PRE-INSULATED PIPING SYSTEM

ISOCLAD

DESCRIPTION AND APPLICATION

Isoclad has a range of both aboveground and underground factory insulated piping system manufactured under stringent quality control conditions.

It is suitable for airconditioning chilled water piping systems, process piping system and domestic hot water piping system with media temperature ranging between - 50°C to + 140°C in any environmental conditions.

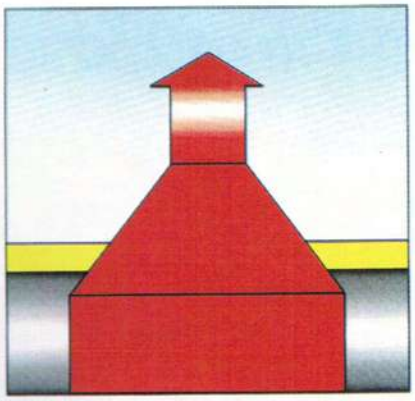
It offers a high efficiency thermal insulation coupled with the ultimate vapour barrier and weather protection. The extremely robust waterproof insulation system can safely support the weight of the pipe and its contents.

Isoclad can therefore be hung from its outer casing thus eliminating the use of cumbersome insulated supports which are usually the potential points of vapour ingress.

Isoclad is available in the casing of your choice utilizing any type of service pipe required.

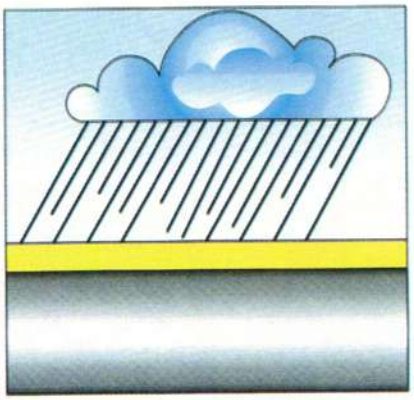
MANUFACTURING PROCESS

Isoclad is manufactured from three basic components. A pressure tight casing, the required service pipe and rigid polyurethane foam. The service pipe is centralised within the outer casing and the resultant annular space between the casing and service pipe is machine filled with polyurethane foam. The foam expands and upon setting foams a dense homogeneous insulation around the pipe.



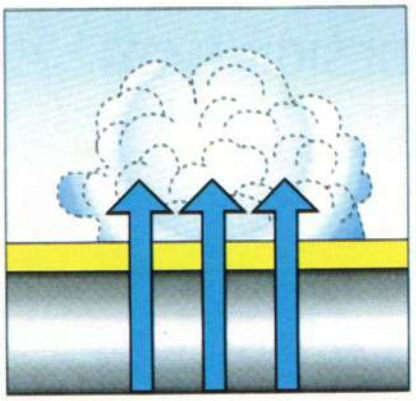
Thermal conductivity and coefficient of expansion

Rigid polyurethane foam has the lowest thermal conductivity and coefficient of expansion of all known insulating materials.



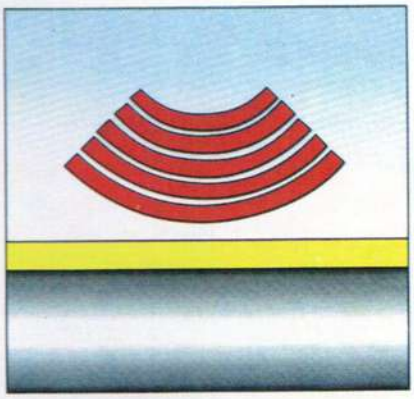
Weather resistance

The outer casing material is galvanised, stainless steel or high density polyethylene tubes which will withstand extreme climatic condition.



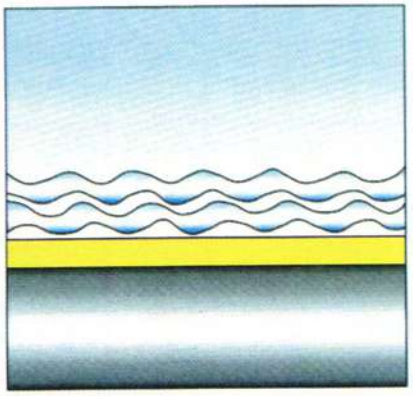
Ultimate Vapour Barrier

The pressure tight spiral-locked seam tube or high density polyethylene tube provides ultimate vapour barrier.



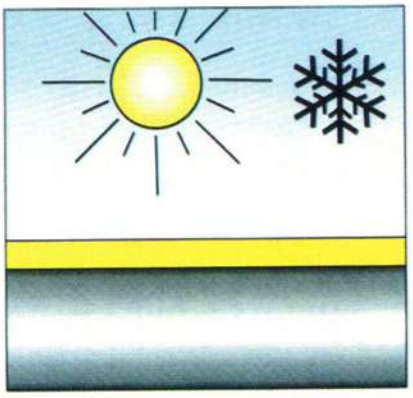
Sound attentuation

Polyurethane foam provides very good damping properties. It reduces noise considerably.



