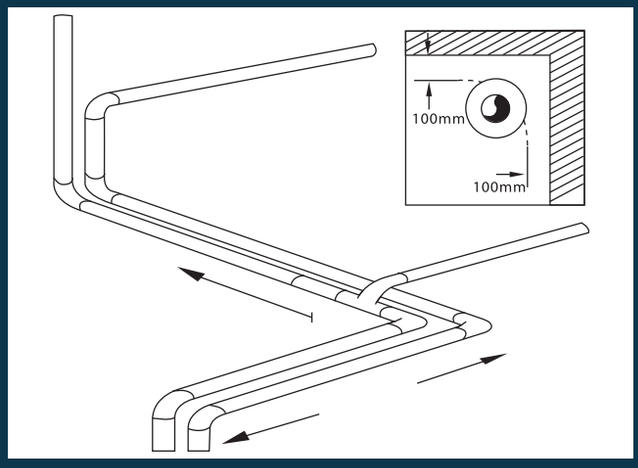
Where expansion bellows or loops are used to cater for expansion, no special allowances are required for using Polypipe. However, if long straight pipe runs are considered, we would highlight the fact that consideration should be given to the expansion stress imposed on the foam and outer casing. This stress criterion depends on many factors but generally expansion into any bends, loop or bellows should be limited to approximately 25 mm of expansion (i.e. 60 metres between bends, loops or bellows at an operating temperature of 80˚C)

If movement calculated exceeds the 25mm allowed then provision must be made to accept this movement by providing a loop offset bellows or other mechanical expansion joint.

Change in length = Original Length X Coefficient of Linear Expansion X Temperature Difference

m = m x m/m˚C x ˚C

Material	Coefficient of Linear Expansion
Steel	12 x 10 -6
Copper	17 x 10 -6
PVC	8 x 10 -6



Process Pipe Selection and Supply

Polypipe can incorporate any specified type of process pipe of any length with due regard to handling and transport. We will be pleased to supply your specified pipe or alternatively, clients may wish to supply their own pipe.

UNDERGROUND PIPING SYSTEM

Typical For Cyclic Systems

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

Polypipe 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 suitablely prepared for field welding and shall be capped for transport and storage.

Outer Casing

High density polyurethane 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 annular between the service pipe and outer casing by a one shot factory process and shall have the following properties :

Density	Nominal in situ 50kg/m^3
Thermal Conductivity	k value.023 w/m˚K at 20˚C
Compressive Strength	260kPa at room temperature
Closed Cell Content	90% by volume minimum
Insulation Thickness	Unless otherwise specified insulation thickness shall be - Pipe up to 32nb 25 mm nominal thickness - Pipes between 40 to125nb 32 mm nominal thickness - Pipes between 150 to 200nb 40 mm nominal thickness - Pipes 250 and over 50 mm minimum thickness

* Alternative thickness available upon request.

Fittings

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

- The service pipe fabrication shall be in accordance with the welding specification specified.
- All casings for fittings shall be prefabricated from high density polyurethane (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. Where preinsulated units are supplied exclusive of bulk heads, the exposed foam faces shall be coated with sealant factory applied.

Joints

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

UNDERGROUND PIPING SYSTEM

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 contractors 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.

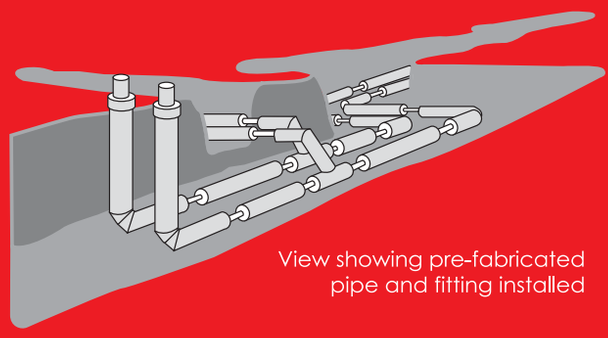
Tenderers are expected to be fully conversant with the manufacturer's installation and handling recommendations. Published technical literature is available.

DESCRIPTION

Polypipe 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 System', 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 prefabricated. 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 our factory.



View showing pre-fabricated pipe and fitting installed

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. Polypipe 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.

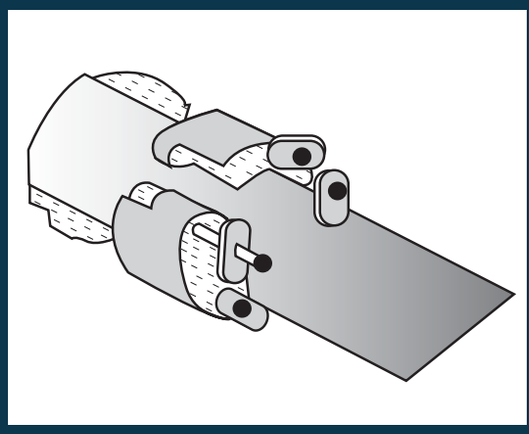
Non-destructive testing of steel pipe welds.

- Thermal aging of insulation.
- Pressure testing of process pipe.
- Mechanical properties of casing materials.
- Thermal conductivity of insulation.
- Mechanical properties of completed foam system.
- 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 British Standard.
- Biological properties of foam system.
- Physical properties of completed system.
- Tests on typical field joints under cyclic thermal
- conditions under external water pressure head.

UNDERGROUND PIPING SYSTEM

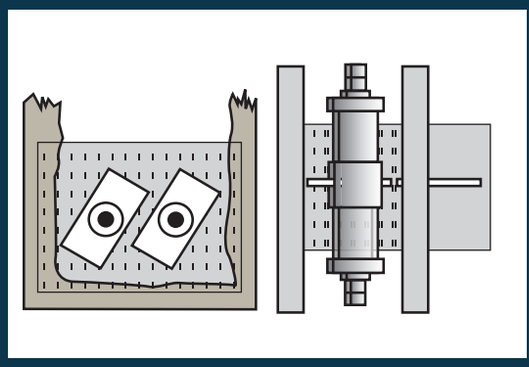
Wall Penetrations And Chambers

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 75 mm sealed and drained with a sump. The Polypipe 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 link seals. 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. ® The table below details the minimum and maximum hole sizes together with the number of links required.



Achors

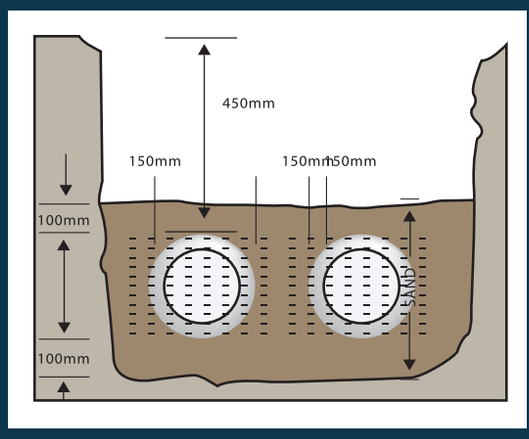
Preinsulated anchors are the only acceptable method of underground pipe. The anchor is provided with steel plates welded to the steel pipe and sealed to the casing. The dimensions of the concrete anchor block are dependent on the local soil condition and must be calculated by a competent person. However 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 100 mm 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 100 mm thick layer of sand underneath the Polypipe.

