

SYABAS' STANDARD SPECIFICATION FOR PIPE LAYING WOKS

First Edition : May 2007

G – ACRYLONITRILE, BUTADIENE, STYRENE (ABS) PIPES AND SPECIALS

1.0 General

- 1.1 ABS (Acrylonitrile Butadiene Styrene) pressure pipes and fittings must be manufactured in accordance with Malaysian Standard MS 1419 for size range from 15mm up to 200mm and must be branded accordingly. The manufacturer must provide documentary evidence to support its claim to MS 1419 for all pipes and fittings sizes and classes intended to be used in this tender.
- 1.2 ABS pipe size above 200mm must be manufactured in accordance with ISO 161.1 and must be tested in accordance to AS 3518: 1988 Part 1 Appendix E. Manufacturer must provide detailed dimensional specification on all the pipes and fittings to be supplied.
- 1.3 The ABS pipes and fittings manufacturer must provide documentary evidence that it has the facility in its manufacturing site to carry out the relevant tests as stated MS 1419.
- 1.4 ABS pressure pipes and fittings compounds shall have a MRS (Minimum Required Strength) value of 16 Mpa and shall comply with the scope, designation of properties and test methods defined in ISO 7245. The resin supplier shall submit data and test reports from independent and reputable test bodies such as CSIRO Australia, Body Cote Germany or PSB Singapore on the creep rupture regression curve on the material to show the pipes are conformed to MRS 16 for 50 years service life. Test must be in accordance to ISO 9080 to 1,000 and 10,000 hours at 3 different temperatures, 20 °C, 40 °C and 60 °C. The manufacturers shall submit invoices to SYABAS to substantiate that their resin are sourced from the supplier whom resin has conformed to MRS 16 for 50 years.
- 1.5 The manufacturers shall **NOT** use recycle or their own re-processable material.

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- 1.6 The physical properties of ABS material to manufacture the pipe and fitting shall be as follow:

PROPERTY	S.I. UNIT	OTHER UNIT
Ultimate Tensile Strength at 20 °C	30 Mpa	4,350 lbf/in ²
Water Absorption (24 hrs at 20 °C)	0.4% by Weight Gain	0.4% by Weight Gain
Elongation at Break at 20 °C	25%	25%
Instantaneous Flexural Modulus at 20 °C	2,000 Mpa	290,000 lbf/in ²
Compressive Strength at 20 °C	42 Mpa	6,100 lbf/in ²
Izod Impact Strength (notched at 20 °C)	340 J/m	6.4 lbf/in ²
Specific Gravity	1.05	1.05
Vicat Softening Point ASTM D1525	104 °C	219 °F
Coefficient of Linear Expansion	10.1 x 10 ⁻⁵ m/m°C	5.6 x 10 ft/ft °F
Maximum Operating Temperature	80 °C	176 °F
Poissons Ratio	0.35	0.35
Thermal Conductivity	0.25 W/m °K	1.7 BTU/ft ² /in/ °F
Specific Heat	1.47 kJ/kg °K	0.38 BTU/lbm/ °F
Volume Resistivity	3.5 x 10 ¹⁶ Ω cm	3.5 x 10 ¹⁶ Ω cm

- 1.7 ABS resin compounds will absorb moisture during storage in the factory and caused an increase in moisture content. Since resin compounds with moisture content higher than the permissible level will affect the quality of the end products. As such, the manufacturer **MUST** reduce the moisture content of the resin with dehumidifier machines.
- 1.8 All ABS pipes and fittings must pass the test of "Effect of the Quality of the Water" under BS 6920. Manufacturer must provide documentary evidence from the relevant standard testing authority confirming this conformance.
- 1.9 All ABS pipes, fittings and ABS Solvent Cement used for joining must be manufactured and supplied by the **SAME** manufacturer to ensure material compatibility, dimension accuracy and quality.