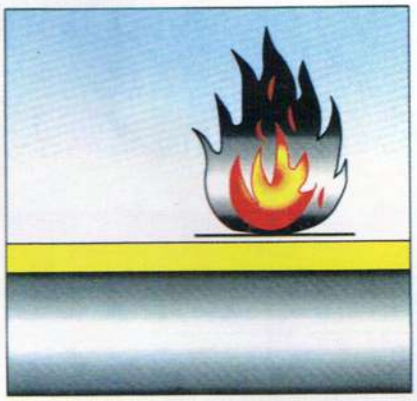
Watertightness

The pressure-tight locked seam tube or the high density polyethylene, homogeneous and seamless tube ensures water tightness.



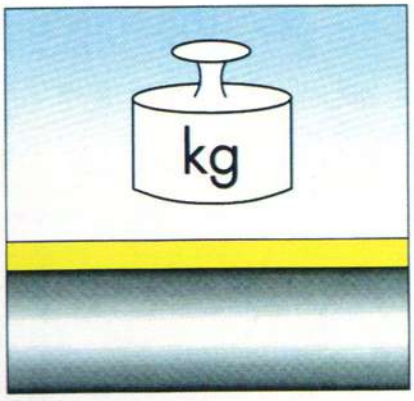
Thermal stability

Isoclad pipe system can be used over a wide range of temperatures between - 50° C up to + 140° C.



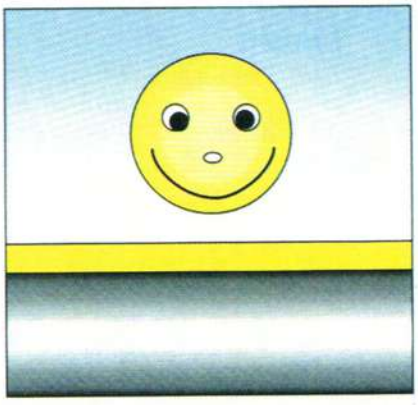
Fire behaviour

Tested to ISO Standard 834 and BS 476. Full report available on request.



Mechanical Properties

With compressive strength up to 275 Kpa, the insulation coupled with the robust outer casing, Isoclad can hung directly on its casing.



Environment Friendly

The polyurethane foam utilizes CFC free blowing agent.

DESIGN DATA

Specification: Typical

All thermally insulated aboveground and underground pipework shall be preinsulated black steel pipe conforming to the following specifications:

Insulation shall be 'Isoclad' pipe in pipe without air gap, or approved equivalent of the physical properties indicated below. This material must be installed strictly in accordance with manufacturer's recommendations.

1 Service Pipe:

Up to and including 6" NB shall be black steel pipe to BS 1387 or equivalent.

8" and over shall be API 5L Grade B standard weight or equivalent.

In either case the pipe shall be suitable for the pressure service specified elsewhere.

2 Outer Casing:

Shall be:

(a) Spiral formed locked seam galvanised iron gauge 24

(b) High Density Polyethyiene (HDPE) for underground system.

3 Finish:

(a) Plain galvanised iron spangle chromated

(b) Black

4 Insulation:

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

4.1 Density
48 kg/m^3

4.2 Thermal Conductivity:
k value 0.023 W/mK
at 20°C mean

4.3 Compressive Strength:
minimum 255 Kpa

4.4 Closed Cell Content:
90% by volume minimum

5 Complete System:

5.1 Water vapour permeability
1.8×10^{-5} metric perms
(2.6×10^{-2} perm inch)

5.2 Fire Rating
2 hr at 1000°C and shall be certified to the approval of the relevant authority.

6 Thickness of Insulation:

(a) Shall be such thickness as to prevent condensation forming on the outer casing under the following conditions:

Ambient Temp	Rh%	Fluid Temp
35°C (95°F)	90	6°C (43°F)
30°C (86°F)	95	6°C (43°F)

DESIGN DATA

Insulation Thickness

The following table details what insulation thickness is available in the Isoclad range.

Pipe N.B.	CASING SIZE (mm)																							
	100	115	125	140	155	175	190	215	225	250	270	300	320	350	375	400	425	450	485	500	550	600	650	700	750
15	39		52																						
20	37	44	49																						
25	33	41		53																					
32	28		41	49																					
40	26		38		53																				
50		27		40		57																			
65			25		40	50																			
80				26		43	51																		
100							38	50		68															
125									42	54	64														
150										42	52	66													
200												40	50	65											
250														39	51	64									
300																38	51	63							
350																		47	65	72					
400																				47	72				
450																					47	72			
500																						46	71		
600																								45	70

Heat Gain and Casing Temperatures

An excellent approximation of heat gained by an insulated pipeline and of insulation surface temperature can be obtained by using the IHVE formulae.

$$Q = \frac{(\theta w - \theta a)\,\pi}{\frac{1}{2k}\log_e\frac{D2}{D1} + \frac{1}{HSO\ D\ 2}}$$

and

$$Tc = \theta a - \frac{Q}{D2\ \ HSO\ \pi}$$

where θw = fluid temperature °C
θa = ambient air temperature °C
K = thermal conductivity of insulation W/mK
Q = heat gain
D1 = outside diameter pipe m
D2 = outside diameter insulation m
Tc = insulation surface temperature °C
HSO = a surface coefficient - normally 8