The width of the trench should be sufficient to enable the pipe to be installed with a minimum clearance of 150 mm between pipe casing and also between casing and the sides of the trench. At the area of the straight joint between Polypipe units, ensure that there is also 150 mm 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 OD	90	110	110	125	125	160	160	180	225	250	280	315	400	450

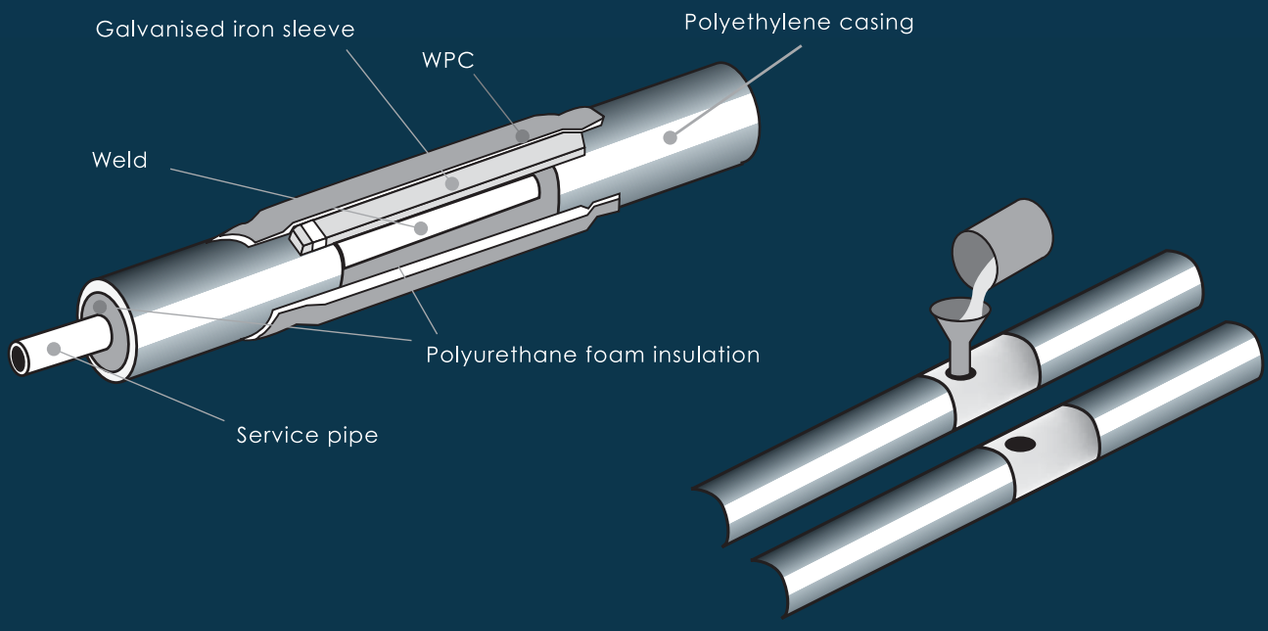
UNDERGROUND PIPING SYSTEM

Site Insulation

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

The making good of thermal insulation between preinsulated 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.

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



UNDERGROUND PIPING SYSTEM

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.

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 pipe at the bulkhead must be kept cool with wet sacking.

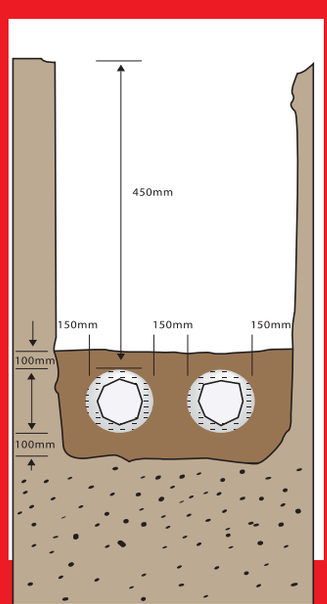
Remember! Should any bulkheads be required to be fitted on site, ensure these are fitted prior to welding up the pipe lengths and note that if a bulkhead is damaged, either prior to or during welding, it cannot be replaced while the pipe is welded up.

Pressure Testing

All welded, prefabricated 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 insulation.

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 where after 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 Polypipe.
Note that pumice should not be used as a backfill material.

REFRIGERATION PRE-INSULATED COPPER PIPE

Refrigeration- VRV, VRF Air Conditioning System

POLYTECH pre-insulated pipe is a completely factory fabricated, insulated and jacketed copper piping system for distribution of domestic hot water and refrigerant gas lines. CopperLine consists of one or two copper tubes insulated with rigid polyurethane foam, which is protected with outer jacket, usually spiral galvanized iron internal lockseam.

The benefits of pre-insulated pipe are:

1. To minimize damages and loss during transportation and / or delivery.
2. More efficient on works applying on 2 pipe system.

All POLYTECH's pre-insulated pipe system suction line is at the exact center including the two copper pipe system, this gives advantages as below:

1. BEST Insulation properties because this copper suction line is insulated evenly from surround.
2. EASY Installation where installer no need to adjust the pipe at variety position / angle just to get 2 pipes connected at the required position.

Benefits of Rigid Polyurethane (PU) foam vs. NBR foam

1. The k factor is lower than NBR foam, which means having good insulation properties hence, condensation is inhibited.
2. PU foam will gives longer life span for insulation properties, and more durable physically.
3. The flowability of PU foam fill up all the space which could lead to any heat loss.

MATERIAL

1. Carrier Pipe :

The carrier pipe shall be Refrigerant R410 with the following standard;

a) ASTM B280 b) AS1571-1985 c) JIS H3300 d) EN 12735-1

** **Specifications cover copper UNS No. C1220 & C12200**

Recommended CopperLine Copper pipe wall thickness for:

* **Liquid Line** (running pressure estimated at 2.8mpa/406psi and above)

1/4" x 0.71mm thick @ 2045psi 3/8" x 0.71mm thick @ 1315psi 1/2" x 0.71mm thick @ 968psi
5/8" x 0.81mm thick @ 879psi 3/4" x 0.91mm thick @ 821psi 7/8" x 1.14mm thick @ 624psi

* **Suction Line** (running pressure estimated at 0.9mpa/130psi)

5/8" x 0.71mm thick @ 766psi 3/4" x 0.71mm thick @ 634psi
7/8" x 0.81mm thick @ 448psi 1 1/8" x 0.91mm thick @ 380psi
1 3/8" x 0.91mm thick @ 310psi 1 5/8" x 1.22mm thick @ 352psi

Note : Max. Working pressure stated above @psi50deg. C

REFRIGERATION
PRE-INSULATED COPPER PIPE

2. Insulation – Polyurethane foam

The insulation polyurethane foam shall be rigid and machine injected, foamed in place completely filling the annual space between carrier pipe and jacket with the minimum ½" insulation thickness shall be apply.

3. Jacket – Spiral Internal / External Lockseam

The jacket material shall be sufficiently sized to allow for desired insulation thickness for optimum performance of system. Galvanized Iron metal jacket shall have an internal or external spiral lockseam.