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- 1.10 ABS pipes and fittings manufacturer must provide documentary evidence to demonstrate its expertise in the manufacturing and supply of ABS pipes, fittings and ABS solvent cement. The ABS pipes and fittings manufacturer must arrange for factory site audit by the owner/consultant prior to letter of award to confirm product quality conformance.
- 1.11 All ABS fittings **MUST** be either injection mould or machine fabricated from pressure pipes extruded by the same manufacturer. Rotor moulding or other butt-welded low-pressure fittings are strictly **NOT** accepted. A factory audit is to be conducted to ascertain capability of the manufacturer. All fittings supplied using fabrication method must be fabricated using a single piece of Class 15 ABS pressure pipes extruded by the same manufacturer. All such fittings **MUST** be subjected to 100% sample test at rated pressure conducted at the manufacturer's premises prior to acceptance for delivery. Test certificates **MUST** be provided.
- All pipes and fittings supplied must be accompanied by inspection and quality reports issued by the manufacturer.
- 1.12 The manufacturer must provide a company profile among other information indicating the relevant management personnel's capability within the organization in the manufacturing of ABS pipes and fittings.

2.0 Colour

The colour of ABS pipe shall be either dark blue or dark blue with navy blue stripes. The minimum number of stripes shall be 4 spaced at 90° intervals and shall be of the same type of resin as used in the compound for the pipe. The stripes shall not exceed 10% of wall thickness.

3.0 Scope of Supply

- 3.1 The Contractor shall manufacture, test, supply and transport to site as per attached Bill of Quantities. All pipes shall be supplied with spigot on both ends or socket on one end and plain on the other. Sockets shall be supplied loose for site installation. All pipes supplied shall conform to the data in the following Table 1.

Contractors shall submit a complete work programme on the schedule of production and delivery.

- 3.2 SYABAS' representatives reserve the right to visit the manufacturer's pipe and fittings manufacturing plant to witness Contractor's capability in manufacturing the pipes and specials. These visits will be notified earlier and will be done

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during tendering and/or after tendering period is over. They can also request to visit the plant anytime during the manufacturing period. All costs shall be borne by the Contractor.

3.3 Contractor shall provide all necessary training and supervision to the pipe-laying plumber at all time. These costs shall be included in the tender price.

TABLE 1 : ABS PIPE DIMENSION

PIPE SIZE (DN/OD)	PIPE CLASS	MAXIMUM OPERATING PRESSURE (kPa)	OUTSIDE DIAMETER (mm)	INSIDE DIAMETER (mm)	WALL THICKNESS (mm)	MASS (kg/m)
½" (DN15)	15	1500	21.4	17.0	2.2	0.14
¾" (DN20)	15	1500	26.8	21.4	2.7	0.21
1" (DN25)	9	900	33.6	29.3	2.1	0.22
1" (DN25)	12	1200	33.6	28.1	2.7	0.28
1" (DN25)	15	1500	33.6	26.9	3.3	0.33
1 ¼" (DN32)	9	900	42.3	37.0	2.6	0.34
1 ¼" (DN32)	12	1200	42.3	35.5	3.4	0.44
1 ¼" (DN32)	15	1500	42.3	34.0	4.1	0.52
1 ½" (DN40)	9	900	48.3	42.3	3.0	0.44
1 ½" (DN40)	12	1200	48.3	40.5	3.9	0.57
1 ½" (DN40)	15	1500	48.3	38.8	4.7	0.68
2" (DN50)	9	900	60.4	53.0	3.7	0.69
2" (DN50)	12	1200	60.4	50.7	4.8	0.88
2" (DN50)	15	1500	60.4	48.6	5.9	1.06
2 ½" (OD75)	6	600	75.1	68.8	3.1	0.75
2 ½" (OD75)	9	900	75.1	65.9	5.1	1.17
2 ½" (OD75)	12	1200	75.1	63.1	6.0	1.36
2 ½" (OD75)	15	1500	75.1	60.5	7.3	1.63
3" (DN80)	6	600	88.9	81.5	3.7	1.04
3" (DN80)	9	900	88.9	78.1	5.4	1.49
3" (DN80)	12	1200	88.9	74.8	7.0	1.90
3" (DN80)	15	1500	88.9	71.7	8.6	2.28
4" (DN100)	6	600	114.3	104.9	4.7	1.71
4" (DN100)	9	900	114.3	100.5	6.9	2.45
4" (DN100)	12	1200	114.3	96.3	9.0	3.13
4" (DN100)	15	1500	114.3	92.2	11.0	3.76
6" (DN150)	4.5	450	168.3	157.7	5.3	2.82
6" (DN150)	6	600	168.3	154.4	6.9	3.68
6" (DN150)	9	900	168.3	148.0	10.1	5.28
6" (DN150)	12	1200	168.3	141.8	13.2	6.75
6" (DN150)	15	1500	168.3	135.9	16.2	8.12