HEAT GAIN TABLE

Pipe Size mm	Nom. Casing mm	Insulation Thickness mm	Heat Gain W/m	Insulation Surface Temp. °C
15	100	39	2.3	34.08
	125	52	2.0	34.36
20	100	37	2.6	33.97
	115	44	2.4	34.17
25	100	33	3.2	33.73
	115	41	2.8	34.04
32	100	28	3.8	33.49
	125	40	3.1	34.02
40	100	25	4.6	33.17
	125	38	3.6	33.86
50	115	27	5.2	33.22
	140	40	4.1	33.83
65	125	25	6.7	32.87
	155	40	4.8	33.77
	175	49	4.2	34.05
80	140	26	7.4	32.90
	175	42	5.1	33.85
	190	51	4.6	34.04
100	175	30	7.9	33.22
	200	43	6.2	33.77
	215	51	5.5	33.99
125	225	42	7.4	33.67
	250	54	6.1	34.22
150	250	41	8.7	33.62
	270	52	7.3	33.99
	300	66	6.1	34.19
200	300	40	10.9	33.55
	320	51	9.2	33.86
	350	64	7.5	34.15
250	350	38	13.8	33.43
	375	51	11.0	33.83
	400	64	9.2	34.08
300	400	38	16.3	33.38
	425	50	12.8	33.8
	450	64	10.7	34.05
350	485	65	11.4	34.06
400	550	71	11.7	34.15
450	600	71	13.0	34.14
500	650	71	14.3	34.12
600	750	70	17.0	34.09

The above data only applicable to ISOCLAD Preinsulated Pipe System under the following conditions:

Chilled Water Working temperature	:	6^0c
Ambient temperature	:	35^0c
Thermal Conductivity of Polyurethane foam	:	0.023 W/mK
Density of polyurethane foam	:	48 kg/m^3
Outer Casing thickness	:	0.6mm
Surface Coefficient of air	:	8
Relative humidity	:	90%

DESIGN DATA

Thermal Movement and Flexibility

Allowance must be made in design, layout and installation for the pipeline's ability to accept movement due to contraction and expansion in operation. In most cases the pipeline's route possesses inherent flexibility through bends and changes of direction to absorb movement and not overstress the system. However, we would point out that thermal movement should be limited to 25 mm at any bend to protect the foam, casing and vapour.

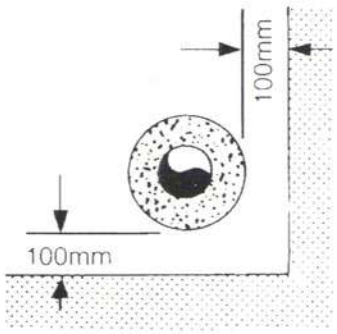
If movement calculated exceeds the 25 mm allowed then provision must be made to accept this movement by providing a loop, offset, bellows or other mechanical expansion joint.

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
Cooper	17 x 10 6
PVC	8 x 10 6

Access

When designing supports and pipe routes consideration should be given to provision of enough working room to enable good on-site insulation. It is recommended a minimum of 100 mm all round is allowed.