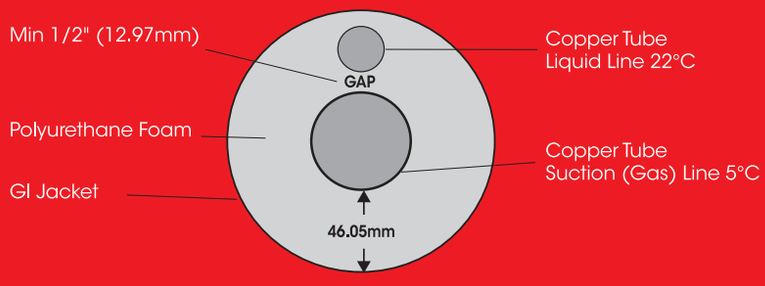
The common sizes of jacket for common gap of ½ inch between liquid line & Suction Line are listed as the table shown below:

Copper Size	Jacket size					
	80 mm	100 mm	127 mm	152 mm	160 mm	178 mm
3/8" & 1/4"	√					
1/2" & 1/4"	√					
1/2" & 3/8"	√					
5/8" & 3/8"		√				
3/4" & 3/8"		√				
3/4" & 1/2"		√				
7/8" & 3/8"		√	√			
7/8" & 1/2"		√	√			
1 1/8" & 3/8"		√	√			
1 1/8" & 1/2"			√			
1 1/8" & 5/8"			√			
1 1/8" & 3/4"			√			
1 3/8" & 1/2"			√	√		
1 3/8" & 5/8"			√	√		
1 3/8" & 3/4"			√	√		
1 3/8" & 7/8"				√		
1 5/8" & 5/8"			√	√		
1 5/8" & 3/4"				√	√	
1 5/8" & 7/8"				√	√	
2 1/8" & 5/8"				√	√	
2 1/8" & 3/4"				√	√	
2 1/8" & 7/8"				√	√	
2 5/8" & 3/4"					√	√
2 5/8" & 7/8"					√	√
2 5/8" & 1 1/8"						√

4. Insulation of Rigid Polyurethane Foam and Physical Properties:

a) Density: +/- min.45kg/m3
b) Thermal Conductivity: 0.020 W/m°C @ 20°C
c) Compressive Strength: 320kPa min.
d) Closed Cell Content: 90% min.
e) Water Vapour Permeability: 3.7 Perm-cm (2.2perm-in)
f) Insulation thickness shall be determined taking into considerationcondensation forming on the outer jacket under the climate condition
eg.1. Ambient temperature 35deg.C, Rh: 90%, Fluid temperature 5deg.C or
eg.2 Ambient temperature 30deg.C, Rh: 95%, Fluid temperature 5deg.C

REFRIGERATION
PRE-INSULATED COPPER PIPE



The above example base on the following factor:

* Pipe size: 1 3/8" & 3/4", Jacket: 127mm (PU thickness is 46.05mm Suction in middle)
* Relative Humidity (RH) : 90%
* Ambient temperature: 35°C
* Dew point: 33.11°C
* Casing temperature for 23°C is 33.68°C, Heat Loss -1.52
* Casing temperature for 5°C is 34.11°C, Heat Loss -2.83

Note : Casing Temperature must above Dew Point is **SAVE**

Below Calculation table is to determine the GAP of 2 pipes ranges gives least heat gain.

Formula : Q = k x 2πL (Δ T)
Ln(D2/D1)

D1	R1= (D1)/2	Gap = variable (mm)	R2=R1+Gap	K	Ln(D2/D1)	Length of pipe=L (meter)	k x 2πL (Δ T)	Temperature of gas pipe = Ta (C°)	Temperature of liquid pipe = Ti (C°)
41.8	20.9	3	23.9	0.020	0.1341	5.8	12.3920	22	5
41.8	20.9	6	26.9	0.020	0.2524	5.8	12.3920	22	5
41.8	20.9	9	29.9	0.020	0.3581	5.8	12.3920	22	5
41.8	20.9	12	32.9	0.020	0.4537	5.8	12.3920	22	5
41.8	20.9	16	36.9	0.020	0.5685	5.8	12.3920	22	5
41.8	20.9	20	40.9	0.020	0.6714	5.8	12.3920	22	5
41.8	20.9	25	45.9	0.020	0.7867	5.8	12.3920	22	5

Temperature change Δ T = Ta-Ti (C°)	Heat Loss = Q	Heat Loss / m	d	Water Vol M^3= (πd² / 4) x L	Density water = Kg/m^3	C=4.187 Kg/Kg°C	tf (C°)
17	92.4133	15.9333	0.04128	0.00776	7.7634	4.1870	5.00284
17	49.0985	8.4653	0.04128	0.00776	7.7634	4.1870	5.00151
17	34.6056	5.9665	0.04128	0.00776	7.7634	4.1870	5.00106
17	27.3105	4.7087	0.04128	0.00776	7.7634	4.1870	5.00084
17	21.7982	3.7583	0.04128	0.00776	7.7634	4.1870	5.00067
17	18.4581	3.1824	0.04128	0.00776	7.7634	4.1870	5.00057
17	15.7514	2.7158	0.04128	0.00776	7.7634	4.1870	5.00048

For when set liquid line initial temperature (ti) as 5 °C, and the suction line at 22 °C.
Base on the calculation of the Heat Gain formula Q = k x 2πL (ΔT)/ ln (D2/D1), when the gap in between these 2 pipes ranges from 3mm to 25mm; the liquid line final temperature is always maintain at very close to 5°C and only very slightly over. Hence the heat gain is negligible.

ADVANTAGES & SYSTEM BENEFITS

SYSTEM BENEFITS

Easy Installation
Specially designed and factory fabricated for easy and speedyinstallation to save time, labour and cost.

High Quality Control
Prefabrication procedure is well controlled to maintain consistently high quality of our products.

Installation Components
Fittings components such as elbows, tees, expansion loops and anchors are factory assembled for fast installation to all types of environment.

Optional Choice Of Jackets
There are many types of jacket such as spirally locked seam aluminium, galvanized steel, plastic-coated galvanized steel and stainless steel are available for specific requirement. PVC, polyethylene and UV inhibited plastic jackets are also available.

Application Environment
Polypipe are specially designed to suit indoor, outdoor, commercial and industrial applications.

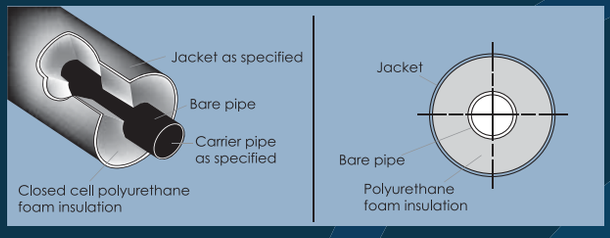
Economy
Prefabricated and preinsulated, our products are easy to install and thus are very cost effective products.

Advantages
- To achieve the maximum thermal efficiency, polyurethane is used for insulation.
- To achieve long lasting, the piping system is protected by metal or plastic material. Capability of supporting from the outside of the outer protective jacket.
- To achieve maximum saving in heat energy, calcium silicate and polyurethane are used as insulating materials.
- Most suitable for application in electric-traced environment.
- Decreased heat loss in the piping system avoiding the overloading and cooling problem of the generator.
- The calcium silicate layer provides high thermal insulation efficiency.
- The polyurethane layer provides the required thickness and density.
- The outer jacket provides the maximum protection to the piping system.
- To achieve maximum system economy, calcium silicate is used exclusively for insulation. Small thickness for desired temperature because of the high compression strength of calcium silicate.
- No temperature limit because calcium silicate is non-inflammable, high-strength inorganic
- locking insulating agent.

Wide Temperature Range

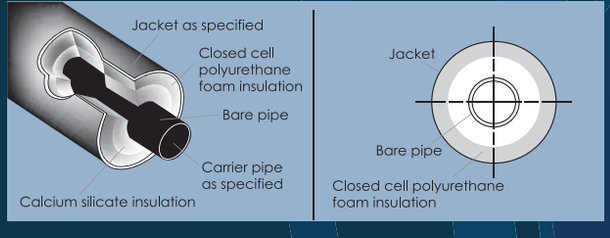
Type A :

Suitable for application of temperature lower and up to 130˚C



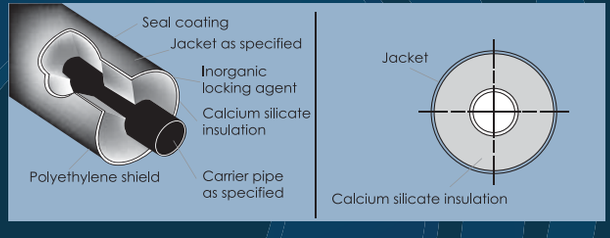
Type B :

Suitable for application of temperature between 130˚C & 150˚C



Type C :

Suitable for application of temperature above 150˚C



INSULATION

System Design

When designing an insulated system, do not design the process pipe first and then consider insulation. Take insulation into account from the outset in order to achieve the full benefits of overall economy, speed of construction, long life and integrity. Consider insulated, heat traced pipe as a single module.
Insulation comes "free" with Polypipe, when you purchase the process pipe system.

