PBA	Procedure : SPECIFICATION FOR MILE	D STEEL (MS) PIPE
	Department : Material Evaluation Technical Committee (METC)	
Pulau Pinang Sdn Bhd (473961-37) Meeting all your water supply needs	Document No : PBA/PIPE/ M.S. PIPE	Revision No : 00
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1.0 SCOPE

This Material Specification details the minimum requirements for the design, manufacture, testing, inspection and supply of Mild Steel (MS) pipe to distribution of potable water.

It is applicable for the project in various locations in the Penang state. However, PBAPP reserves the rights to add / delete / change the locations as per requirement, all as instructed and directed by the Engineer.

2.0 STANDARDS, CODES AND GUIDELINES

All activities relating to this section of the specification shall comply with the following or approved equivalent standards. The following codes and standards, to the extent specified herein, form a part of this specification. The latest edition of these codes and standards shall govern the work.

(b) SPAN TS 21827 : Part 2 - Specification for Steel Pipes, Fittings and Joints for Water and Sewage - Part 2 : Tube Requirements (c) BS 534 - Steel Pipes, Joints and Specials for Water and Sewerage (d) BS EN ISO 10893- 6:2019 - Non-destructive Testing of Steel Tubes – Part 6: Radiographic Testing of the Weld Seam of Welded Steel Tubes for the Detection of Imperfections (e) A.P.I Standard 1104 - Welding of Pipelines and Related Facilities (f) BS 7079:2009 - General Introduction to Standards for Preparation of Steel Substrates before Application of Paints and Related Products (g) ISO 8501 1:2007 Preparation of Steel Substrates before Application of Paints and Related Products – Visual Assessment of Surface Cleanliness – Part 1: Rust Grades and Preparation of Grades of Uncoated Steel Substrates and of Steel Substrates after Overall Removal of Previous Coatings (h) ISO 8501-3 Preparation of Steel Substrates before Application of Paints and Related Products – Visual Assessment of Surface Cleanliness – Part 3: Preparation of Grades of Weld, Edges and Other Areas with Surface Imperfections	(a)	SPAN TS 21827: Part 1	-	Specification for Steel Pipes, Fittings and Joints for Water and Sewage - Part 1 : Technical delivery requirements
(c) BS 534 - Steel Pipes, Joints and Specials for Water and Sewerage (d) BS EN ISO 10893- 6:2019 - Non-destructive Testing of Steel Tubes – Part 6: Radiographic Testing of the Weld Seam of Welded Steel Tubes for the Detection of Imperfections (e) A.P.I Standard 1104 - Welding of Pipelines and Related Facilities (f) BS 7079:2009 - General Introduction to Standards for Preparation of Steel Substrates before Application of Paints and Related Products (g) ISO 8501 1:2007 Preparation of Steel Substrates before Application of Paints and Related Products – Visual Assessment of Surface Cleanliness – Part 1: Rust Grades and Preparation of Grades of Uncoated Steel Substrates and of Steel Substrates after Overall Removal of Previous Coatings (h) ISO 8501-3 Preparation of Steel Substrates before Application of Paints and Related Products – Visual Assessment of Surface Cleanliness – Part 3: Preparation of Grades of Weld, Edges and Other Areas with Surface Imperfections	(b)	SPAN TS 21827 : Part 2	-	Specification for Steel Pipes, Fittings and Joints for Water and Sewage - Part 2 : Tube Requirements
(d) BS EN ISO 10893- 6:2019 - Non-destructive Testing of Steel Tubes – Part 6: Radiographic Testing of the Weld Seam of Welded Steel Tubes for the Detection of Imperfections (e) A.P.I Standard 1104 - Welding of Pipelines and Related Facilities (f) BS 7079:2009 - General Introduction to Standards for Preparation of Steel Substrates before Application of Paints and Related Products (g) ISO 8501 1:2007 Preparation of Steel Substrates before Application of Paints and Related Products – Visual Assessment of Surface Cleanliness – Part 1: Rust Grades and Preparation of Grades of Uncoated Steel Substrates and of Steel Substrates after Overall Removal of Previous Coatings (h) ISO 8501-3 Preparation of Steel Substrates before Application of Paints and Related Products – Visual Assessment of Surface Cleanliness – Part 3: Preparation of Grades of Weld, Edges and Other Areas with Surface Imperfections	(c)	BS 534	-	Steel Pipes, Joints and Specials for Water and Sewerage
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	(h)	ISO 8501-3		Preparation of Steel Substrates before Application of Paints and Related Products – Visual Assessment of Surface Cleanliness – Part 3: Preparation of Grades of Weld, Edges and Other Areas with Surface Imperfections