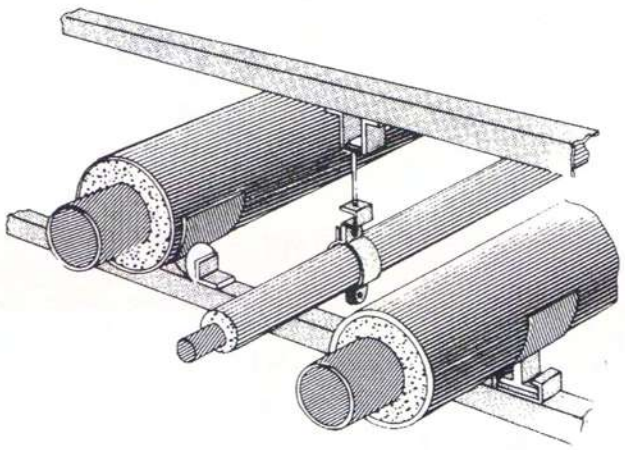


Pipe Supports

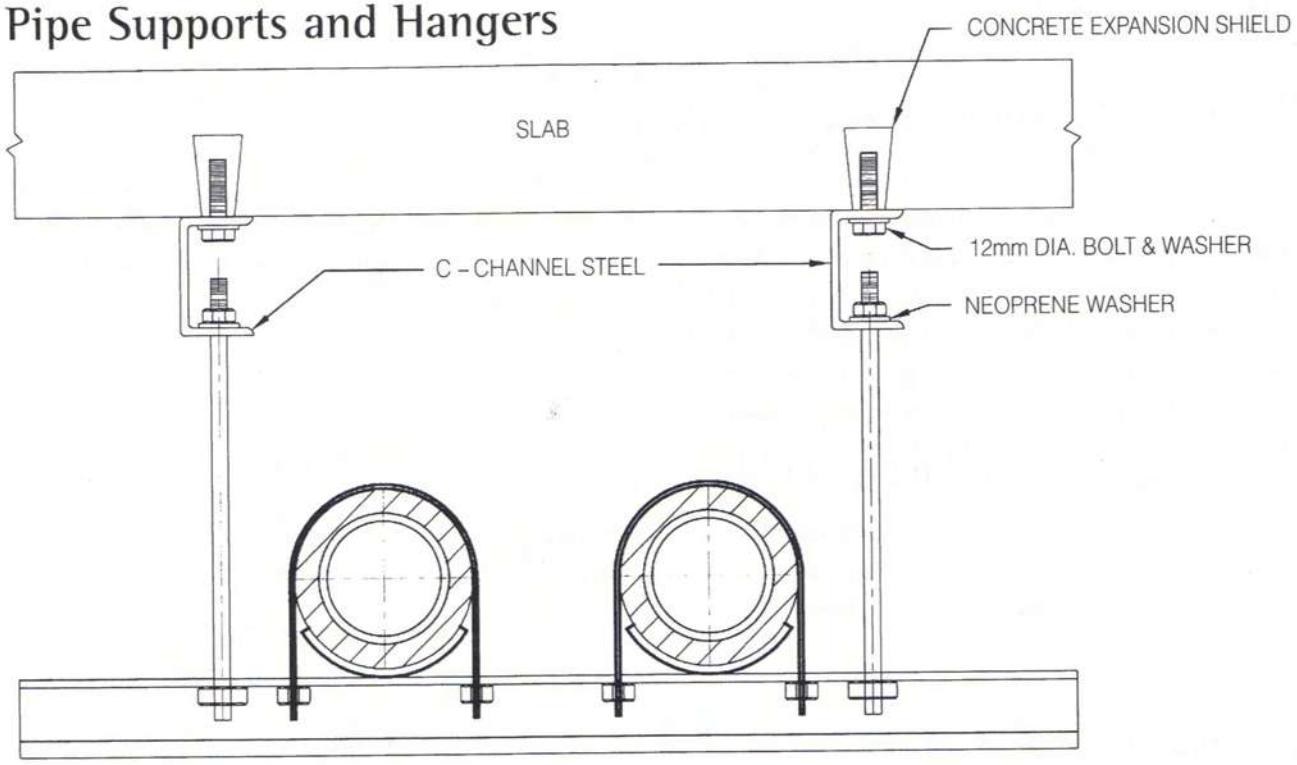
Isoclad is a rigid insulation system capable of being supported on the outer casing in a number of ways.

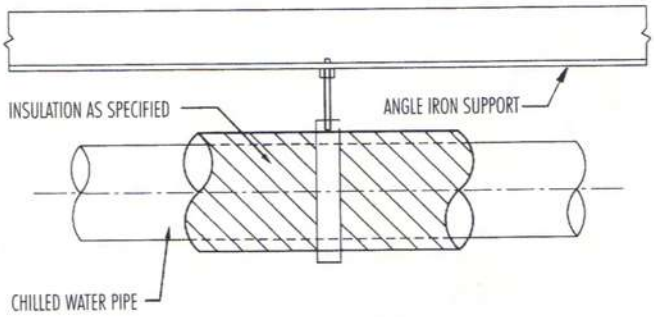
Care should be taken in designing supports to ensure that the loads are distributed over an acceptable area. The compressive strength of the foam is quoted at 320 Kpa but this strength varies as temperature increases.

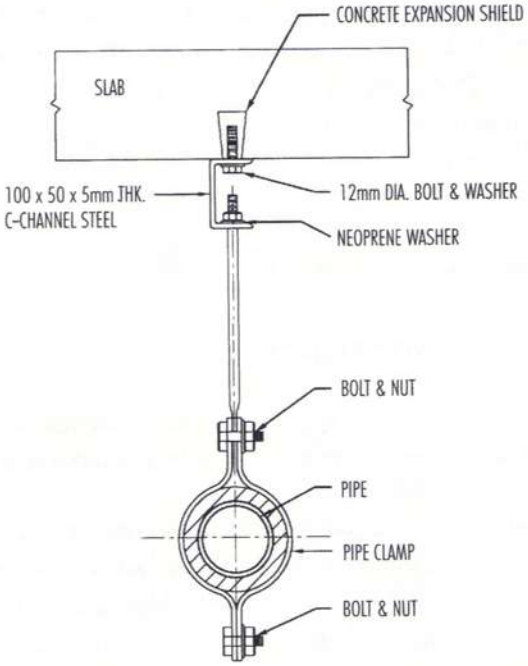
It is recommended that supports and hangers be designed based on a safe comprehensive strength of 170 Kpa taken over the bottom third of the casing for applications where temperatures are unlikely to exceed 100°C and for temperatures over 100°C a safe compressive strength of 100Kpa over the bottom third of the casing.