Physical Properties

Thermal Conductivity	(BS 874 rigid, MDI based polyurethane foam.)	
mean 19.7°C	thermal resistance	2.3m² °K/W
	thermal conductivity	0.022 W/m°K
mean 80.2°C	thermal resistance	2.1m² °K/W
	thermal conductivity	0.024 W/m°C

High Quality Control

Prefabrication procedure is well controlled to maintain consistently high quality of our products.

Shear strength

(BS 4370 : 1968 Method 6)	205kPa
Closed cell	93% by volume
Friability (ASTMC-421/C-367)	13% wt/10mins
Average in-place density	45 kg/m3
Compressive strength	320 kPa.

Action Of Fungi And Bacteria

Insulation is inert to test organisms. Will not support growth nor suffer mould damage.

'K' Factor (Comparative)

(at 20°C mean temperature)

Rigid Polyurethane	Polystyrene	Fibreglass	Foam Rubber	Foam Glass
0.017 (CFCII) 0.021 (HCFC1416)	0.038	0.035	0.038	0.047

Compressive Strength kPa

Rigid Polyurethane	Polystyrene	Fibreglass	Foam Rubber	Foam Glass
*320	175	35	-	690

Water Vapour Permeability

45kg/m3	3.7 Perm-cm (2.2 Perm-IN)	50kg/m3	3.5 Perm-cm (2.1 Perm-IN)

Comparative Insulation Thickness

The following are insulation thicknesses necessary to limit heat gain to 10W/m in an outdoor ambient of 35°C on an 80 nb pipeline at -20°C. Insulation comes "free" with Polypipe, when you purchase the process pipe system.

Polypipe	43mm
Fibreglass Sectional	75mm
Foamed PVC	90mm
Foamed Polystyrene	90mm
Calcium Silicate	125mm
Foam Glass	125mm

Temperature Rise Through An Insulated Pipeline

May be determined from the following formula :

where

$$\frac{Te = (qw - qa)}{ex} + qa$$

Te = exit temperature °C
qw = input temperature °C
qa = ambient air temperature °C
Cp = specific heat J/kg
M = mass flow rate kg/s
L = length of pipeline m
Q = heat gain or loss W/m
x = $\frac{L.Q}{M.Cp\ (qw - qa)}$

Description

Analysis Parameter includes:

Parameter	Test Method
(i) Core Density	JIS A9513
(ii) Compressive Strength Parallel to foam rise	JIS A9514
(iii) Thermal Conductivity K - factor	JIS A9514
(iv) Dimensional Stability (70 °C & < -20 °C) x 24 hrs	ASTM D.756

Results

Core Density	kg/m³	35.65
Compressive strength	kg/cm²	1.43
Thermal Conductivity	kcal/mh°C	0.0183
Dimensional Stability (70 °C x 24 hrs)		
(i) Thickness	%	- 0.36
(ii) Length	%	- 0.07
(iii) Width	%	- 0.66
(< -20 °C x 24 hrs)		
(i) Thickness	%	- 0.09
(ii) Length	%	- 0.05
(iii) Width	%	- 1.07

• Dimensional Stability: + indicate expension
- indicate shrinkage

Conclusion

The test results were within the normal specification
Dimensional stability within the range of = 3.0%

Insulation Thickness

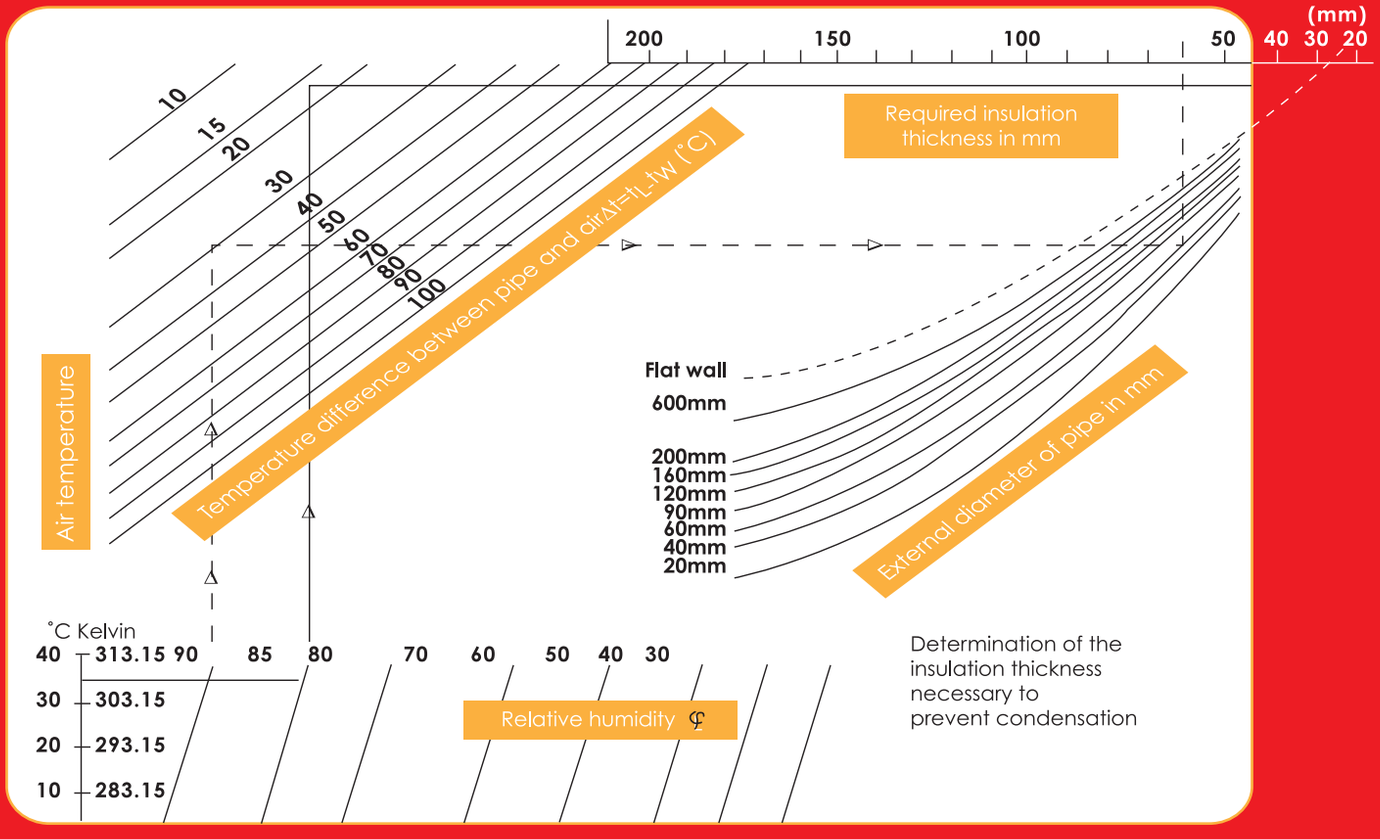
The following table details what insulation thickness is normally available in the Polypipe range. Other thicknesses are available for specific applications.