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OD225mm	4.5	450	225.3	214.6	5.3	3.85
OD225mm	6	600	225.3	211.4	6.9	5.00
OD225mm	10	1000	225.3	202.8	11.2	7.92
OD225mm	12	1200	225.3	198.6	13.3	9.29
OD225mm	15	1500	225.3	192.6	16.3	11.22
OD250mm	4.5	450	250.4	238.6	5.9	4.72
OD250mm	6	600	250.4	234.9	7.7	6.16
OD250mm	10	1000	250.4	225.3	12.5	9.77
OD250mm	12	1200	250.4	220.8	14.7	11.45
OD250mm	15	1500	250.4	214.1	18.1	13.84
OD315mm	4.5	450	315.4	300.6	7.4	7.47
OD315mm	6	600	315.4	295.9	9.7	9.76
OD315mm	10	1000	315.4	283.9	15.7	15.49
OD315mm	12	1200	315.4	278.1	18.6	18.17
OD315mm	15	1500	315.4	269.7	22.7	21.96
OD355mm	4.5	450	355.4	338.8	8.3	9.48
OD355mm	6	600	355.4	333.5	10.9	12.39
OD355mm	10	1000	355.4	320.0	17.6	19.66
OD355mm	12	1200	355.4	313.5	20.9	23.06
OD355mm	15	1500	355.4	304.0	25.6	27.87
OD400mm	4.5	450	400.5	381.8	9.3	12.02
OD400mm	6	600	400.5	375.9	12.3	15.71
OD400mm	10	1000	400.5	360.6	19.9	24.95
OD400mm	12	1200	400.5	353.3	23.5	29.26
OD400mm	15	1500	400.5	342.6	28.9	35.37
OD450mm	4.5	450	450.6	429.5	10.5	15.19
OD450mm	6	600	450.6	422.9	13.8	19.86
OD450mm	10	1000	450.6	405.7	22.3	31.55
OD450mm	12	1200	450.6	397.4	26.5	37.01
OD450mm	15	1500	450.6	385.4	32.4	44.75
OD500mm	4.5	450	500.5	477.2	11.6	18.74
OD500mm	6	600	500.5	469.8	15.3	24.51
OD500mm	10	1000	500.5	450.7	24.8	38.95
OD500mm	12	1200	500.5	441.9	29.4	45.69
OD560mm	4.5	450	560.6	534.5	13.0	23.48
OD560mm	6	600	560.6	526.2	17.1	30.72
OD560mm	10	1000	560.6	504.9	27.8	48.83
OD560mm	12	1200	560.6	494.9	32.9	57.28
OD630mm	4.5	450	630.7	601.3	14.6	29.70
OD630mm	6	600	630.7	592.0	19.3	38.86
OD630mm	10	1000	630.7	564.7	31.2	61.78
OD630mm	12	1200	630.7	556.8	37.0	72.48

4.0 Solvent Cement

The solvent cement designed for the bonding of ABS pipes and fitting shall have a viscosity in the range of 0.6 Pa.s to 1.9 Pa.s when tested in accordance with Appendix B of MS 1419 : Part 3 : 1997. The manufacturers shall provide recognised documentary evidence that the solvent cement manufactured by them complied with

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such requirement. The manufacturers should have a Rotational Torsion Viscometer in their factories for SYABAS' representatives to carry out the test.