Pipe Supports and Hangers

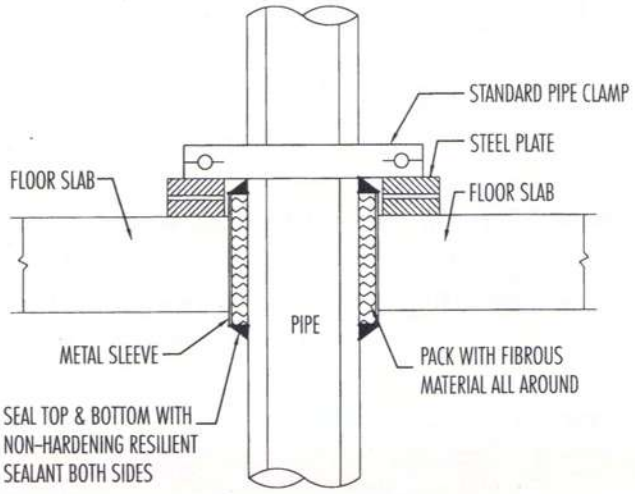




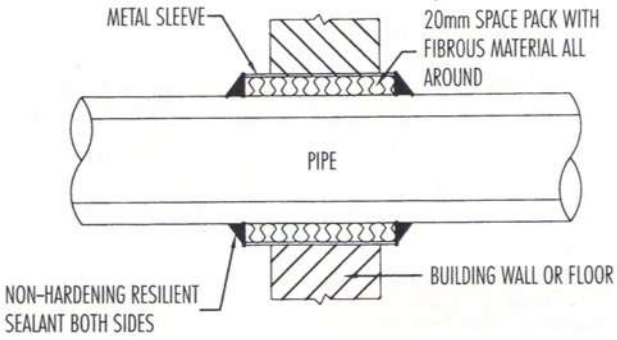


Nominal Pipe Size (For Single Pipe)	Maximum Span-M	Minimum Rod Diameter - mm
Up to and including 50 mm	2.00	9
65 mm bore to 100 mm bore	3.5	12
125 mm bore to 150 mm bore	4.0	15
200 mm bore to 300 mm bore	4.0	20
Above 300 mm bore	4.0	25

Wall and Floor Penetrations



Typical Floor Penetration

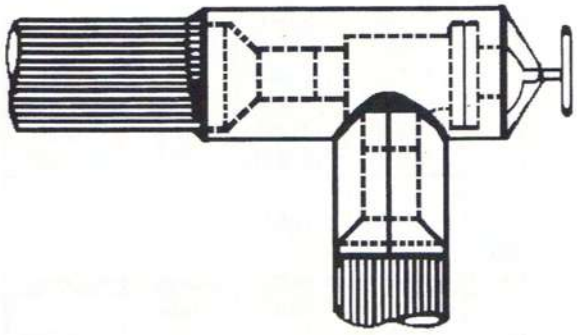


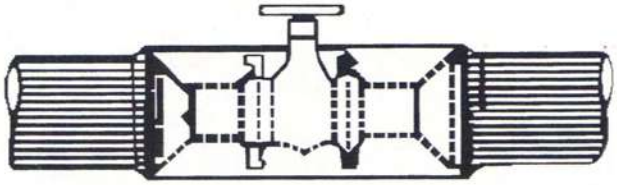
Typical Wall Penetration

Valves and Mechanical Couplings

Consideration should be given to access for maintenance on valves and it is recommended that they are not insulated with polyurethane foam poured in situ but with a sectional pipe loose fill type.

When insulating mechanical couplings designed to allow thermal movement, the coupling should be wrapped with flexible insulation before insulating to ensure insulation does not affect operation.





SERVICE PIPE SELECTION

Isoclad system can incorporate any specified type of service pipe (see pipe tables).

Those commonly used are:

Pipe Size	Standard
15 mm to 150 mm	Black, medium or heavy steel to BS 1387
200 mm and above	(a) Black ERW or seamless steel pipe to Apl 5L GR. B std weight
	(b) Black steel pipe to JIS G 3452
	(c) Black ERW steel pipe to BS 3601

Bs 1387: 1985

Steel Tubes and Tubular (Light, Medium, Heavy)

Nominal Bore		Outside Diameter				Thickness	Weight of Black Tube		Sockets min.	
		max.		min.			Plain End	Screwed & Socketed	Outside Diameter	Length
in	D/N mm	in	mm	in	mm	mm	kg/m	kg/m	mm	mm
Light										
*1/4	8	.532	13.6	0.518	13.2	1.8	0.515	0.519	18.5	27
*3/8	10	0.671	17.1	0.656	16.7	1.8	.670	0.676	22.0	28
1/2	15	0.841	21.4	0.825	21.0	2.0	0.947	0.956	27.0	37
3/4	20	1.059	26.9	1.041	26.4	2.3	1.380	1.390	32.5	39
1	25	1.328	33.8	1.309	33.2	2.6	1.980	2.000	39.5	46
1 1/4	32	1.670	42.5	1.650	41.9	2.6	2.540	2.570	49.0	51
1 1/2	40	1.903	48.4	1.882	47.8	2.9	3.230	3.270	56.0	51
2	50	2.370	60.2	2.347	59.6	2.9	4.080	4.150	68.0	60
2 1/2	65	2.991	76.0	2.960	75.2	3.2	5.710	5.830	84.0	69
3	80	3.491	88.7	3.460	87.9	3.2	6.720	6.890	98.0	75
4	100	4.481	113.9	4.450	113.0	3.6	9.750	10.000	124.0	87
Medium										
*1/4	8	.547	13.9	0.522	13.3	2.3	0.641	0.645	18.5	27
*3/8	10	0.685	17.4	0.660	16.8	2.3	0.839	0.845	22.0	28
1/2	15	0.856	21.7	0.831	21.1	2.6	1.210	1.220	27.0	37
3/4	20	1.072	27.2	1.047	26.6	2.6	1.560	1.570	32.5	39
1	25	1.346	34.2	1.316	33.4	3.2	2.410	2.430	39.5	46
1 1/4	32	1.678	42.9	1.657	42.1	3.2	3.100	3.130	49.0	51
1 1/2	40	1.919	48.8	1.889	48.0	3.2	3.570	3.610	56.0	51
2	50	2.394	60.8	2.354	59.8	3.6	5.030	5.100	68.0	60
2 1/2	65	3.014	76.6	2.969	75.4	3.6	6.430	6.550	84.0	69
3	80	3.524	89.5	3.469	88.1	4.0	8.370	8.540	98.0	75
4	100	4.524	114.9	4.459	113.3	4.5	12.200	12.500	124.0	87
5	125	5.534	140.6	5.459	138.7	5.0	16.600	17.100	151.0	96
6	150	6.539	166.1	6.459	164.1	5.0	19.700	20.300	178.0	96
Heavy										
*1/4	8	0.547	13.9	0.522	13.3	2.9	0.765	0.769	18.5	27
*3/8	10	0.685	17.4	0.660	16.8	2.9	1.020	1.030	22.0	28
1/2	15	0.856	21.7	0.831	21.1	3.2	1.440	1.450	27.0	37
3/4	20	1.072	27.2	1.047	26.6	3.2	1.870	1.880	32.5	39
1	25	1.346	34.2	1.316	33.4	4.0	2.940	2.960	39.5	46
1 1/4	32	1.678	42.9	1.657	42.1	4.0	3.800	3.830	49.0	51
1 1/2	40	1.919	48.8	1.889	48.0	4.0	4.380	4.420	56.0	51
2	50	2.394	60.8	2.354	59.8	4.5	6.190	6.260	68.0	60
2 1/2	65	3.014	76.5	2.969	75.4	4.5	7.930	8.050	84.0	69
3	80	3.524	89.5	3.469	88.1	5.0	10.300	10.500	98.0	75
4	100	4.524	114.9	4.459	113.3	5.4	14.500	14.800	124.0	87
5	125	5.534	140.6	5.459	138.7	5.4	17.900	18.400	151.0	96
6	150	6.539	166.1	6.459	164.1	5.4	21.300	21.900	178.0	96

