STEEL PIPES

Harum Bidang Sdn. Bhd. (407387-U)

Contents

Contents

Total Quality
Steel Pipe Manufacturer

Harum Bidang Sdn Bhd, a TOTAL quality organisation committed to provide consistent high quality product and services of INTERNATIONAL STANDARDS and to continually improve its position as a leading pipe manufacturer by providing TOTAL CUSTOMER SATISFACTION.

1) CUSTOMER SATISFACTION – Continual improvement in customer satisfaction and we aim to exceed customer expectation.
2) TOTAL QUALITY STEEL PIPE MANUFACTURER – To provide consistent high quality products and services to customer and aim to be the market leader in the industry.
3) SAFE WORKPLACE AND PRODUCTIVE WORKFORCE – Provide adequate training to ensure skilled, motivated and quality conscious workforce and to create safe, healthy, pleasant and productive manufacturing environment.

Our overriding quality objectives shall be reviewed on a continual basis to ensure consistency with our quality policy.

DATO SRI KHO KAK BENG
Group Managing Director

Introduction

KKB Engineering Berhad (KKBEB) had its humble beginnings way back in 1962 as a small engineering workshop in Sarawak founded by the present Chairman and Group Managing Director, Dato Sri Kho Kak Beng which was then undertaking modest steel fabrication works.

The business was officially registered as a sole proprietorship in 1966 with the progression into steel fabrication works for factory buildings and products such as steel storage tanks.

On 20 February 1976, the business was incorporated as a private limited company under the name and style of Kho Kak Beng Welding and Engineering Contractor Sdn Bhd, the name which was subsequently changed on 11 March 1994 to KKB Engineering Sdn Bhd.

The status of the company was later converted to a public limited company on 23 March 1994 and was listed on the Second Board of Bursa Malaysia Securities Berhad (BMSB) on 9 November 1994. On 21 June 2007, the Company was successfully transferred to the Main Market of Bursa Malaysia Securities Berhad.

The present activities of KKB Engineering Berhad encompass 5 divisions, viz.,

1 Steel Fabrication Division

2 Hot - Dip Galvanising Division

3 Civil Construction Division

4 LPG Cylinders Manufacturing & Requalification Division

5. Oil & Gas (EPCIC)

KKB Engineering Bhd through its subsidiary, Harum Bidang Sdn Bhd (HBSB) has further diversified into steel pipe and pipe specials manufacturing at Sejingkat Industrial Estate in Kuching, Sarawak. With steel fabrication knowledge, experience, expertise and facilities accumulated over a period of 60 years, we continuously seek for improvement in our quality products and services for our customers.

HBSB Steel Pipes

Production

HBSB manufactures steel pipes in range of diameters from 100mm to 2500mm with provision for system expansions when required.

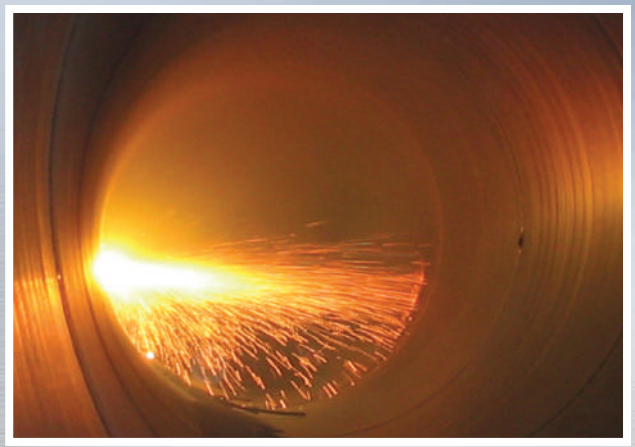
The methods of manufacture used in our factory are

a) The Bend Rolling Process (Sectional Welded Steel Pipe)

b) The Spiral Forming Process (Spiral Welded Steel Pipe)

These pipes are manufactured by the semi automatic submerged arc welding process and are normally supplied in standard lengths of 9.3 meters and specified lengths can be supplied upon request.

HBSB current initial installed capacity per shift per annum of mild steel pipes is approximately 36,000 metric tons, which is contributed by both sectional and spiral welded steel pipes production.



Product Certification &

Quality Management System



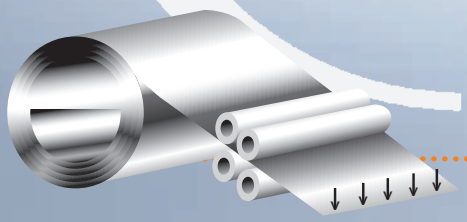

1. ISO 9001:2015 Quality Management System (Manufacture of Steel Pipe and Pipe Specials)
2. IKRAM Product Certification of KKB Steel Pipes (SAW) Size: 323.9mm - 2235mm
3. IKRAM Product Certification of KKB Steel Pipe Specials (SAW) Size: 323.9mm - 2235mm
4. IKRAM Product Certification of KKB Steel Pipes (ERW) Size: 114.3mm - 457mm
5. IKRAM Product Certification of KKB Steel Pipe Specials (ERW) Size: 114.3mm - 457mm
6. IKRAM Product Certification of KKB Steel Pipes (SAW: PU Lined) Size: 323.9mm – 2235mm
7. IKRAM Product Certification of Steel Pipes for Water & Sewage (SAW: Concrete/PU Lined) SPAN TS 21827: Part 1:2013
8. IKRAM Product Certification of Steel Fittings for Water & Sewage (SAW: Concrete/PU lined) SPAN TS 21827: Part 1:2013
9. IKRAM Product Certification of Steel Pipes for Water & Sewage (EW) SPAN TS 21827: Part 1: 2013
10. IKRAM Product Certification of Steel Fittings for Water & Sewage (EW) SPAN TS 21827: Part1: 2013
11. ISO 45001:2018 Certification - Health & Safety Management



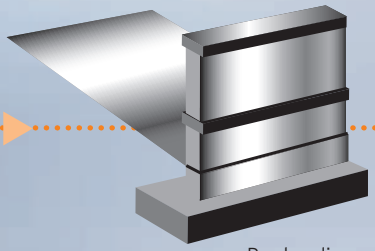


Sectional Welded
Steel Pipe Process

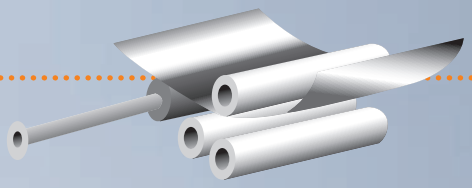
Sectional welded steel pipe process starts from the heavy duty decoiler, straightener and shearing integrated machine which decoils, straightens the Hot Roll Coil into flat plate and shears the flat steel plate into required length. Then our highly flexible roller bending process makes possible a very large range of available diameters and wall thickness, transforms the plate into steel shell (barrel). All steel shell is (internal and external) Longitudinally Submerged Arc Welded to form complete welded steel shell. A number of steel shells (depend on the length required) will be put together to form a long pipe with a number of internal and external Submerged Arc Circumferential Welds.