5.0 Jointing

- 5.1 All ABS joints shall be of cold solvent cement welded. The Contractor shall provide sufficient ABS solvent cement for all pipe and socket joints under this Contract. The Contractor shall ensure that the correct ABS solvent cement is supplied for ABS pipes and fittings in accordance to the MS 1419. ABS solvent cement and MEK Cleaner (Primary) fluids used in the jointing of ABS pipe, fitting and in the fabrication of ABS fitting shall be in accordance with MS 1419. uPVC cement or glue are strictly **NOT** allowed for use with ABS pipe and fittings. Jointing techniques proposed by the Contractor shall be submitted to the S.O. for approval at least two (2) weeks before the works commenced. Only purpose-made ABS solvent cement and MEK cleaner manufactured and supplied by the same pipes and fittings manufacturer are approved for used.
- 5.2 All pipes shall be cut square and swarf, etc. removed prior to jointing. Pipe shall be inserted to full depth of fitting socket. Installed fittings which do not have pipe inserted to full depth shall be considered below required standard and shall be rectified at the Contractor's expense. Backing ring shall be used in all flanged joints.
- 5.3 The use of solvent cemented sockets; flange and shoulder style couplings are permitted to join pipe and fittings as required. Equipment connections 50mm and less may be threaded.
- 5.4 ABS pipe connections to other materials must not be made by cementing or glued joints.
- 5.5 The use of hand operated lever winch or other suitable means of supplying a steady effort sufficient to join fittings to pipes shall be made available when jointing pipe sizes above 100mm. The used of hammers etc. to join fitting is NOT permitted at anytime.

6.0 Support

- 6.1 The maximum distance between pipe supports shall be in accordance with the manufacturer recommendation. The width of pipe supports shall be in accordance with the manufacturer recommendations. Pipe support shall not exert undue pressure on the pipe wall or deform the pipe wall against the clamp or support. All clamps on horizontal pipe shall allow axial movement of the pipe.

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- 6.2 Large valve, filter or other heavy items should always be independently supported or anchored to prevent undue loading and stress being transmitted to the pipe. Valve support plates can be used in place of flange backing ring to provide necessary support.
- 6.3 ABS pipe may be connected directly to other pipe or equivalent using flange or threaded connection. Flanges are the recommended method for all sizes, however threaded connections may be used for size 50mm and below.
- 6.4 Horizontal pipe support centers for ABS pipe at various temperatures is given in the Table 2. For vertical pipes, support centers may be increased by 50%. The adjacent correction factor shown in Table 3 should be applied for other pipe classes. Pipe at 80°C must be continuously supported.

Table 2 : Horizontal Pipe Support Centre

PIPE SIZE (mm)	CLASS 15 (PN15) PIPE SUPPORT CENTRE (m)		
	AVERAGE PIPE WALL TEMPERATURE (°C)		
	20 °C	50 °C	70 °C
15	1.00	0.80	0.60
20	1.10	0.80	0.70
25	1.20	0.90	0.80
32	1.30	1.00	0.80
40	1.40	1.10	0.90
50	1.60	1.20	0.90
80	1.80	1.56	1.00
100	2.20	1.80	1.10
150	2.50	2.00	1.30
225	2.80	2.20	1.40
250	3.10	2.70	1.80
315	3.40	2.70	1.80
355	3.70	2.90	2.00
400	4.10	3.20	2.20
450	4.70	3.60	2.40
500	4.70	3.60	2.40
630	5.10	3.90	2.60

Table 3 : Correction Factor

PIPE CLASS (PN)	CORRECTION FACTOR
9	0.88
12	0.92
15	1.00

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7.0 Safety Precautions

The following requirements are in addition to any government safety legislation or established company work practices.

- Read safety precautions available on ABS solvent cement and MEK cleaner containers.
- Work area must be well ventilated
- As solvent cement and cleaner are flammable liquids, ensure work area is clear of falling sparks or other sources of ignition e.g. smoking
- To wear safety glass and protection glove at all times when using ABS solvent cement and MEK cleaner

The contractor shall submit safety data sheets in their tender.

8.0 Jointing Procedure

The following procedure shall be observed and obliged at all times during pipeline installation works.