SERVICE PIPE SELECTION

Jis G 3452-1968

Carbon Steel Pipes

Designation of Pipe		Outside Diameter		Wall Thickness		Plain End Weight	
(A)	(B)	in	mm	in	mm	kg/ft	kg/m
200	8	8.516	216.3	0.228	5.8	9.174	30.100
*225	9	9.520	241.8	0.244	6.2	10.973	36.000
250	10	10.528	267.4	0.260	6.6	12.924	42.400
300	12	12.539	318.5	0.272	6.9	16.154	53.000
350	14	14.000	355.6	0.311	7.9	20.635	67.700
400	16	16.000	406.4	0.311	7.9	23.652	77.600
450	18	18.000	457.2	0.311	7.9	-	87.500
500	20	20.000	508.0	0.311	7.9	-	97.400

BS 3601

Steel Pipes and tubes for Pressure Purposes

200	8	8.625	219.1	-	5.9	-	31.000
250	10	10.750	273.0	-	7.1	-	46.600
300	12	12.750	323.8	-	7.1	-	55.500
350	14	14.000	355.6	-	8.0	-	68.600
400	16	16.000	406.4	-	8.0	-	78.600
450	18	18.00	457.2	-	8.0	-	88.600
500	20	20.00	508.0	-	8.0	-	98.600

Note: The symbol * is used to indicate that these sizes are only available in the case of special orders.