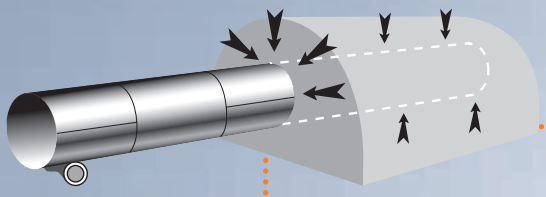
Decoiling, Straightening & Shearing



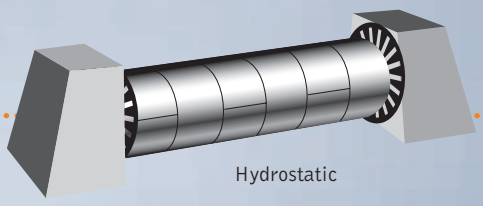
Pre-bending



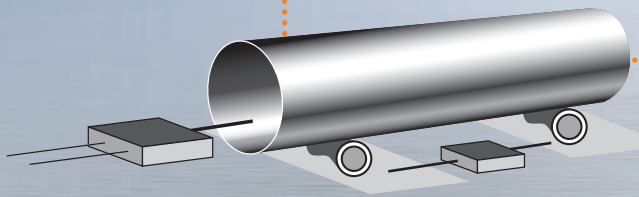
Rolling



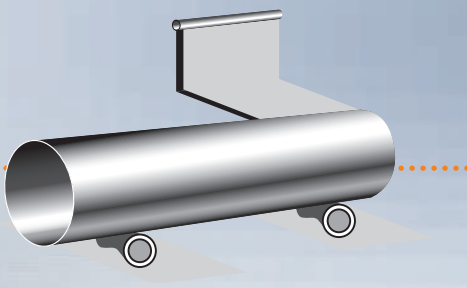
Surface Preparation



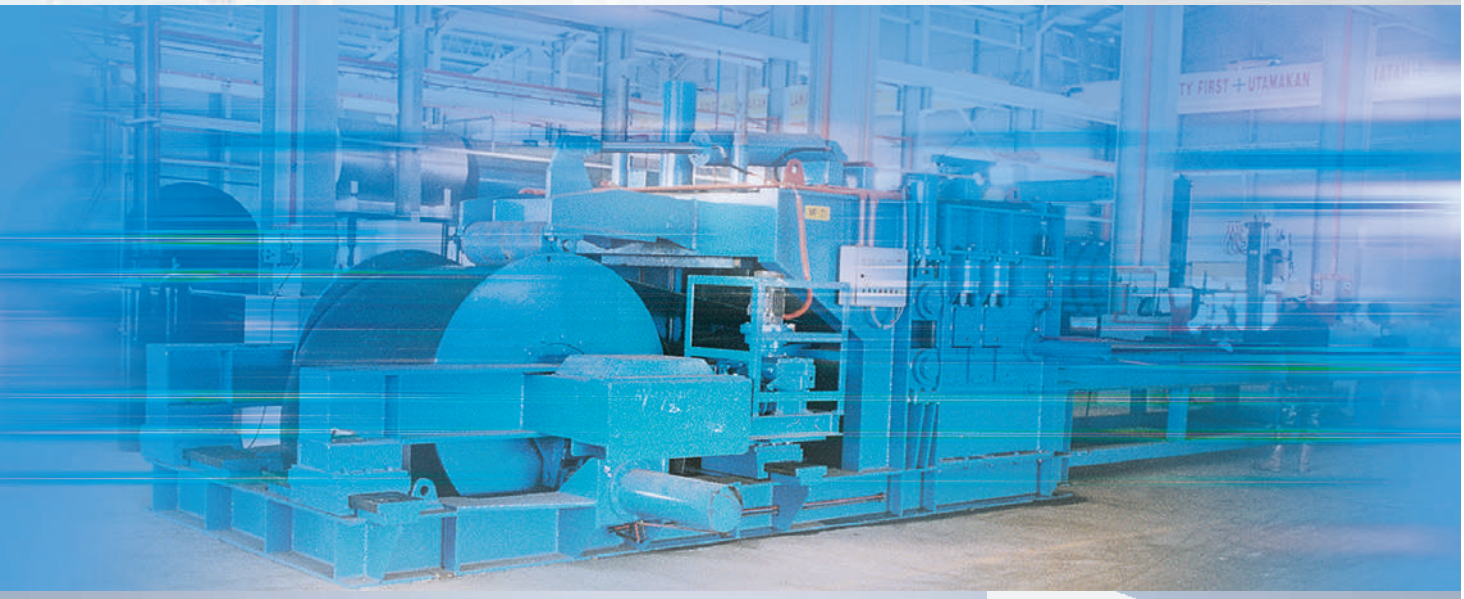
Hydrostatic

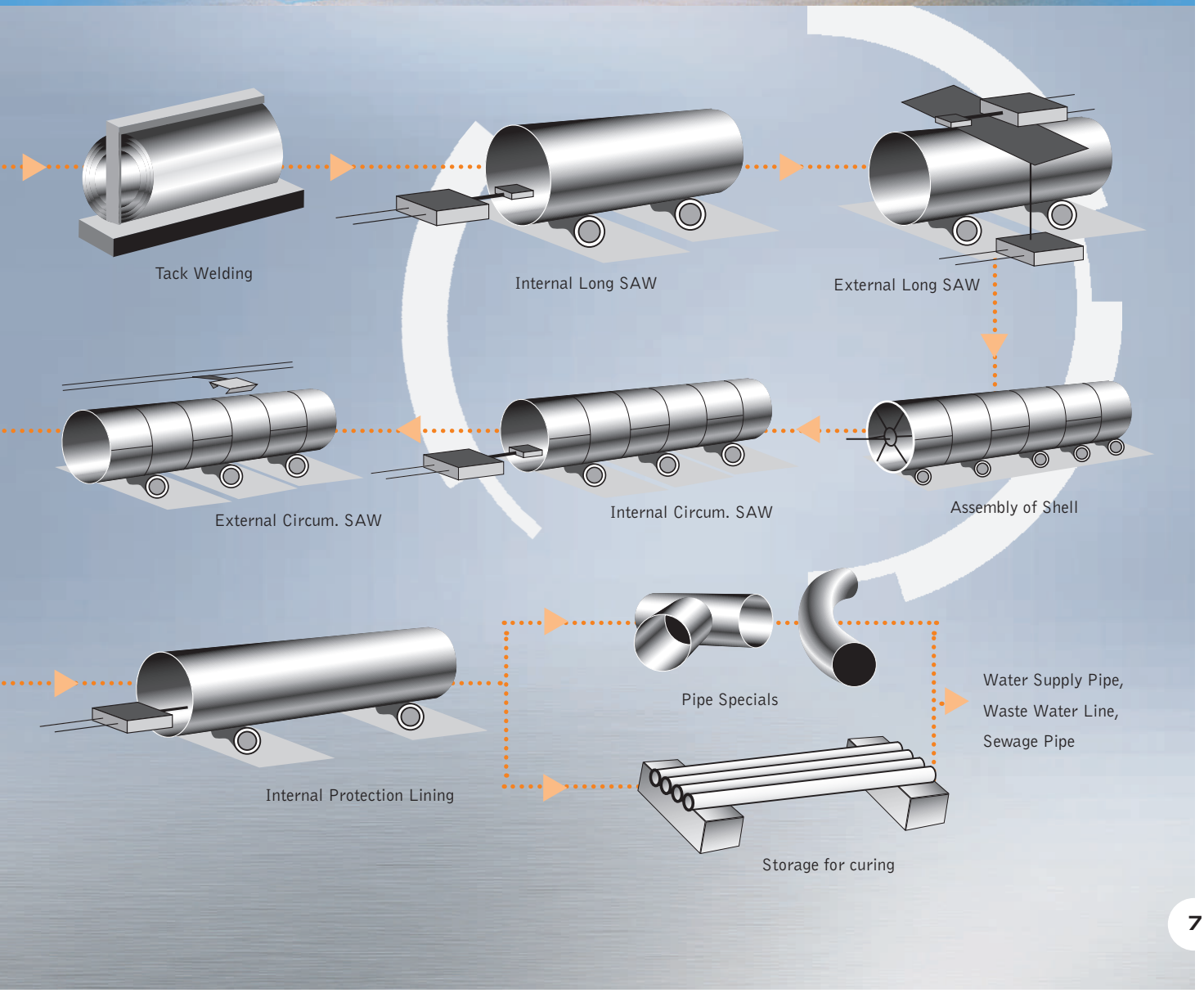


External Primer Application

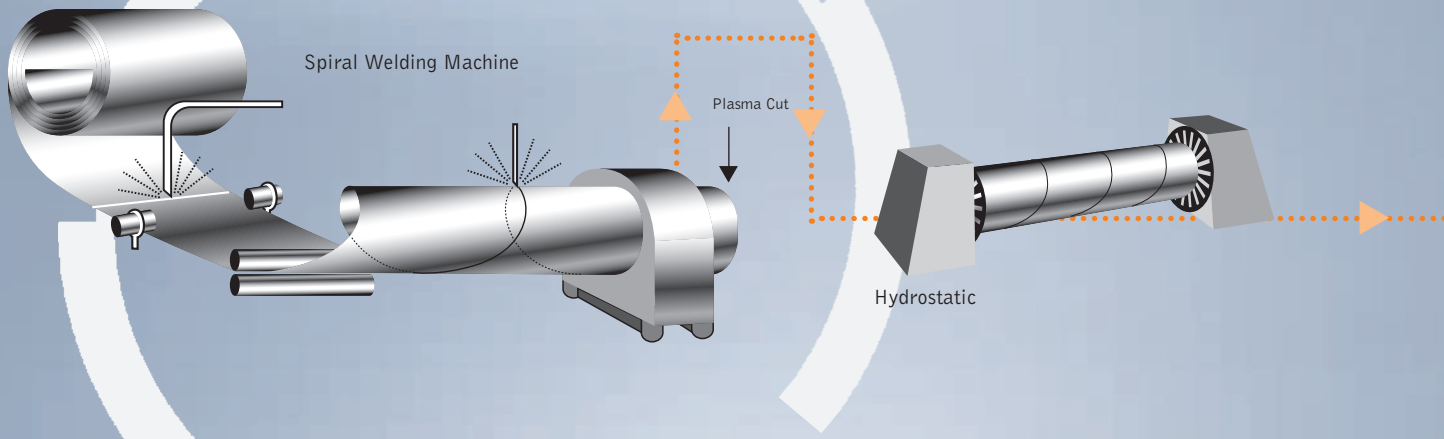


External Protection Coating




Tack Welding
Internal Long SAW
External Long SAW
Assembly of Shell
Internal Circum. SAW
External Circum. SAW
Pipe Specials
Water Supply Pipe,
Waste Water Line,
Sewage Pipe
Internal Protection Lining
Storage for curing

Spiral Welded
Steel Pipe Process

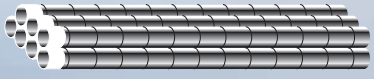


Besides the existing reliable sectional weld pipe process, HBSB ventures into new era of high speed and excellent quality Spiral Weld Pipe process.

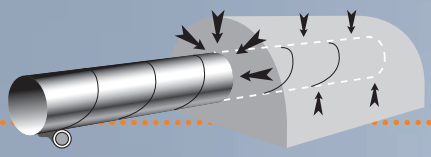
Spiral weld pipe, as the name implies, is a steel pipe that has a seam running its length in a spiral form.