	Casing Size (mm)														
Pipe NB (mm)	80	100	125	150	160	175	200	225	250	320	325	350	375	400	425
15	29	39													
20	26	36	49												
25	23	33	45												
32		28	41	54											
40		26	38	51											
50		20	32	45											
65			24	37	42	49									
80				30	35	43	55								
100					23	30	43	55							
125							30	42	55						
150								30	41						
200										50	52	65			
250												38	51	63	
300														38	51

Prevention Of Condensation

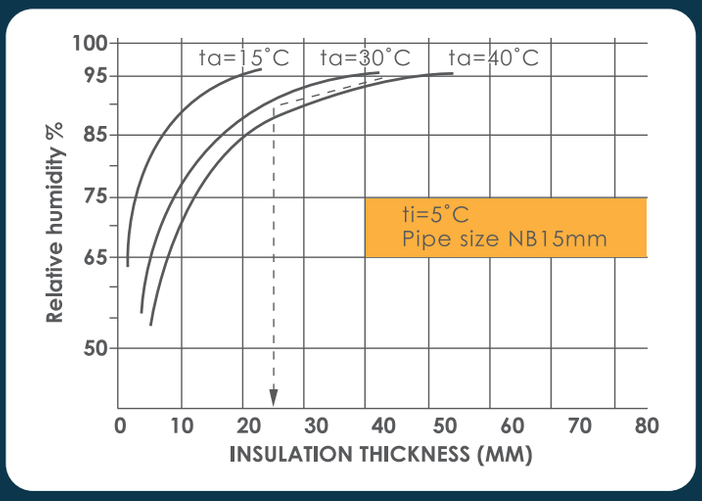
Even thin layers of rigid Polyurethane prevent condensation. To determine the thickness of Polyurethane foam insulation required to prevent condensation for insulated pipes refer to figure A.

Figure A : Nomogram to determine Polyurethane insulation thickness to prevent condensation.



CONDENSATION POINT

The following graphs are prepared as a guide to show the minimum insulation thickness required for prevention of condensation on the surface of outer jacket at ambient temperature of ta = 15˚C, 30˚C and 40˚C.



EXAMPLE

When

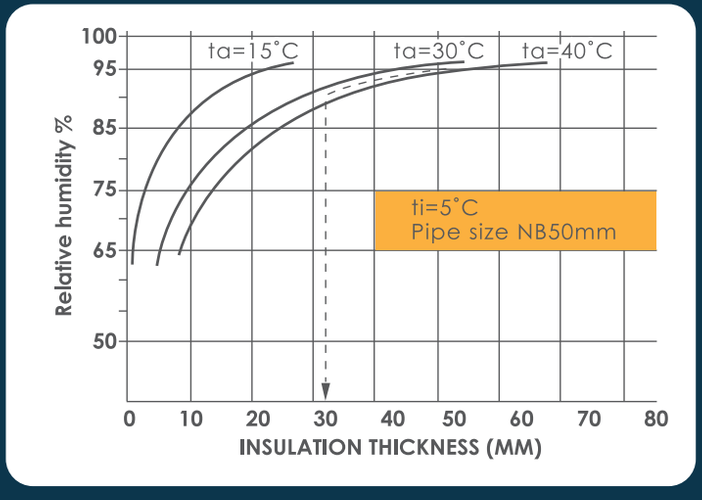
Pipe Size : 15 mm

Fluid Temp : 5˚C

Ambient Temp : 35˚C

RH : 90%

Required insulation thickness is over 25mm.



EXAMPLE

When

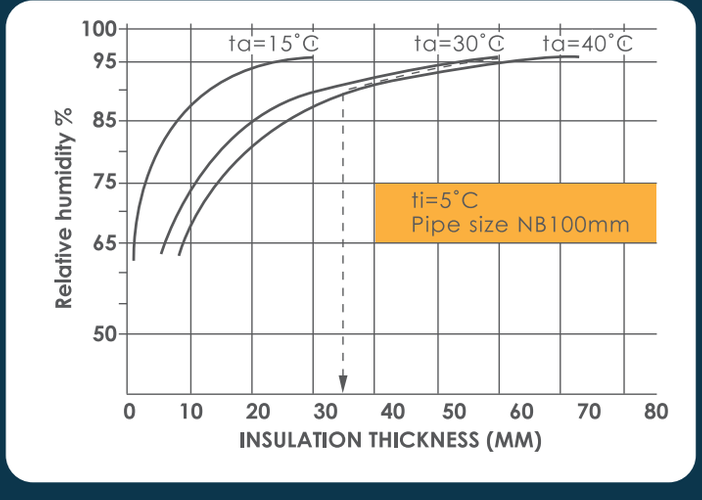
Pipe Size : 50 mm

Fluid Temp : 5˚C

Ambient Temp : 35˚C

RH : 90%

Required insulation thickness is over 32mm.



EXAMPLE

When

Pipe Size : 100 mm

Fluid Temp : 5˚C

Ambient Temp : 35˚C

RH : 90%

Required insulation thickness is over 35mm.

HEAT GAIN TABLE

Assumes Fluid Temperature 6˚C

Pipe Size		Nom Casing	Insulation Thickness	△T 20˚C Heat Gain	20˚C Dew Point	△T 35˚C Heat Gain	35˚C Dew Point	△T 45˚C Heat Gain	45˚C Dew Point	△T 55˚C Heat Gain	55˚C Dew Point	△T 65˚C Heat Gain	65˚C Dew Point
NB mm		OD mm	mm	Watts/Lin m	RH%	Watts/Lin m	RH%	Watts/Lin m	RH%	Watts/Lin m	RH%	Watts/Lin m	RH%
mm	in	80*	29	1.9	94	3.3	91	5.5	84	5.2	85	6.2	82
		100	36	1.6	96	2.8	92	3.7	91	4.4	89	5.2	88
20	¾	125	49	1.4	98	2.4	94	8.1	93	3.8	92	4.5	92
		150	61	1.25	98	2.2	96	2.8	95	3.4	95	4.1	95
		100	32	2.4	92	3.4	90	4.3	88	5.3	84	6.3	83
25	1	125	45	2.0	96	2.8	94	3.7	93	4.5	92	5.3	90
		150	57	1.8	97	2.5	96	3.2	95	3.9	94	4.7	92
		100	28	2.4	95	4.3	90	5.6	87	6.7	85	10.2	78
32	1¼	125	40	1.9	96	3.4	93	4.5	91	5.4	90	6.5	88
		150	53	1.7	98	2.9	95	3.8	94	4.7	92	5.5	91
		100	25	2.8	94	4.9	88	6.4	86	7.8	83	9.2	80
40	1½	125	38	2.2	96	3.9	92	5.0	91	6.1	89	7.2	87
		150	50	1.9	98	3.3	95	4.2	93	5.2	91	6.2	90
		125	32	2.8	94	5.0	90	6.4	86	7.9	86	9.3	84
50	2	150	44	2.3	96	4.1	94	5.2	92	6.4	90	7.6	89
		175	56	2.0	98	3.5	96	4.5	94	5.5	92	6.5	92
		125	25	3.8	94	6.7	87	9.3	83	10.5	80	12.4	80
65	2½	150	37	2.9	95	5.1	92	7.0	89	8.1	88	9.5	86
		175	49	2.4	96	4.3	95	5.5	92	6.7	91	7.9	90
		150	30	3.9	94	6.9	90	8.9	86	10.9	84	12.9	80
80	3	175	42	3.1	96	5.5	92	7.0	90	8.6	88	10.2	86
		200	54	2.6	97	4.6	96	5.9	93	7.3	92	8.6	90
		175	30	4.8	94	8.5	89	11.0	89	13.4	84	16.0	80
100	4	200	43	3.8	96	6.6	92	8.5	90	10.4	88	12.3	86
		225	55	3.2	96	5.5	95	7.1	92	8.1	92	10.2	90
		200	30	5.9	93	10.4	88	13.4	84	16.4	82	19.3	80
125	5	225	42	4.5	95	7.9	92	10.2	89	12.5	88	14.7	85
		250	54	3.7	96	6.5	94	8.4	92	10.2	92	12.1	89
		250	41	5.3	95	9.3	91	11.9	88	14.6	86	17.3	84
150	6	275	54	4.3	96	7.6	93	9.7	92	11.9	90	14.1	88
		325	52	5.4	96	9.4	92	12.1	91	14.3	90	17.5	88
200	8	350	64	4.5	96	7.9	94	10.3	92	12.5	92	14.8	90
		350	38	8.4	95	14.7	90	18.9	88	23.2	85	27.4	82
		375	51	6.7	95	11.7	92	15.0	91	18.4	88	21.7	86
250	10	380	53	6.4	96	11.2	93	14.4	92	17.7	88	20.8	89
		400	63	5.6	96	9.8	95	12.6	92	15.4	92	18.2	90
		400	38	9.9	94	17.4	90	22.3	88	27.2	85	32.2	82
		425	50	7.8	95	13.6	92	17.6	90	21.5	88	25.4	86
300	12	450	63	6.5	96	11.4	94	14.6	92	17.9	91	21.0	89
		458	67	6.2	97	10.8	94	13.9	93	17.0	92	20.0	90