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3.0 TECHNICAL REQUIREMENTS

3.1 Manufacture and Testing

- 3.1.1 The manufacture and testing of all steel pipes shall comply with the current edition of SPAN TS 21827: Part 1 and SPAN TS 21827: Part 2 unless otherwise specified. Pipework shall generally be concrete lined internally and covered externally with a reinforced asphaltic bitumen wrapping.
- 3.1.2 Pipe end shall be Plain End Type for pipe size below DN 900 and for pipe end Spigot End shall be only for pipe DN 900 and above as the pipe shall be jointing inside and outside the pipe
- 3.1.3 Pipe ends shall generally be suitable for forming externally and welded slip joint. Flanged and plain ended pipework are also specified and the ends of these pipes shall be suitable for jointing with flanged pipework and with mechanical couplings of collars respectively.

3.2 Process of Manufacture

- 3.2.1 The pipes shall be made by either:-
 - (a) Rolling a strip, sheet or plate so that a helical seam is formed around the circumference of the pipe. The helical seam shall be butt welded internally and externally by an automatic submerged arc welding process.

3.3 Chemical Composition - Grade of Steel

- 3.3.1 The grade of steel shall be SAW L275 as stated in Table 1 & Table 3 of SPAN TS 21827: Part 2. The cast analysis of the steel shall comply with the requirements stated in Table 1 of SPAN TS 21827: Part 2 and the tensile test shall comply with the minimum requirement stated in Table 3 of SPAN TS 21827: Part 2.
- 3.3.2 It is mandatory for the manufacturer / supplier to submit to the PBAPP a copy of the "mill certificates" of the grade of steel used in the manufacture of each batch of pipes.

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3.4 Dimension - Thickness and Diameter

3.4.1 The minimum finished thicknesses of the steel pipe shells and the finished external diameters of the pipes shall be as shown in **<u>Table 1</u>**, except as otherwise specified.

TABLE 1: PBAPP SPECIFICATION FOR MILD STEEL PIPES							
Nominal	Outside Diameter		*F <i>inished</i> Minimum	Concrete	Concrete Lining		
Diameter (DN)	Specification	Tolerance	Nominal Steel Thickness	Specification	Tolerance	Bitumen Lining	
(mm)			(mm)				
150	168.3	<u>+</u> 1.3	3.6	10	+3, -0	6	
200	219.1	<u>+</u> 1.6	4.0	10	+3, -0	6	
300	323.9	<u>+</u> 2.4	4.0	10	+3, -0	6	
450	457.0	<u>+</u> 3.4	5.0	13	+3, -0	6	
600	610.0	<u>+</u> 4.6	6.3	13	+3, -0	6	
900	914.0	<u>+</u> 6.0	8.0	19	+6, -0	6	
1200	1219.0	<u>+</u> 6.0	10.0	25	+6, -0	6	
1400	1422.0	<u>+</u> 6.0	10.0	25	+6, -0	6	
1600	1626.0	<u>+</u> 6.0	11.0	25	+6, -0	6	
1800	1829.0	+ 6.0	12.5	25	+6, -0	6	

Note: * The above Finished Minimum Nominal Steel Thickness shall not be subjected to any negative tolerance for acceptance purpose

- 3.4.2 The weld metal shall have smooth finish and shall not stand more than 2.5 mm proud of the pipe shell internally and externally.
- 3.4.3 The weld metal on the external surfaces on the ends of all plain ended pipes shall be machined flush with the external surfaces of the pipe shell for a sufficient distance to facilitate joining with couplings or steel collars. At the ends of all spigot and socket ended pipes the weld metal shall be similarly machined externally on the spigot end and internally on the socket of the pipe.