Present spiral weld production line consists of a decoiling device, straightening rollers, edge preparation tools, pre-bending devices, roller bending and cage forming system, an internal welder and an external welder (both Submerged Arc Welding), Non-destructive testing apparatus and cutting devices.

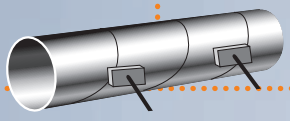
Advantages of spiral welded large diameter pipes are most obvious in high pressure pipeline application.



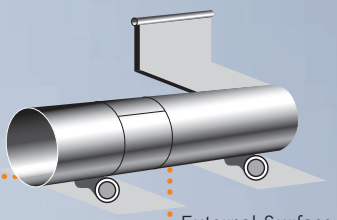
Pile Pipe, Structural Member & Etc



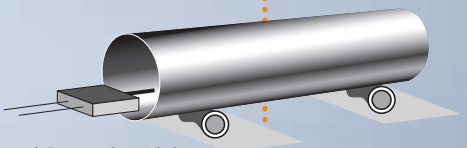
Surface Preparation



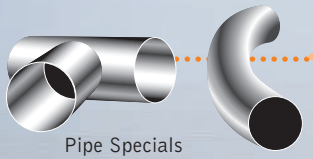
External Primer
Protection Application



External Surface
Protection Coating

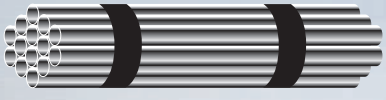


Internal Protection Lining



Pipe Specials

Storage for curing



Manufacturing Standards

HBSB manufactures steel pipes generally in accordance with B.S. 3601-1987 Steel Pipes and Tubes for Pressure Purposes and B.S. 534 -1990 - Steel Pipes, Joints And Specials for Water and Sewage. Pipes complying with American Water Works Authority (AWWA), American Petroleum Institute (API) Standard, Australian Standard (AS), Japanese Industrial Standard (JIS), Singapore Standard (SS) or other specifications and standards can also be supplied