Vapour Sealing

Where pipelines operate at less than ambient temperatures, it is essential that the outer surface of the insulation be totally vapour sealed. All Polypipe piping systems incorporate a 'one piece' pressure type tube as the outer casing ensuring the ultimate vapour barrier. Seams and joints in the casing are limited to bends, tees, straight joints, etc. and at these points the integrity of the vapour sealing is maintained using the best of modern technology available for the various materials used. Vapour sealing is critical for cryogenic and refrigeration applications.

Water Vapour Permeability

Test results are as follows :

ASTM - C355 Spiral wound galvanised or polyester powder coated casing solidpipe -less than 1.8×10^{-5} metric perms.

ASTM - E398 High density polyethylene casing solidpipe -less than 2.82×10^{-7} metric perms.

HEAT LOSS TABLE

The following table gives approximate heatloss from either Aboveground or Underground pipelines - For precise figures use the formula below.

Pipe Size NB		Nom Casing ID mm	Insulation Thickness mm	Temperature Differential 45°C	65°C	85°C	100°C	120°C	140°C
				Approx. Heat Loss Watts Per Lin M					
mm	IN								
25	1	80*	23	6.9	9.9	13.0	15.3	18.4	21.5
		100	32	5.6	8.2	10.7	12.5	15.1	17.6
		111*	42	5.2	7.5	9.8	11.6	13.9	16.2
32	1¼	00	28	7.	10.2	13.3	15.7	18.8	22.0
		111*	34	6.4	9.2	12.1	14.2	17	19.8
		125	42	5.7	8.3	10.8	12.8	15.3	17.9
40	1½	)(	2'	8.	11.9	1 .6	18.4	22.1	25.8
		111*	31	7.4	10.6	14	16.3	19.6	22.9
		125	39	6.5	9.4	12.3	14.5	17.4	20.3
50	2	111*	25	9.8	14.2	18.5	22.0	26.2	30.6
		125	32	8.4	12.1	15.8	18.6	22.4	26.1
		+150	44	6.8	9.9	12.9	15.2	18.3	21.3
65	2½	125	26	11.1	16.1	21.0	24.7	29.7	34.6
		145*	35	8.96	12.9	16.9	19.9	23.9	27.9
		+150	37	8.6	12.4	16.2	19.0	22.9	26.6
80	3	145*	28	12.3	17.8	23.2	27.3	32.8	38.3
		+150	30	11.5	16.7	21.8	25.7	30.9	36
		159*	35	10.5	15.2	19.9	23.4	28.1	32.8
		+175	43	9.1	13.2	17.3	20.3	24.4	28.5
100	4	+175	30	14.1	20.5	26.7	31.5	37.8	44.1
		185*	35	12.7	18.3	24	28.2	33.8	39.5
		+200	42	11.0	15.9	20.9	24.5	29.5	34.4
125	5	+200	30	17.3	24.9	32.6	38.4	46.1	53.8
		213*	36	14.9	21.5	28.1	33.0	39.6	46.3
		+225	42	13.2	19.1	25.0	29.4	35.3	41.2
150	6	+225	30	20.6	29.7	38.8	45.7	54.9	64.0
		250	41	15.5	22.4	29.3	34.5	41.4	48.3
		+275	53	12.7	18.3	24.0	28.2	33.8	39.5
200	8	+275	28	26.2	37.8	49.5	58.2	69.9	81.5
		300	40	19.5	28.1	36.8	43.3	52.0	60.7
		+325	53	15.8	22.8	29.8	35.1	42.1	49.1
250	10	+350	39	24.5	35.5	46.4	54.6	65.5	76.4
		380	53	18.8	27.3	35.5	41.8	50.1	58.5
300	12	+400	38	28.9	41.7	54.6	64.2	7.7	90S
		425	50	22.8	32.9	43.1	50.7	60.9	71.0
		458	69	18.1	26.2	34.2	40.3	48.3	56.4

Items marked : * in High Density Polyethylene casings only ; + in metal casing only

For Aboveground systems an excellent approximation of heat gained or lost by an insulated pipeline and of insulation surface temperature can be obtained by using the IHVE formula -

$$Q = \frac{(\theta w - \theta\alpha)\,\pi}{1/2k \ln \left[\frac{D2}{D1}\right] + \frac{1}{hso\ D2}} \qquad \text{and } Tc = \theta\alpha + \frac{Q}{D2\ hso}$$

Where
- θw = fluid temperature °C
- $\theta\alpha$ = ambient air temperature °C
- K = thermal conductivity of insulation W/m°K
- Q = heat gain
- D1 = outside diameter pipe (m)
- D2 = outside diameter insulation (m)
- Tc = insulation surface temperature °C
- hso = a surface coefficient - normally 8

For Underground systems the BS4508 quotes the following formula -

$$Ri = \frac{\ln (1+2t/d1)}{2\pi ki} \qquad Rs = \frac{\ln (4h/d2)}{2\pi ks} \qquad Q = \frac{\theta w - \theta\alpha}{Ri + Rs}$$

Where
- θw = process temp °C
- $\theta\alpha$ = ambient temp °C
- d1 = outside diameter of process pipe m
- t = thickness of insulation m
- d2 = outside diameter of casing (m)
- h = depth of burial m
- ki = thermal conductivity of insulation W/mk
- ks = thermal conductivity of soil W/mk

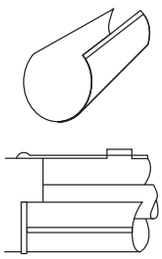
Quantity Of Chemical (ISO & Polyol) Required Per Joint