- Measure and cut pipe squared.
- Remove internal and external swarf and file a 2 – 10mm; 30^o chamfer on the outer edge of the pipe.
- Lightly abrade the gloss from the outer surface of the pipe and the inner surface of the fitting using emery paper.
- Clean the surface with clean rag moistened with MEK cleaner.
- Mark the pipe distance back from the end equal to the depth of the socket plus 10mm. This is to allow you to ensure that the joint is fully “home”.
- For sizes above 100mm, position the winch to pull the joint together after solvent cement is applied.
- Apply the solvent cement as quickly as possible first to the socket and to the pipe using longitudinal brush strokes. For size 100mm and above, two coats will be required on both the pipe and the fitting.

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- Immediately after application of the solvent cement, push pipe fully “home” using the mark on the pipe as a guide. Do not twist fitting on the pipe. If using a winch, do not exert additional force once the pipe is fully “home”.
- As all Malaysian Standard ABS fittings are a tapered interference fit, it is essential the fitting be held in position for a time intervals of between 10 seconds to one minute to prevent any movement. When using the winch on larger fittings, leave the winch in position until winching is required for the next consecutive joint.
- Wipe excess solvent cement from the joint. Care should be taken to avoid excess deposits of solvent cement inside small diameter fittings as this can weaken the wall of the pipe or fittings.

9.0 Notes on Jointing

The following precautions and notes shall always be observed by the Contractor.

- Work in a shaded well-ventilated area clear of hazards.
- Treat ABS solvent cement and MEK cleaner with care, as they are volatile flammable liquids. Replace lids after use.
- ABS solvent cement should be stirred before use. Do **NOT** dilute solvent cement with MEK.
- Double check dimensions before cementing fittings to pipe. It is impossible to remove fitting intact once jointed to pipe.
- Solvent cement jointing must be completed quickly, typically within 2 minutes of applying the first coat of cement. A 2-person team for sizes 200mm and above is recommended.
- ABS pipe cannot be successfully cemented under wet conditions. Pipe must be dry for effective jointing.
- In preparation for jointing, pipe should be stored in a shaded area as the working life of the solvent cement is reduced when applied to “hot” pipe and fitting.
- Use only clean rags and brushes. Brushes must be cleaned in MEK cleaner after used.

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- Cement may be removed from your hands with soap and water or industrial hand cleaning soap. Do not use MEK cleaner to remove ABS solvent cement from your skin.
- Use only purpose-made ABS solvent cement and MEK cleaner from the same manufacturer.
- The key to fast efficient jointing particularly with large pipe diameter is preparation. When using a lever winch, have everything ready before applying cement. A canopy over the jointing area is desirable when working in full sun.

10.0 Usage of Solvent Cement

An indication on the number of joints likely to be made with ABS solvent cement following the recommended procedure is as stipulated in Table 4

A socket counts as 2 joints, a tee as 3 joints etc. The usage of MEK is approximately 2/3 times that of ABS cement.

Table 4 : Number of Solvent Weld Per Litre of Solvent Cement

PIPE DIAMETER (mm)	SOLVENT WELD / LITRE
Up to 50	135
80	45
100	35
150	20
225	10
250	4
315	4
355	3
400	2
450	1
500	1

11.0 Solvent Cement Welding Drying Times

The drying time for joints varies depending on:-

- The amount of ABS solvent cement and MEK cleaner applied.
- The diameter of the pipe or fitting.
- Ambient temperature.

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- The fit between the pipe and fitting.
- Class of the pipe.

Whilst full rated pressure may not be applied for 24 hours, joints in smaller diameters can often be put back into service within minutes of being made. An approximate guide is to allow 1 (one) hour per 100kPa working pressure for size up to 80mm. For size 100mm and above, the time should be increased to 1.5 hours per 1 bar.

12.0 Sockets

Socket joints are permitted to be used for pipe and plains ended fittings. Socket joints are permanent and cannot be disassembled.

13.0 Pipe Markings

All pipes must have the following markings:

- Manufacturer's name or trade mark
- Pipe Diameter, SDR
- Material Supplier and MRS
- Pressure Class (PN)
- The word SYABAS (50mm high) in capital letter
- Production Date
- Batch Production Code
- SIRIM QAS License Number
- Specification
- Minimum Wall Thickness

14.0 Installation of Saddles

14.1 Drill the hole in the pipe wall with a small clearance to suit the spigot size of the saddle. A hole-saw is useful for pipe size up to 100mm whereas a jigsaw may be more effective for larger sizes.