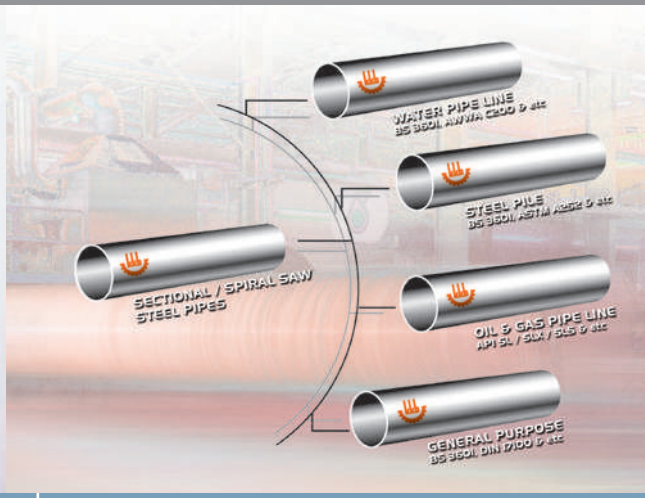


TABLE I. GRADE OF STEEL

STANDARDS	GENERAL APPLICATIONS	GRADE	CHEMICAL COMPOSITION (%)				
			C Max	Si Max	Mn Max	P Max	S Max
API 5L Note: EW: electric welded CW: continuous welded NE: non expanded CE: cold expanded	High strength oil & gas pipelines, refinery piping & etc	A25 CI I EW/CW	0.21	-	0.6	0.03	0.03
		A25 CI II EW/CW	0.21	-	0.6	0.08	0.03
		A NE/CE	0.21	-	0.9	0.03	0.03
		B NE/CE	0.26	-	1.15	0.03	0.03
		X42 NE/CE	0.28	-	1.25	0.03	0.03
		X46 NE	0.30	-	1.35	0.03	0.03
		CE	0.28	-	1.25	0.03	0.03
		X52 NE	0.03	-	1.35	0.03	0.03
		CE	0.28	-	1.25	0.03	0.03
		X56 NE/CE	0.26	-	1.35	0.03	0.03
		X60 NE/CE	0.26	-	1.35	0.03	0.03
		X65 NE/CE	0.26	-	1.40	0.03	0.03
		X70 NE/CE	0.23	-	1.6	0.03	0.03
		X80 NE/CE	0.18	-	1.80	0.03	0.018
BS EN 10025 2019	Hot Rolled products of structural steel	S275JR	0.25	-	1.60	0.045	0.045
		S355JR	0.27	0.6	1.70	0.045	0.045
BS4360 1990	Water & sewage systems. General applications	43A	0.25	-	1.60	0.05	0.05
		43B	0.21	-	1.50	0.05	0.05
		43C	0.18	0.50	1.50	0.04	0.04
		50B	0.20	0.50	1.50	0.05	0.05
		50C	0.20	0.50	1.50	0.04	0.04
JIS G3101 - 1991	Water & sewage systems. General applications	SS 400	-	-	-	0.05	0.05
		SS 490	-	-	-	0.05	0.05
ASTM A 252	Piling	1	-	-	-	0.050	-
		2	-	-	-	0.050	-
		3	-	-	-	0.050	-
DIN 17100 - 1980	Piling	st44-2	0.21	-	-	0.05	0.05
		st52-3	0.20	-	-	0.04	0.04

Grade Of Steel

The grade of steel most commonly used in the manufacturing of steel pipes, specials and fittings are BS EN 10025: 2019 Grade S275JR and BS 4360:1986 Grade 43A or equivalent. If higher strength of steel is required, then Grade S355JR of BS EN 10025: 2019 and Grade 50B of BS 4360:1986 or API-5L X Grades can be used.

Table 1 lists out the specifications of steel to BS EN 10025: 2019, BS 4360:1986, DIN 17100:1980 and JIS G3101 requirements that are widely used. Pipes manufactured from materials to other international standard for particular application can be supplied if required.

	TENSILE TEST			
OTHERS	**Y.S. (MIN) N/mm²**	**T.S. N/mm²**	**ELONGATION (MIN)**	
-	173	310		
-				
-	207	332		
Ti, V, Nb	241	414	E= 625,000	$A^{0.2}$
Ti, V, Nb	289	414		$U^{0.9}$
Ti, V, Nb	317	435		
Ti, V, Nb			A= Transverse area in sq inches	
Ti, V, Nb	360	455		
Ti, V, Nb			U= SM.T.S in Psi	
Ti, V, Nb	356	490		
Ti, V, Nb	414	517	E= Elongation in 2 inches	
Ti, V, Nb	448	532		
-	483	566		
-	552	621		
-	Up to and incl. 16mm – 275	410 ~ 560	GL= 80mm	22
Nb: max 0.06 V: 0.15	Over 16mm up to and incl. 40mm - 355	510 ~ 680	GL= 5.65√So	
-	Up to and incl. 16mm - 275		GL= 200mm	
-	Over 16mm up to and incl. 40mm - 265	430 ~ 580	GL= 5.65√So	22
-				
Nb: 0.003 - 0.10	Up to and incl. 16mm - 355	490 ~ 620	GL= 200mm	18
V: 0.003 - 0.10	Over 16mm up to and incl.		GL= 5.65√So	20
-	Up to and incl. 16mm - 245	400 ~ 510	For thickness up to 50mm	
	Over 16mm up to 40mm - 235		21 - 26	
-	Up to and incl. 16mm - 285	490 ~ 610	For thickness up to 50mm	
	Over 16mm up to 40mm - 275		17 - 21	
			t ≤ 0.312″	
-	207	345	E = 48t + 15.00	
			t > 0.312″	
			E = 30 (GL 2″)	
			t ≤ 0.312″	
-	241	414	E = 40t + 12.50	
			t > 0.312″	
			E = 25 (GL 2″)	
			t ≤ 0.312	
-	310	455	E = 32t + 10.00	
			t > 0.312″	
			E = 20 (GL 2″)	
-	Up to 16mm - 275	410 ~ 540	3 ≤ t ≤ 40	
	Over 16mm up to 40mm -265		L - 22; C - 20	
-	Up to 16mm - 355	490 ~ 630	3 ≤ t ≤ 40	
	Over 16mm up to 40mm - 265		L - 22; C - 20	

Quality Assurance

At Harum Bidang Sdn Bhd, there is a commitment to manufacture high quality products which begins from the selection of pipe making machineries and the raw materials required until finished product and onward transportations.

The Company is a holder of ISO 9001: 2015 certification from Lloyd's Register Quality Assurance, ISO 45001: 2018 OHSA from Bureau Veritas Certification and is an IQCI (IKRAM Quality and Certification Institute) certified Company for Steel Pipes and Steel Pipe Specials for use in all Government Approved, Local Infrastructure Development and Water Supply Projects. Modern and sophisticated equipment as well as highly qualified and experienced technical personnel have enabled the implementation of a formal quality program across the entire organisation.