3.4.4 Tolerance on Pipe Outside Diameter

- (a) The tolerance on the outside diameter of the pipe shall be controlled by the circumference of the pipe measured on the outside.
- (b) The variance on the circumference of the pipe measured on the outside shall be within the tolerance stated in **Table 1**.

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3.5 Lengths

- 3.5.1 Standard lengths for straight pipes to be supplied shall be as below:
 - a) For maintenance purposes (PBAPP Store only)
 - (i) DN600 and above, pipe length shall not less than 9m (DN600 ≥ 9m) Less than DN600, pipe length shall not be greater than 6m (DN600 < 6m)
 - b) For New Connections Project and Development
 - (i) DN 450 and above, pipe length shall not less than 9m (DN450 $\ge 9m$)
 - (ii) Less than DN450, pipe length shall not be greater than 6m (DN450 < 6m).
 - (iii) If the above pipe lengths are not applicable, please provide the justification to be considered.
- 3.5.2 The maximum variation in length from the standard lengths shall be kept to the minimum possible within the normal method of manufacture and shall not exceed 150 mm.

3.6 Workmanship and Welding Standards

- 3.6.1 The Welding Standards must be Submerged Arc Welded (Spiral) type.
- 3.6.2 As a control on weld quality the manufacturer / supplier will be required to take and submit radiographs for 2% of all welds on each tube for the Engineer / S.O.'s clearance. The Engineer / S.O. will advise the manufacturer / supplier / contractor where he requires the radiographs to be taken.
- 3.6.2 Where radiographic examination reveals defects in the welds the Engineer / S.O. will either reject the length of pipe containing such defects or will permit the contractor to carry out repairs and to submit radiographs of such repairs for clearance. Length of pipes containing defects in welds after repair will be liable to be rejected.
- 3.6.3 If defects in welds are found in a length of pipe, the welds of the pipes immediately before and after the defective pipe in the production line shall be radiographed until the Engineer / S.O. is satisfied that all the welds are satisfactory. The cost of such radiographs shall be at the expenses of the *manufacturer* / supplier and such radiographs shall not be considered to form part of the 2% of all welds specified in the first paragraph of this clause.

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3.7 Mechanical Properties & Tests

- 3.7.1 Leak Tightness Test Hydrostatic Test @ Hydraulic Test
 - 3.7.1.1 The manufacturer / supplier shall carry out Hydrostatic Test @ hydraulic tests on all pipes before they are lined or coated. The hydraulic test pressure shall be in accordance with **Table 2**.

<u>TABLE 2</u> : PBAPP SPECIFICATION FOR MILD STEEL PIPES						
Nominal Diameter		Outside Diame	*Finished Minimum	Factory Hydrostatic Test		
(DN)	Specification	Tolerance	Min	Мах	Nominal Steel Thickness	Pressure
(mm)			(mm)			(bar)
150	168.3	<u>+</u> 1.3	167.0	169.6	3.6	70.0
200	219.1	<u>+</u> 1.6	217.5	220.7	4.0	70.0
300	323.9	<u>+</u> 2.4	321.5	326.3	4.0	54.0
450	457.0	<u>+</u> 3.4	453.6	460.4	5.0	48.0
600	610.0	<u>+</u> 4.6	605.4	614.6	6.3	45.0
900	914.0	<u>+</u> 6.0	908.0	920.0	8.0	34.0
1200	1219.0	<u>+</u> 6.0	1213.0	1225.0	10.0	29.0
1400	1422.0	<u>+</u> 6.0	1416.0	1428.0	10.0	27.0
1600	1626.0	<u>+</u> 6.0	1620.0	1632.0	11.0	27.0
1800	1829.0	<u>+</u> 6.0	1823.0	1835.0	12.5	26.0

3.7.2 The manufacturer / supplier shall also carry out tensile tests and weld bend tests on the pipes in accordance with SPAN TS 21827: Part 2.