14.2 Mark out the area on the pipe to be covered by the saddle.

14.3 Lightly abrade the area to be covered on the saddle and pipe to remove any gloss.

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- 14.4 Feed into the pipe a minimum two worm drive (jubilee) style stainless steel clips placing one either side of the saddle position. On the larger saddle sizes (225-630mm) two or more clamps per side may be required.
- 14.5 Clean the abraded surfaces of the pipe and saddle using MEK cleaner.
- 14.6 Apply minimum of two coats of ABS solvent cement to pipe and saddle.
- 14.7 Immediately place the saddle in position, secure with the saddle in position, and secure with the stainless steel clamps. The saddle must be pulled down onto the pipe to ensure there is no gap between the pipe and the saddle. This may require the use of a clamp. Leave worms drive clips in place for a minimum of 48 hours. It is recommended to leave the stainless steel clamp on at all times. Wipe off excess cement.
- 14.8 A minimum of 24 hours drying time must be allowed before applying full pressure. On sizes 250mm and above a drying time up to 48 hours is recommended.

15.0 Connections – ABS to Other Pipe Systems

There are several methods of connecting other pipe systems directly to ABS pipe.

- Composite Unions
- Flanges
- Threaded adaptors
- Shoulders end style couplings
- "Milnes" style clamps

16.0 Flanged Joints

Two styles of flange jointing systems shall be used:-

- Full face flange for size ½" to 6" and stub flange for size 2" to 630mm
- Stub flange assemblies shall have the same pressure rating as full face flanges assemblies

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- Backing rings must be used with both full face and stubs flanges available in all standard-drilling configurations. Gaskets must be used with flanges.
- ABS stub or full-face flange assemblies may be bolted directly to other pipe systems of the same flange-drilling standard. Gaskets and backing rings must be used at the joints. Torque values for flange face are as stipulated in Table 5.

Table 5 : Recommended Bolt Torque's and Bolt Sizes

Pipe size (mm)	Bolt Sizes (mm)	Recommended Torque (NM)	Hole per Flange
15	M12 x 50	7	4
20	M12 x 50	10	4
25	M12 x 50	14	4
32	M12 x 50	13	4
40	M16 x 60	20	4
50	M16 x 65	22	4
80	M16 x 70	33	4
100	M16 x 80	25	8
150	M20 x 90	42	8
225	M20 x 100	63	8
250	M20 x 130	80	12
315	M20 x 150	74	12
355	M24 x 160	133	12
400	M24 x 170	163	16
450	M24 x 180	157	16
500	M24 x 190	185	20
560	M27 x 230	190	20
630	M27 x 240	190	20

Standard butterfly valves shall be placed between ABS stubs or full-face flange assemblies without modification. Valve should be checked for full and free movement prior to final tightening of flange bolts.

17.0 Threaded Connection

The following table shows the class of pipe which shall be used for BSP threading.

When threading, sharp die shall be used and cut full thread depths, without lubricant in one operation.

All threaded fitting shall be rated at 12 bar at 20°C.

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For high-pressure installations it is preferable to use adaptors or fitting with male ABS threads in preference to female threaded fittings.

Composite unions, available in male and female threaded configurations to 50mm are recommended for joining ABS pipe to metal threads particularly in systems subject to thermal cycling.

Tightening should only be done by hand with a maximum of an extra quarters turn with a pipe wrench. There is often a tendency to over tighten threads however this only causes distortion and leaks.

If leakage occurred at the threaded joint, disassemble the joint. If there is no damaged at the thread, remake the joint and care shall be taken not to over tighten.

PTFE tape is the recommended thread sealant.

Do not use liquid thread sealant, e.g. Loctite or PTFE, as they contain chemicals, which attack most plastic materials.