SERVICE PIPE SELECTION

API 5L Grade B welded and seamless

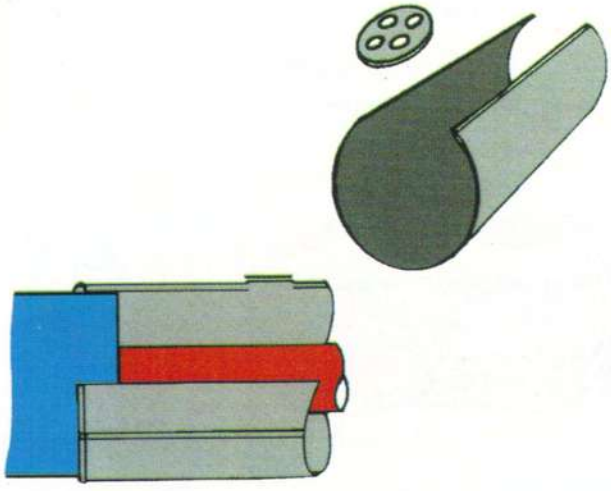
Standard Sizes and Weights

Nominal Size	Outside Diameter		Wall Thickness		Class	Schedule No.	Weight
in	in	mm	in	mm			kg/m
1/2	0.840	21.3	0.109	2.8	std	40	1.26
3/4	1.050	26.7	0.113	2.9	std	40	1.68
1	1.315	33.4	0.133	3.4	std	40	2.50
1 1/4	1.660	42.2	0.140	3.6	std	40	3.38
1 1/2	1.900	48.3	0.145	3.7	std	40	4.05
2	2.375	60.3	0.154	3.9	std	40	5.43
2 1/2	2.875	73.0	0.203	5.2	std	40	8.62
3	3.500	88.9	0.216	5.5	std	40	11.28
4	4.500	114.3	0.237	6.0	std	40	16.6
5	5.563	141.3	0.258	6.6	std	40	21.76
6	6.625	168.3	0.280	7.1	std	40	28.23
8	8.625	219.1	0.322	8.2	std	40	42.49
10	10.750	273.0	0.365	9.3	std	40	60.24
12	12.750	323.8	0.375	9.5	std	–	73.75
			0.406	10.3	–	40	79.65
14	14.000	355.6	0.375	9.5	std	30	81.21
			0.438	11.1	–	40	94.41
16	16.000	406.4	0.375	9.5	std	30	93.13
			0.500	12.7	xs	40	123.18
18	18.000	457.2	0.375	9.5	std	–	105.05
			0.438	11.1	–	30	122.25
			0.500	12.7	xs	–	139.07
			0.562	14.3	–	40	155.77
20	20.000	508.0	0.375	9.5	std	20	116.97
			0.500	12.7	xs	30	154.96
			0.594	15.1	–	40	183.21
24	24.000	609.6	0.375	9.5	std	20	140.81
			0.500	12.7	xs	–	186.75
			0.562	14.3	–	30	209.35
			0.688	17.5	–	40	254.91

SITE INSTALLATION

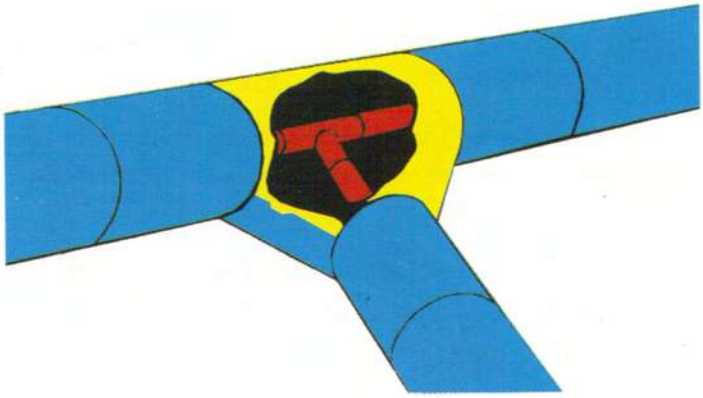
Straight Joint

1. Weld pipes as normal
   Key points: Position heat shields at exposed foam faces prior to welding.
2. Apply the vapour sealing mastic to the internal surfaces of the longitudinal and circumferential swages of the casing sleeve. Ensure the sealant is applied in a continuous even bead and kept clean.
3. Centralise the casing sleeve over the joint and pop rivet into position and tap down swages as necessary to ensure a tight seal is obtained.
   Key points: Overlap the swages, and position them facing downwards and away from view if possible. Rivet centres not greater than 75mm
4. Drill a 25 mm air hole and two 3mm air holes
   Key Points: Locate pour holes on uppermost side of casing to facilitate pouring.
   Locate air holes adjacent to the highest foam face.
5. Wax the area of the pour hole, air holes and all lapped areas.
   Key points: As waxing is done to make cleaning of any foam spillage easy, ensure all such areas are waxed.
6. Mix and pour foam
7. Remove excess foam from air holes, clean and seal with pop rivets.
8. Using a soft rag clean residual foam and vapour mastic off the casing.
9. To seal the pour hole apply galvanised sheet and pop rivet over the pour hole.



Tee Joint

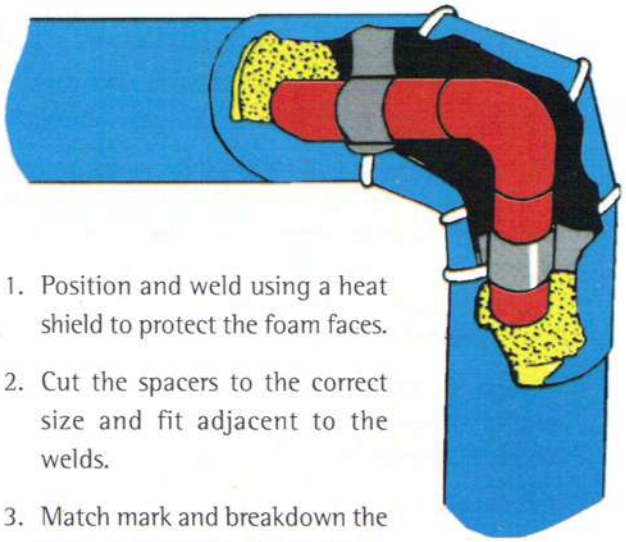
1. Mark the required tee position on the casing and measure 150-175 mm maximum either side of your mark scribe a cutting line.
2. Using a hacksaw cut through the casing at the cutting line, then cutting diagonally across the section now isolated, remove the unwanted casing and foam.
   Key points: Do not cut into the service pipe. Use a knife to remove the foam.
3. Complete lee weld.
   Key points: Position heat shields at exposed foam face prior to welding.
4. Apply vapour mastic to seams on mains sleeve and position over tee. Pop rivet through pre-drilled holes.
5. Apply vapour sealing mastic to internal surface of longitudinal and circumferential swages on branch sleeve.



6. Position and pop rivet branch sleeve over both casing and one tee sleeve assuring main sleeve is concentric in both places.
7. Repeat Step 5 on two remaining sleeves.
8. Position and pop rivet main way sleeves onto casing and tee sleeve.
9. Drill pour hole, air holes and mix and pour foam.