Designation	Elbow Joint	Reducer Joint	Tee Joint	Straight Joint
15/80	0.08	0.07	0.11	0.06
15/100	0.15	0.13	0.21	0.12
15/125	0.24	0.22	0.23	0.19
20/80	0.07	0.07	0.11	0.06
20/100	0.15	0.13	0.21	0.12
20/125	0.24	0.22	0.33	0.19
25/80	0.07	0.06	0.10	0.05
25/100	0.14	0.13	0.21	0.11
25/150	0.34	0.32	0.51	0.27
32/100	0.14	0.12	0.20	0.10
32/125	0.23	0.20	0.34	0.17
32/150	0.34	0.31	0.52	0.26
40/100	0.13	0.12	0.20	0.10
40/125	0.23	0.20	0.35	0.17
40/150	0.35	0.31	0.53	0.25
50/100	0.12	0.10	0.17	0.08
50/125	0.23	0.19	0.32	0.15
50/150	0.40	0.34	0.57	0.27
65/125	0.21	0.17	0.30	0.13
65/150	0.36	0.28	0.49	0.22
65/180	0.50	0.40	0.70	0.31
80/125	0.17	0.13	0.23	0.10
80/160	0.33	0.24	0.44	0.19
80/200	0.72	0.53	0.96	0.41
100/160	0.30	0.20	0.39	0.15
100/175	0.43	0.29	0.54	0.21
100/215	0.83	0.55	1.05	0.41
125/220	0.84	0.53	1.02	0.37
125/250	1.23	0.77	1.48	0.54
125/300	2.02	1.27	2.44	0.89
150/250	1.11	0.64	1.29	0.44
150/280	1.45	0.84	1.69	0.58
150/300	2.25	1.30	2.61	0.89
200/300	1.65	0.82	1.79	0.54
200/350	1.96	0.97	2.12	0.65
200/400	4.35	2.16	4.70	1.44
250/350	2.23	1.00	2.31	0.63
250/400	3.93	1.77	4.06	1.11
250/450	4.98	2.33	5.16	1.47
300/400	2.96	1.22	2.95	0.73
300/350	4.25	1.88	4.30	1.20
300/520	7.90	3.43	7.88	2.00
350/450	3.45	1.67	3.53	1.01
350/520	8.36	3.98	8.35	2.45
400/520	9.01	4.23	8.98	2.98

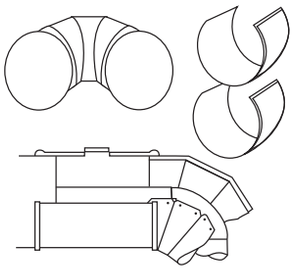
SITE INSTALLATION DATA

Pre-Insulated and Pre-Fabricated Fittings

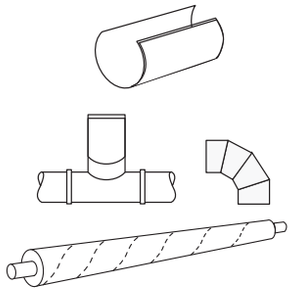
Straight Joints



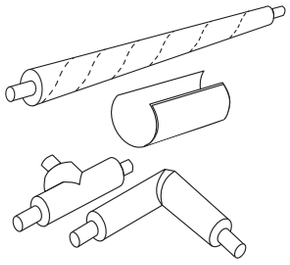
Bends



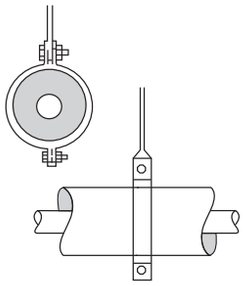
Site System



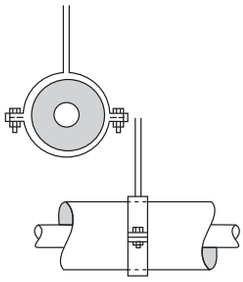
Unitised System



A. Pipe Hanger (ROD)

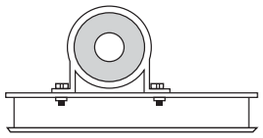


B. Pipe Hanger

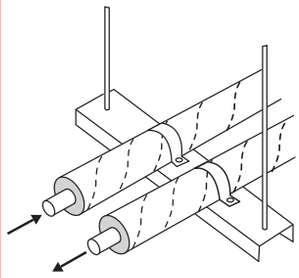


C. U Clamp

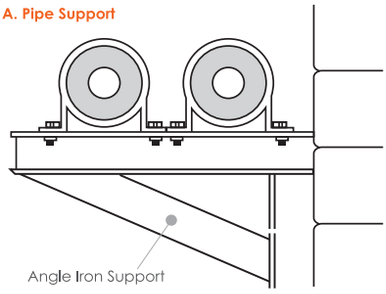
D. Pipe Guide



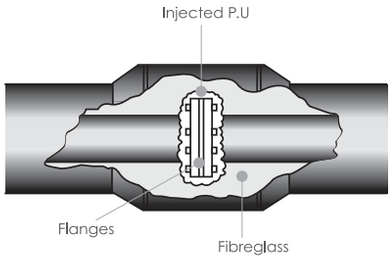
E. Typical Hanger



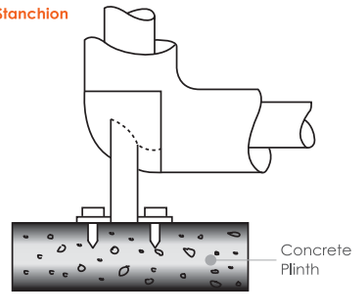
A. Pipe Support



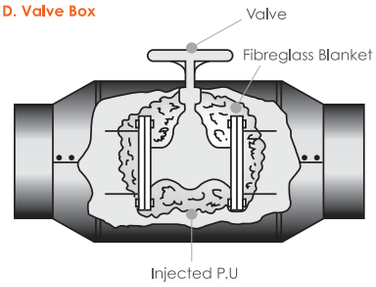
B. Flange Box



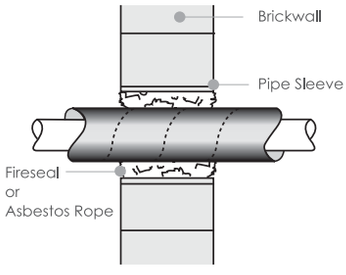
C. Stanchion



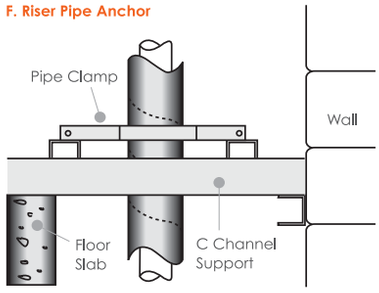
D. Valve Box



E. Wall Penetration



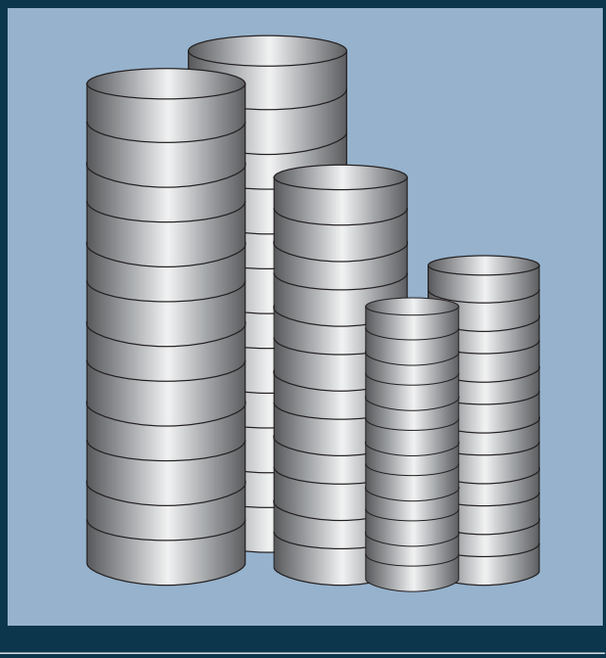
F. Riser Pipe Anchor



SPIRAL ROUND DUCT

Spiral Round Duct Systems Benefits :

- Energy Efficient
- Cost less to install
- Often requires less spaces
- Needs less hangers
- Operation costs lower
- More noise free
- Installation simplified
- Cleaning less complicated
- Airflow measurements easier
- Lighter in weight

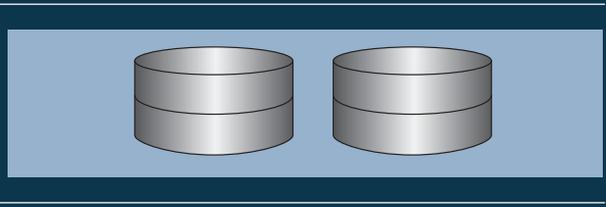


Duct

We offer you a flexible range of standard gauges, diameters, lengths and methods of assembly to meet your changing needs for strength, wearability and stability. Our duct is available in standard diameters 80 – 1350mm.