All steel pipes that bear the undergo thorough, rigid quality control on inspection of raw materials (Hot Roll Coil) and include welding wire and flux for suitability and technical compatibility, in process and final inspections and tests before final deliveries from our plant.

Each pipe is also hydrostatically tested as per BS 3601 specifications. In additions, radiography testing may be conducted at the weld seam for each pipe and Third Party Inspectors may be appointed to carry out quality assurance, inspection and testing in our manufacturing process at our plant to suit requirements. Every pipe is subjected to a rigorous check at final stand to ensure that only the best quality pipes are supplied.






Inspections & Tests

The following inspections and tests for steel pipe are available:

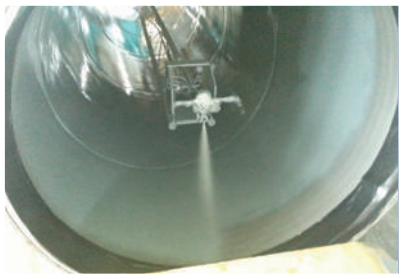
No	Basic inspections and tests	Sectional/Spiral welded pipes			
		A	B	C	D
1	Chemical Analysis	-	✓	✓	✓
	Mechanical Tests include:				
2	Tensile Test	✓	✓	✓	✓
3	Charpy Test	-	-	✓	-
4	Drop Weight Tear Test	-	-	✓	-
5	Flattening Test	-	-	-	-
6	Guided Bend Test	✓	-	✓	✓
7	Bend Test	-	-	-	-
8	Hydrostatic Test	✓	-	✓	✓
	Radiological Inspections Include:				
9	Radiographic Film	-	-	✓	-
10	Fluorescent Screen	-	-	✓	-
11	Ultrasonic Inspection	-	-	✓	-
	Electromagnetic Inspections Include:				
12	Eddy Current	-	-	-	-
13	Magnetic Particle	-	-	✓	-
14	Dye Penetrant Test	-	-	✓	-


The following Coating and Lining inspections and tests are also available:

1. Holiday Test
2. Weight Test
3. Coating Thickness Test
4. Sand Sieving Test
5. Concrete Cube Test
6. Peel Test
7. Pull off Test (Dolly Test)
8. Shore D Hardness Gauge

Note
A = AWWA
B = ASTM A252
C = API 5L
D = BS 3601

Prior to the application of the external or internal corrosion protection system, the surfaces of the steel pipes are grit blasted to remove mill scale, rust, grease and other foreign materials. The surfaces are cleaned to the quality of surface finish as specified in B.S. 4232 or ISO 8501-1:1988(E) or any other applicable standard specified.



External Surface Protection Systems include:

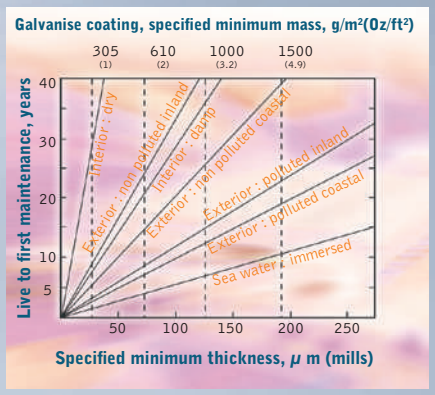
1 Reinforced Bitumen Enamel
2 CoatingReinforced Coal Tar Enamel Coating
3 Organic and Inorganic Zinc Rich Coating
4 Coal Tar Epoxy and other Epoxy Coating
5 Primer Coat Painting eg. Red Lead Oxide
6 Hot Dip Galvanising
7 Zinc Metallize Coating – min 130 g/m²
8 Polyurethane Coating

Internal Surface Corrosion Protection Systems:

1 Centrifugal Spun-In Concrete Lining
2 Centrifugal Spun-In Bitumen Lining
3 Centrifugal Spun-In Coal Tar Lining
4 Epoxy and Coal Tar Epoxy Lining
5 Paint Systems
6 Hot Dip Galvanising
7 Polyurethane Lining

General Galvanising

Steel is a strong material for fabrication of structural member as well as transmission towers, but it still has to be protected from corrosion. There are many ways to protect it from corrosion but the most economical way is to coat with zinc in Hot Dip Galvanisng (HDG) system. Generally, galvanising is carried out to conform to BS 729:1971 specifications.

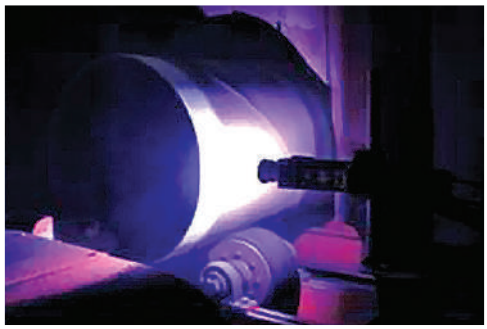


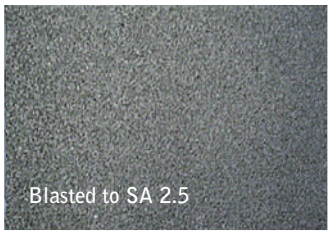
Advantages

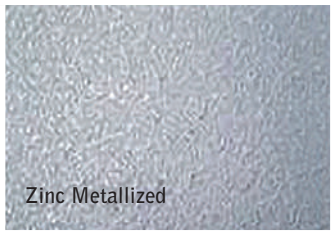
The advantages of HDG are:

1 Extend the age of steel or iron, for example: Galvanised coating thickness for 610gr/m2 is free for maintenance for over 30 years in rural and 15 - 25 years in urban area. (Please refer to the above diagram)
2 It will not peel off easily because it has been metallic bonded to base metal so the following activites e.g. fabrication work and transportation will not damage the coating.
3 Galvanising coating corrodes preferentially to zinc, providing sacrificial or cathodic protection to small area steel exposed through damage the coating area.
4 Giving a comprehensive protection including sharp indentations and inaccessible areas.
5 Even in cases where the initial cost of galvanising is higher than a comparable alternative, galvanising is almost invariably cheapest in the long term.
6 The use of galvanising considerably reduces maintenance for very long periods compared with other coatings for steel.