SITE INSTALLATION

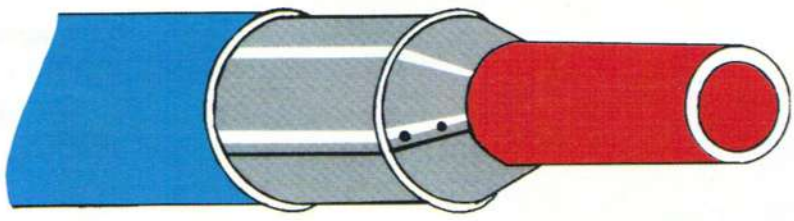
Bend Joint



1. Position and weld using a heat shield to protect the foam faces.
2. Cut the spacers to the correct size and fit adjacent to the welds.
3. Match mark and breakdown the bend casing into segments.
4. Reassemble the bend in position on the pipe applying vapour sealing mastic into the swaging provided on all circumferential and longitudinal seams. Use pop rivets provided.
5. Position the bend casing on its spacers, assuring it is concentric with casing on both legs.
6. Apply vapour sealing mastic to internal surfaces of longitudinal and circumferential swages of the casing sleeves.
7. Position the casing sleeves and pop rivet into place, tapping down swages where necessary.

Reducing Joint

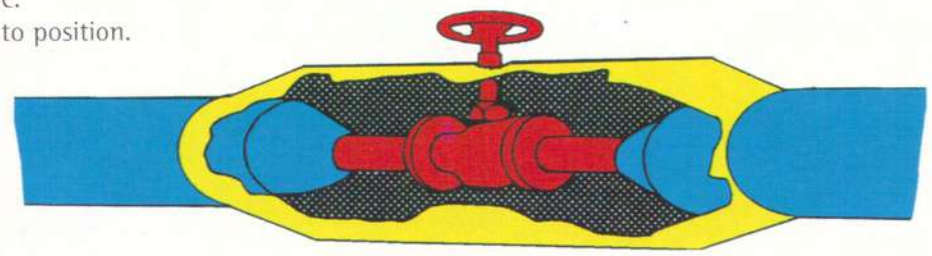
1. Separate the sleeve casing and cone.
2. Apply the vapour sealing mastic to the internal surfaces of the longitudinal and circumferential swages of the casing sleeve. Ensure the sealant is applied in a continuous even bead and kept clean.
3. Apply vapour mastic to cone overlap.
4. Fit cone over pipe and apply bead of vapour mastic on the inside of overlap only.
5. Position cone 185 mm from the end of the exposed insulation face and rivet the overlap of the cone.
6. Position the casing sleeve as shown, rivet into position and tap down swages as necessary to ensure a tight seal is obtained.
   Key points: Engage end swage of casing sleeve over cone. Ensure 25 mm overlap back to preinsulated casing.
7. Drill a 25 mm pour hole
   Key points: Located pour hole on uppermost side of casing to facilitate pouring.
8. Wax the area of the pour hole and all lapped areas.
   Key points: As waxing is done to make cleaning of any foam spillage easy, ensure all such areas are waxed.
9. Mix and pour foam.
10. Using a soft rag clean residual foam and vapour mastic off the casing.
11. To seal the pour hole apply galvanised sheet and pop rivet over the pour hole.



SITE INSTALLATION

Valve Joint

1. Fit vapour seal and insulate the standard cones from casing to pipe. Fit and vapour seal the transition cones to the casing.
2. Measure valve bonnet and cut sleeve casing to suit at longitudinal joint.
3. Insulate valve with glass fibre blanket up to approximately 20 mm thicker than the internal diameter of the casing sleeve.
   Key points: Strap blanket into position.
4. Vapour seal the swages of the oversize casing sleeve.
5. Fit the oversize casing sleeve into position connecting to the transition cones and compressing the glass insulation as doing so.
6. Pop rivet the casing sleeve to the transition cones.
7. Lay a fillet of vapour sealing mastic around the valve bonnet and hole in the casing sleeve.



The Quantities listed below for each joint are the total quantity of chemical required in grams. The ratio of Isocynate to Polyo 1 is 1:1. Therefore the quantities of each type of chemical required is half the quantities shown.

Pipe/Casing	Straight Joint	Elbow Joint	Tee Joint	Reducer Joint
15/100	125	155	215	315
20/100	120	150	210	130
25/115	120	150	210	130
25/140	270	340	510	320
32/125	175	235	345	205
32/140	260	340	520	310
40/125	175	235	355	205
40/155	255	355	535	315
50/140	270	380	500	320
50/155	280	410	580	350
65/155	225	365	500	285
65/175	320	550	750	450
80/175	300	500	700	350
80/190	450	750	1000	560
100/190	230	450	560	310
100/215	410	830	1050	550
125/225	375	850	1050	550
125/250	550	1250	1500	800
150/250	450	1200	1350	700
150/270	600	1500	1750	900
150/300	890	2250	2650	1300
200/300	600	1700	1900	900
200/320	650	1950	2150	1000
200/350	1400	400	420	2000
250/350	635	2300	2400	1000
250/400	1150	4000	4100	1800
300/425	1000	4050	4100	1700
300/450	1200	4300	4500	1900

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