BSP Size (in.)	BSP Size (mm)	Pipe Class
½"	15	T
¾"	20	T
1"	25	T
1¼	32	T
1½"	40	T
2"	50	T
3"	80	T
4"	100	T

18.0 Instrumentation Connections

Instrument connections may be made a combination of saddle and threaded reducing bushes. In addition, for 80mm and larger pipe sizes, drilling and tapping directly in the pipe at a fitting may be from these combinations. Maximum size tapping as follows:

Pipe Size (mm)	Maximum Instrument Tapping Point Size
80	¼"
100 - 150	3/8"
200	½"
250	¾"
315	1½"
400 - 500	2"

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19.0 Buried Pipes

19.1 Pipe Trench

- Trenches should be constructed in accordance with SYABAS requirements.
- In general, trenches should be as narrow as possible having regards to the practicalities of handling the pipes in the trench and the stability of the ground conditions.
- A minimum bottom of trench width equal to the outside diameter of the pipe plus 200 – 300mm should be sufficient. Depth of the trench, as per following table, should allow for the required top cover plus diameter of the pipe and the depth of the bedding.
- Where very heavy vehicle loads are anticipated, trench depths should be calculated in accordance with SYABAS requirements.

19.2 Recommended Minimum Pipe Bedding

Trench bottom should be as even as possible to support the pipe. Trenches constructed in ground containing sharp stones or rock must have a minimum 75mm cover of bedding layer of coarse sand or fine gravel above and below pipe.

19.3 Thrust Blocks

Thrust blocks may be installed for solvent cement jointed buried pipelines at changes of direction, termination, changes in pipe diameter or tees.

Thrust blocks may be required where valve or other equipment is positioned in the pipeline and are not independently supported.

19.4 Installing Pipe

- Pipe length up to 12 meters is available and is recommended to minimize the number of joints and to speed up handling and installation time.
- Pipes joined above ground should remain undisturbed for a minimum of 2 hours before being “snaked” into the trench.
- Pipe sizes 250mm and above should be joined in the trench.

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- Particular care must be taken to ensure pipes and jointing material are clean and dry when making a joint.

19.5 Final Connections

Final connection, backfilling and tamping should be completed in the coolest part of the day, i.e. early morning. This is to prevent undue tensile loads being imposed on the pipe joints. If final joints or backfilling is completed in the hotter part of the day, the pipe contracts during the cooler hours of the night, excessive tensile loads may be placed on the joints.

19.6 Backfilling and Tamping

- Screened excavated material or bedding sand/gravel should be used to back fill trench to a minimum cover of 75mm above the top of the pipe. Backfill must be effectively tamped under both sides of the pipe to provide proper support. Joints should be left uncover until pressure testing has been completed. Excavation material may be used for final backfilling.
- For installation of pipelines operating at above or below ambient temperatures, a complete method of installation shall be submitted to S. O. for approval.

20.0 Hydrostatic Pressure Testing

The following test procedure should be followed where installations must be pressure tested.

The test pressure to be applied shall be equivalent to 1.5 times the static head.

Testing must not be carried out until the following times have elapsed since completion of the last joints.

Pipe Size (mm)	Times (Hours)
10 – 200	24
250 – 355	36
400 – 630	48

For large installation split the system into several sections for testing.

- Fill section with clean ambient temperature water (20°C is ideal). Do not pressurize.

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- Ensure no air trapped in the system.
- Inspect system for gas leaks.
- Allow the system to stand for one hour to allow temperature to stabilize and equilibrium reached.
- If there are no leaks remove any remaining air and increase pressure to 3 bar. Leave at this pressure for 15 minutes and inspect for leaks.
- If pressure remains constant, increase pressure to recommended test pressure. Leave pressurized for a period not exceeding one hour. During this time pressure should hold almost constant.
- All pipes shall be tested at a test pressure 1.5 times higher than the system operating pressure less the allowance for temperature / pressure de-rating at the current test temperature.

NOTE : If extended times are required to achieve the test pressure either leakage is occurring or there is air trapped in the system. Inspects for leakage and if apparent reduce the pressure and check for trapped air which must be removed before the test and continue.

CAUTION : Under no circumstances should pressure tests be carried out using pressurized gases. Such test could be extremely dangerous should a failure occur.