Blasting and Zinc Metallizing Process



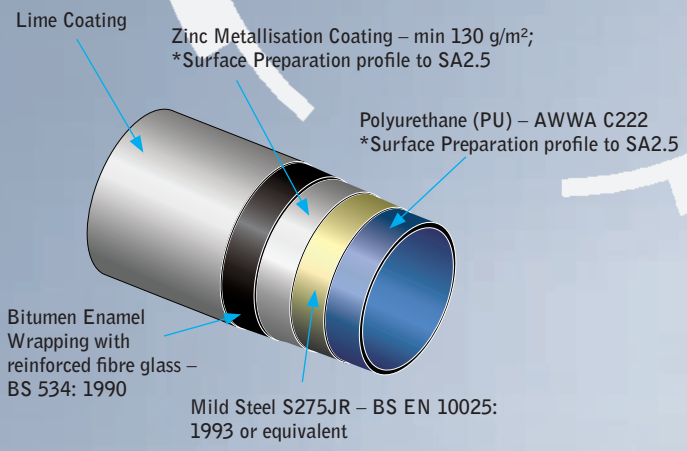




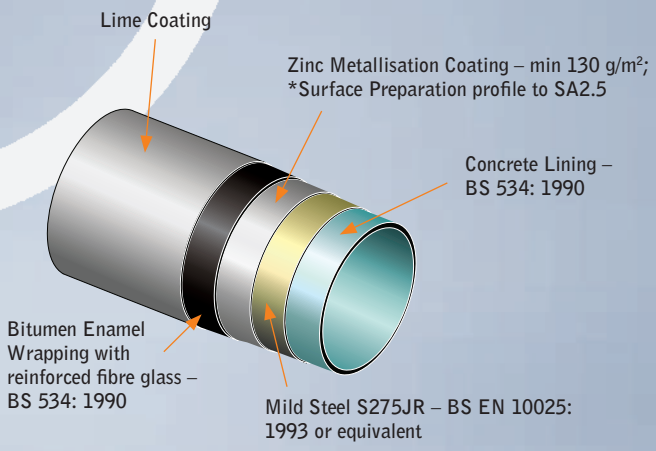
Inspections & Tests

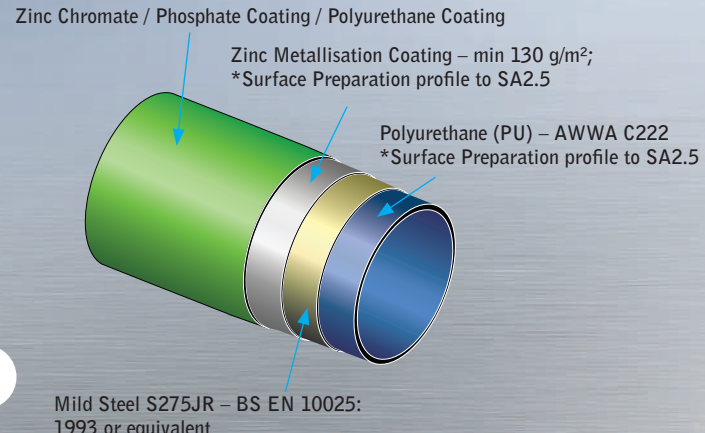
Polyurethanes (PU) have found extensive applications in the pipe coating/lining industry because they exhibit excellent corrosion resistance, abrasion resistance, toughness, and chemical resistance, as well as a wide range of useful mechanical properties. A MSPUL pipe of a similar size to a MSCL pipe is lighter in weight and makes for better ease of transportation. The bigger internal diameter of a PU pipe facilitates a higher water flow volume compared to a MSCL pipe

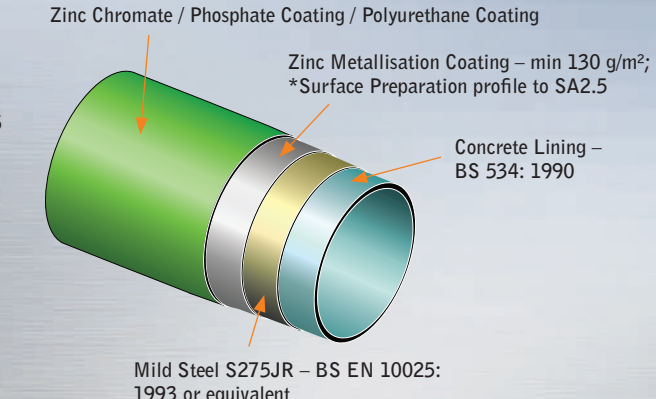
Mild Steel - Sectional View MSPUL Pipe



Sectional View MSCL Pipe







Steel Pipe Specials

Fittings & Joints

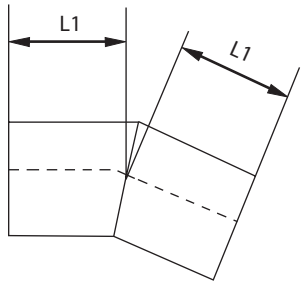


Figure 1. Gusseted bend type 1, not more than 30°

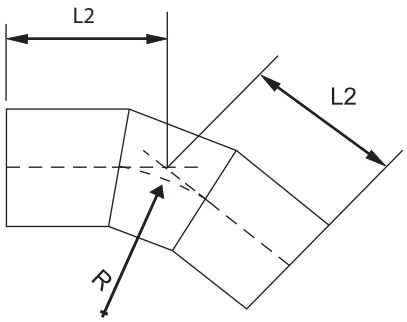


Figure 2. Gusseted bend type 2, over 30° up to 60°

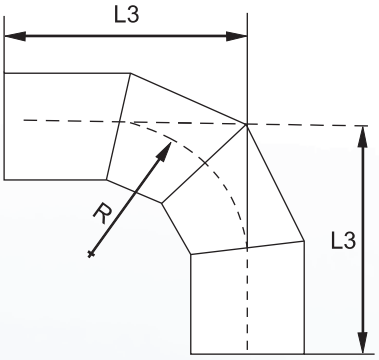


Figure 3. Gusseted bend type 3, over 60° up to 90°

Fabricated steel pipe specials, fittings and joints such as bends, reducing bends, tapers, crosses, y-pieces, off-take tees, level invert tees, access manhole tees, joint harness, manifolds, ring girder supports, stiffener rings, expansion joints, flexible couplings, flanged adapters, butt straps, collars, ring and blank flanges etc. are manufactured to British Standards, American Water Works Association Standards and other International Standard to suit client requirement.

The internal lining and external coating of these items are also carried out to suit the requirements of the particular service application they are subjected to.

Welded Steel Pipe Specials

For reference table 2 show details and dimensions commonly used. **HBSB** can manufacture and supply a comprehensive range of specials, fittings and other appurtenances associated with pipeline construction to suit client's specification and requirement. Whilst all diagrams show specials and as plain ended, we can manufacture and weld plate type, flat or raised face flanges to any standards to the pipe ends. Puddle flanges, tie ring thrust flanges, and harness lugs can be welded onto the pipe specials if required. Bends of all angles up to 90° are manufactured by gusseting and welding. The number of gussets can be increased to give a smoother flow.

Table 2: Dimensions of Gussetted Bend Sizes 100mm to 2200mm Dia. Inclusive.