3.8 Surface Preparation - Cleaning

- 3.8.1 After hydraulic testing of each pipe has completed satisfactorily, pipes shall be thoroughly descaled by acid pickling or grit blasting to ensure effective adhesion of the internal lining and external coating.
- 3.8.2 The quality of the surface finish shall not be inferior to Second Quality (Sa 2 and P2) as described in BS 7079, ISO 8501-1 and ISO 8501-3.

3.9 Internal Lining

3.9.1 All steel pipes shall be lined internally to the thicknesses specified in <u>Table 1</u> with concrete made from ordinary Portland cement and fine aggregate. The materials used for lining, the method of lining and curing of the finished lining shall comply with Clause 16.7 of SPAN TS 21827: Part 1 and shall be carried out to the satisfaction Engineer / S.O. Two (2) test cubes shall be made daily whenever concrete lining of

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pipes is in progress. The manufacture and testing of such test cubes shall comply with Clause 16.7.5 of SPAN TS 21827: Part 1.

- 3.9.2 The Engineer / S.O. may reduce the curing period if the pipes are manufactured in tropical countries and provided the crushing strength of the concrete has attained its minimum allowable value.
- 3.9.3 The surface of the concrete lining shall be smooth, continuous, of uniform finish and free from irregularities. Surface irregularities shall be classified as unevenness and roughness with presence of knots, pitting or voids. Concrete lining surfaces shall feel smooth to the touch with no discernable irregularities on close inspection. Lining which do not comply with the above shall be regarded as defective and unless otherwise rectified, the pipes shall be rejected.
- 3.9.4 Fine surface crazing appearing on the concrete lining shall be acceptable but cracks into which a metal gauge of 0.2 mm thickness can be inserted to a depth of half the lining thickness shall be regarded as defective and unless otherwise rectified, the pipes shall be rejected.

3.10 External Coating

- 3.10.1 All steel pipes shall be protected against external corrosion by coating and wrapping in the neat and workmanlike manner.
- 3.10.2 Immediately after each pipe have been cleaned to bare metal, a uniform thin coat of primer compatible with the coating material to be used shall be cold applied by flood coating, spraying or brushing. The primer shall be allowed to dry properly before the coating material is applied but the primer becomes dead, powdery or crumbly it shall be cleaned off and the pipe shall be re-primed.
- 3.10.3 The pipes shall be coated with a layer of bitumen containing mineral filler complying with Category 1, Grade b of BS EN 10300. The coating shall be applied hot to have minimum thickness of 6 mm as specified in <u>Table 1</u>. The coating shall be reinforced with an inner wrapping and an outer wrapping.

3.11 Wrapping

- 3.11.1 The wrapping materials shall be spirally wound onto the pipes simultaneously with the coating material. Each wrap shall be as stated in Clause 16.4 of SPAN TS 21827: Part 1. Care shall be taken to ensure that the inner wrap does not come in contact with the pipe or with the outer wrap.
- 3.11.2 **Inner Wrap:** The inner wrap shall be a glass fiber resin bonded tissue, reinforced in longitudinal direction with parallel glass threads spaced 10 mm apart. The nominal thickness shall be 0.5 mm and the minimum weight shall be 4.64 kg per 100 squares meters.
- 3.11.3 **Outer Wrap:** The outer wrap shall be of glass fibre resin bonded tissue reinforced in the longitudinal direction with parallel glass threads spaced 10 mm to 25 mm apart.

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It shall be impregnated with a material fully compatible with the coating material to give a finished thickness of 0.8 mm.

3.12 Coating Inspection and Repairs

- 3.12.1 The whole coated surface area of all pipes shall be tested for pinholes or other invisible defects in the coating using an approved holiday detector at a potential of 14,000 volts.
- 3.12.2 Any length on which the coating is, in the opinion of the Engineer / S.O., poorly applied shall be cleaned to bare metal and re-coated. Minor defects may be repaired by touching up. All repairs shall be checked for thickness and continuity.