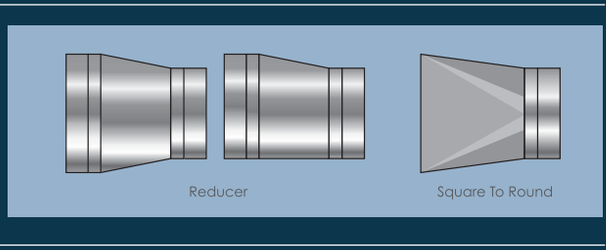
Socket / Connector

Socket or connector is joint connection for the duct.



Reducer and Square to Round

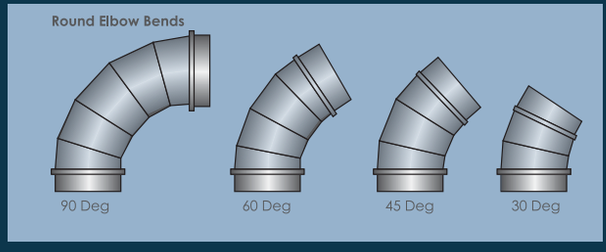
Reducer and square to round very often form an integrated part of any duct system – typically where machines have to be connected, where duct velocities need to be modified etc.



Elbows

We offers you a flexible range of standard gauges, diameters, degrees and method of assembly to fill your changing needs for strength, wearability and space availability.

Our elbows are segmented and available in standard diameters 100mm to 1500mm.



Job Reference :-

		CHW System	VRV System	Spiro Duct
TSH Biotech Wakuba	Tawau, Sabah	√		
Giant	Sepang, Selangor			√
Rapid KL	Kuala Lumpur	√		
Mahkamah Shah Alam	Shah Alam, Selangor	√		
MPOB Block PDAC	Bangi, Selangor	√		
Rakan Muda Bera	Kuantan, Pahang	√		
MLIP	Kuantan, Pahang	√		
Bukit Tinggi	Klang, Selangor	√		
Nilai International School	Nilai, NS		√	
Sunway College	Sunway, Selangor	√		
Double Tree Hotel	Ampang, KL	√		
Hotel Pahlawan 1	Melaka	√		
Senai Airport (Extension)	Johor	√		
Alson Klana Bukit Tinggi Hotel	Klang, Selangor	√		
Casa Del Rio Melaka Hotel	Melaka	√		
Akademi Seni Budaya & Warisan Kebangsaan	Kuala Lumpur	√		
Pusat Islam Malaysia	Kuala Lumpur		√	
Hartalega Factory Extension	Kuala Selangor, Selangor	√		
Maybank Bukit Jelutung	Shah Alam, Selangor	√		
TYT Industry Sdn Bhd	Sitiawan, Perak	√		
City Square	Kuala Lumpur	√		
Inspen Sepang	Sepang, Selangor	√		
Sentosa Hospital	Kuala Lumpur	√		
Akept	Nilai, NS	√		
Alesco Paint Factory	Klang, Selangor	√		
KSL City	Johor Bahru, Johor	√		
University Malaya Asasi Sains	Petaling Jaya, Selangor		√	
JPJ	Alor Setar, Kedah	√		
University Malaya Fakulti Pergigian	Petaling Jaya, Selangor		√	
Glomac	Kuala Lumpur	√		
Management and Science University (MSU)	Shah Alam, Selangor		√	
Delta Height Jalan Tun Razak	Kuala Lumpur	√		
Freescale	Petaling Jaya, Selangor	√		
Perdana Hospital Kelantan	Kota Bahru, Kelantan		√	
Lab & Pharmacy Manufacturrer	Nigeria	√		
Audit Negara	Seremban, NS	√		
UTM	Jalan Semarak, KL		√	
Institut Kemahiran Belia Negara	Banting, Selangor	√		
UITM	Shah Alam, Selangor		√	
Hotel Pudu Dalam	Kuala Lumpur	√		
Mines2	Balakong, Selangor	√		
Mahkamah Syariah	Jalan Duta, KL	√	√	
Nouvelle Hotel	Kuala Lumpur	√		
Tesco (Refrigeration)	Melaka		√	
RTM	Kota Kinabalu, Sabah	√		
Giant (Refrigeration)	Ulu Tiram, Johor			√
Ibiden	Penang	√		
Mardi, Serdang Makmal Lepas Tuai	Serdang, Selangor	√		
UIAM	Kuantan, Pahang	√		
UMK	Kota Bahru, Kelantan		√	

		CHW System	VRV System	Spiro Duct
Kid Zania Mutiara	Damansara, Selangor	√		
Politeknik Nilai	Nilai, NS		√	
Niosh	Bangi, Selangor		√	
Carrefour Seksyen 23	Shah Alam, Selangor		√	
UTM BIO SAINS	Johor Bahru, Johor		√	
Stride	Kajang, Selangor	√	√	
UOA Phase2 Blok 7 - 10	Bangsar, KL	√		
Marinara Building (Menara 238)	Kuala Lumpur	√		
Multitape	Kulim, Kedah	√		
Cinema Subang Parade	Subang, Selangor	√		
Onsemi	Senawang, NS	√		
IAB	Sepang, NS	√		
KK2 Klinik Kesihatan	Kuala Lumpur	√		
Station 1 Complex	Segamat, Johor	√		
NSK Supermarket	Kuchai Lama, KL	√		
Malaysia Milk	Klang, Selangor	√		
Damansara Specialist Hospital	Damansara, Selangor	√		
Plaza Sentosa	Johor Bahru, Johor	√		
Kompleks Mini Khedn	Langkawi, Kedah	√		
MSU Phase 2	Shah Alam, Selangor		√	
Tiong Nam (Refrigeration)	Shah Alam, Selangor	√		
Pekan Bukit Kepayang	Seremban, NS	√		
New Gaming	Genting Highland, Pahang	√		
Pearl Regency	Penang	√		
Sony	Bangi, Selangor	√		
Wisma Persekutuan	Kuala Terengganu	√		
Pearl Regency	Penang	√		
Elken	Subang, Selangor	√		
Island Hospital	Penang	√		
Rawang Hospital	Rawang, Selangor	√		
Panasonic	Penang	√		
Mydin	Melaka	√		
Cheras Central	Kuala Lumpur	√		
Ibiden Phase2	Penang	√		
Weil Hotel	Ipoh, Perak	√		
Waterfrant	KK, Sabah	√		
Nilam Tekad	Port Klang, Selangor	√		
Fibertex Personal Care	Nilai, Negeri Seremban	√		
IPK	JB, Johor		√	
Tune Hotel	Jln Sultan Ismail, KL		√	
Dpulze Ventures	Cyberjaya	√		
Manipal University	Nilai, Negeri Seremban	√		
Infineon	Melaka	√		
Daiman Landmark Hotel	Johor Centre, Johor	√		
AEON Jusco	Bukit Mertajam, Penang	√		
Le Apple Hotel	Kuala Lumpur	√		
Tiga Man Square Shopping Central	Shah Alam, Selangor	√		
Artia Damansara	Damansara, Selangor	√		
Gleneangle Medini Hospital	Johor Bahru, Johor	√		
Giant	Kampar, Perak			√

POLYTECH INSULATION

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Website : www.polytechpu.com.my

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