Pipe OD	Type 1	Type 2				Type 3	
	Not more than 30°	Over 30° to 45°		Over 45° to 60°		Over 60° to 90°	
mm	L_1 mm	R mm	L_2 mm	R mm	L_2 mm	R mm	L_3 mm
114.3	175	150	200	150	250	150	300
139.7	200	200	250	200	250	200	350
168.3	225	225	300	225	300	225	400
193.7 *	275	275	300	275	300	275	400
219.1	300	300	350	300	400	300	500
244.5 *	300	350	350	350	400	350	550
273	375	375	450	375	500	375	650
323.9	375	450	450	450	500	450	700
355.6	450	525	550	525	600	525	800
406.4	450	675	600	450	600	450	850
457	450	675	600	450	600	450	850
508	450	750	600	500	600	500	850
559	450	825	650	550	600	550	850
610	550	900	750	600	750	600	1000
660	550	975	750	600	750	600	1000
711	550	1050	800	700	750	700	1100
762	600	1125	850	750	850	750	1100
813	600	1200	850	800	850	800	1200
864	600	1275	850	850	850	850	1200
914	600	1350	900	900	900	900	1300
1016	750	1500	1100	1000	1100	1000	1500
1219	850	1800	1200	1200	1200	1200	1700
1420	850	2100	1300	1400	1300	1400	1900
1628	900	2400	1400	1600	1400	1600	2100
1829	900	2700	1500	1800	1500	1800	2200
2032	1000	3000	1600	2000	1600	2000	2500
2235	1000	3300	1700	2200	1700	2200	2600

Joint Details

For Use With Steel Pipes

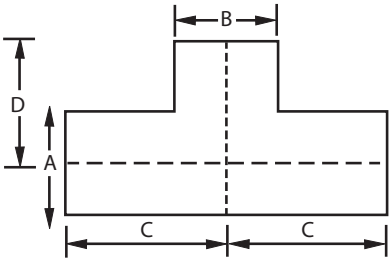


Figure 4. Plain end tee for slip-on type coupling and butt welded joint

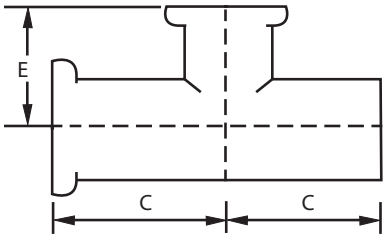


Figure 5. Sleeve joint tee for welding

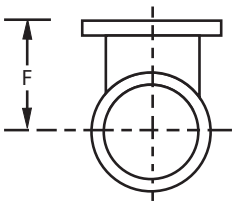
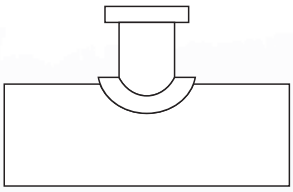


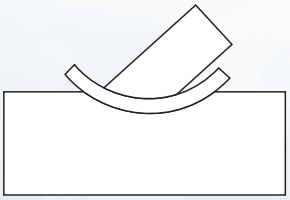
Figure 6. Tee with flanged branch

(A)



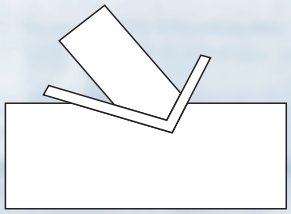
COMPENSATING PLATE TYPE

(B)



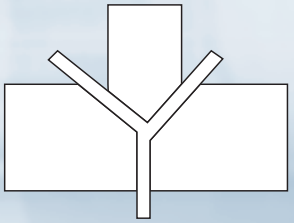
ONE PIECE CROTCH PLATE WYE TYPE

(C)



TWO PIECES CROTCH PLATE WYE TYPE

(D)



THREE PIECES CROTCH PLATE WYE TYPE

Table3. Dimensions of tee. Sizes 60mm to 2200mm nominal diameter inclusive.

Barrel		Branch			
Outside diamater A	C	Outside diamater B	D	E	F
			0.5 times o.d.of barrel 'A' plus		
mm	mm	mm	mm	mm	mm
60.3	240	60.3	200	100	100
76.1	240	76.1	200	100	100
88.9	250	88.9	200	100	110
114.3	270	114.3	200	100	130
139.7	280	139.7	200	110	140
168.3	290	168.3	200	110	140
193.7*	300	193.7*	200	110	150
219.1	370	219.1	250	110	150
244.5*	380	244.5*	250	130	160
273	410	273	250	130	160
323.9	450	323.9	250	130	160
355.6	530	355.6	300	150	200
406.4	600	406.4	300	150	230
457 to 711	**1.5 times o.d. of branch 'B'**	457 to 711	300	230	300
762 to 914	**but with a minumum of**	762 to 914	380	300	300
1016 to 2235	**0.5 times o.d. of barrel 'A'**	1016 to 2235	380	380	380

Note:

The diagrams above show details and dimensions of unreinforced tees only. If design criteria or operating conditions require that the tees or Y-branches be provided with proper reinforcement, HBSB can supply them with reinforcements to the requirements of AWWA M11 or as specified by client. Typical Reinforcement details of tees and angle branches are as above.

Tapers

The provision of the straight parallel sections at both ends allows either welding directly into the adjoining pipes with collar joints or attachment of flanges couplings or flanged adapters for stronger and faster connection.