3.13 End protection

- 3.13.1 The internal concrete linings and external coatings of pipes to be joined by welding shall be omitted for a sufficient distance from the ends to prevent damage to the protection during site welding. The external coatings of pipes to be jointed by mechanical couplings of flange adaptor shall be omitted for a sufficient distance from the ends to permit assembly of the joints but the concrete linings shall extend to the ends of the pipes. Unlined surfaces shall be protected with suitably approved ensis oil or similar material during manufacture so that extensive cleaning of the surface is not required before and after jointing on site.
- 3.13.2 The end of the pipe shall be supplied with plain cut and the end shall be free of excessive burrs.

3.14 Marking

- 3.14.1 Each length of pipe pipe shall be legibly marked by stenciling or other indelible marking with the following information in the sequence indicated:-
 - (a) "PBAPP" in capital letter;
 - (b) The dimension Size of Pipe O.D. mm;
 - (c) The certification mark of certification body
 - (d) Type of tube, Submerged Arc Weld (SAW) and
 - (e) Permanent and legible identification number (e.g. order or item number or pipe number)
 - (f) Standard Number e.g: SPAN TS 21827: Part 1: 2013
- 3.14.2 Marking on the tube shall commence not more than 300 mm from one end.

3.15 Inspection

3.15.1 All pipes to be supplied under the Contract may be inspected by the Engineer/S.O. or his representative at the PBAPP's premises or at site.

3.16 Independent Tests

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- 3.16.1 The Engineer / S.0. reserves the right to carry out any independent tests he may deem fit on the completed pipes to be used in the Contract, at any stage of manufacture or delivery.
- 3.16.2 Any samples of pipes which may be required for such tests shall be provided by the supplier at no extra cost to the PBAPP.
- 3.16.3 The cost of making such independent test shall be borne by the PBAPP, unless it can be shown that the workmanship or materials under test are not in accordance with the Specification in which case the cost of the tests shall be borne by the manufacturer / supplier.
- 3.16.4 Any materials, workmanship or completed pipes which are shown by such independent tests to be not in accordance with the Specification shall be rejected notwithstanding any previous acceptance.

3.17 Supplier's Test Certificate / Manufacturer's Quality Control Report

3.17.1 The supplier shall submit to the Engineer / S.O. one copy of results of all tests which have been performed on pipes to be supplied to PBAPP.

3.18 Notices of Deliveries

3.18.1 Where applicable, manufacturer / Supplier shall send to the Engineer / S.O., advance notices of all consignments. Every consignment shall be accompanied by a detailed delivery note with the item number of each pipe.

3.19 Protection against Damage in Transit

3.19.1 The ends of all pipes shall be suitably placed and protected against damage during transit. Pipes shall be wrapped or cushioned so that no load is taken directly on the external coating.

3.20 Handling – General

- 3.20.1 Coated pipes shall be lifted and moved only by wide non-abrasive slings or by other means acceptable to the Engineer / S.O. Wire ropes, chains and hooks shall not be permitted to come in contact with the coating. No pipes shall be moved by rolling.
- 3.20.2 Coated pipes shall be stacked as accordance with <u>Table 3</u> and in such a manner that the coating is not damaged. Coated pipes must be kept clear of the ground and rested on padded sleepers or supports.

TABLE 3: STACKED LAYER FOR M.S PIPE		
RANGE OF PIPE SIZE	NUMBER OF LAYER	
(Nominal Diameter, DN)		
(mm)	No.	
DN ≤ 200	7	

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DN = 300	5
$450 \le \text{DN} \le 600$	4
900 ≤ DN ≤ 1200	3
DN ≥ 1400	1

3.21 Delivery and Handling Over

- 3.21.1 The contractor shall deliver to, of-load and stack the pipes in the pie dumps where they will be examined, inspected and taken over by the Engineer / S.O. or his representative.
- 3.21.2 The supplier shall be responsible for the provision of all labor, plant, equipment and packing necessary including the provision of padded timber supports, wedges, hessian or straw for off-loading the pipes from the transport vehicles and stacking them.
- 3.21.3 Any of the pipes, found at the time of unloading to be faulty or damaged shall be repaired or replaced by the supplier as directed by the Engineer / S.O. In this respect, the supplier shall have in attendance during the examination before taking over, a supervisor, with authority to carry out the Engineer's / S.O.'s instruction.