Figure 7. Concentric Tapers

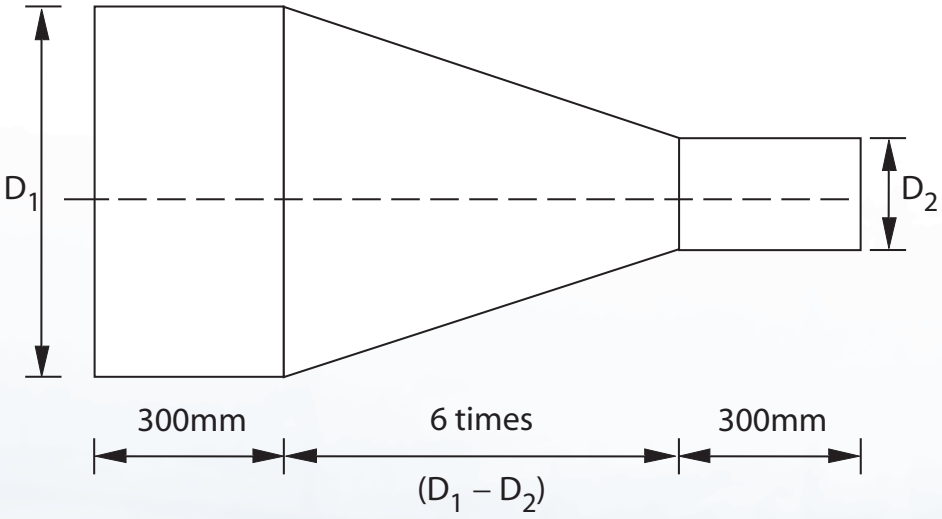
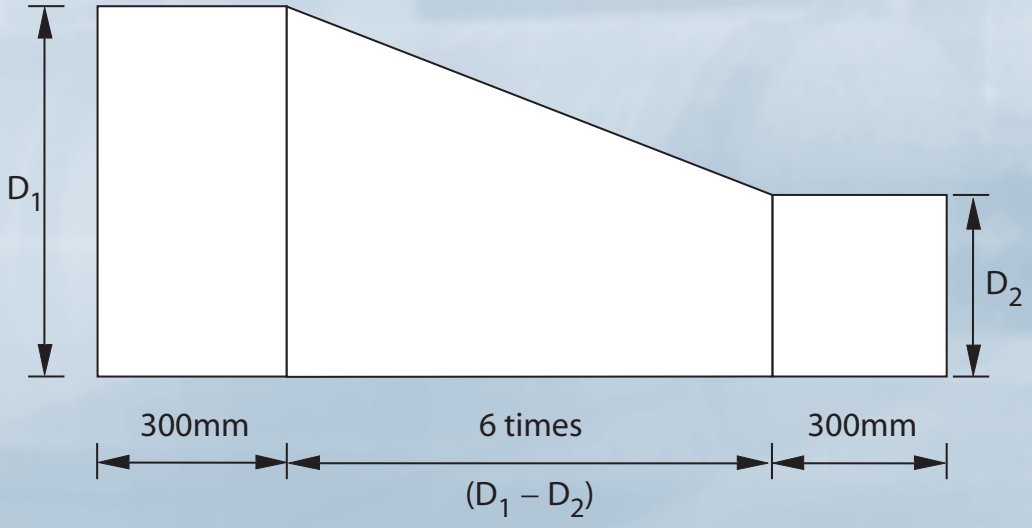


Figure 8. Eccentric or Flat Taper



Joint Details
For Use With Steel Pipes

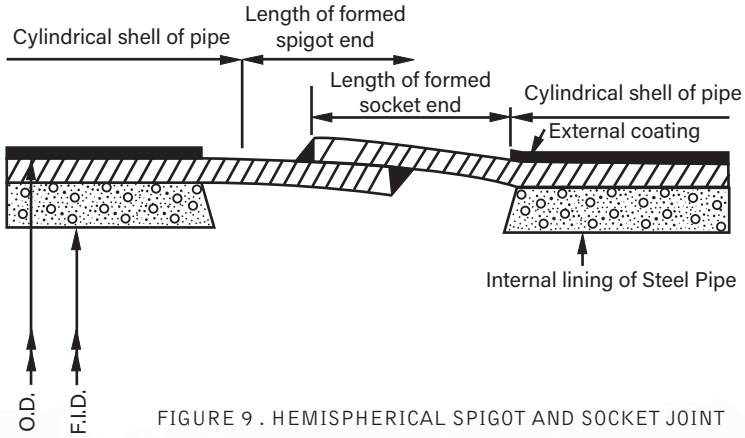


FIGURE 9 . HEMISPHERICAL SPIGOT AND SOCKET JOINT

Hemispherical Spigot & Socket Joint

Available in all sizes of steel pipes and very commonly used in Malaysia. Able to accommodate an angular deflection of up to 2^0 per joint. For diameters above 610mm both internal and external fillet welding at site. Easy slip-in and does not require sophisticated and elaborate techniques for assembly. Another version available is the parallel sleeve type where the spigot end is plain ended.

Spherical spigot & Socket Joint

Available in sizes from 610mm to 2200mm diameters. Able to accommodate an angular deflection of 5^0 per joint. Air testing of completed joint allows the whole pipeline to be immediately backfilled.

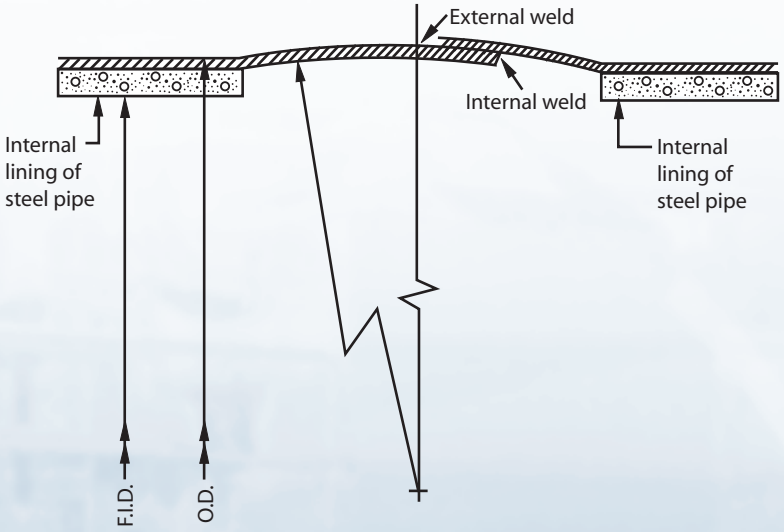


FIGURE 10 . SPHERICAL SPIGOT AND SOCKET JOINT

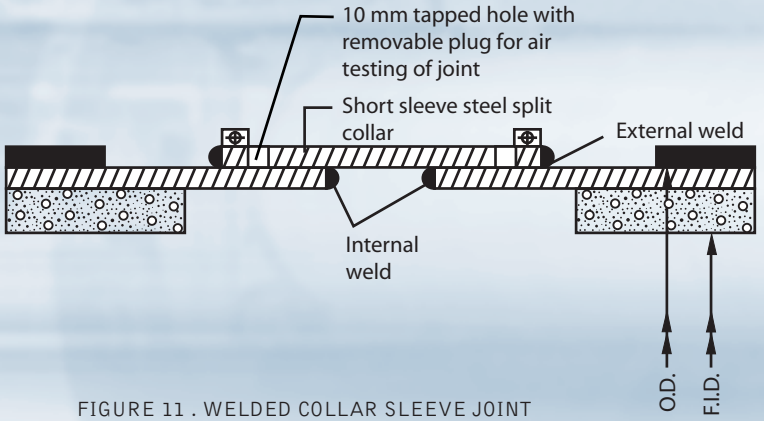


FIGURE 11 . WELDED COLLAR SLEEVE JOINT

Collar Joint

Suitable for closing lengths or even whole pipeline. Provide rigid joint. Available in split type and make it easier to align pipes for welding. Both internally and externally fillet welded for 711mm OD and above. On sizes smaller than 711mm OD the joint should be welded.

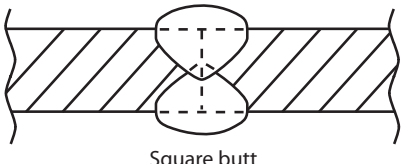


FIGURE 12 . BUTT ENDS JOINT

Butt Ends Joint

Pipe ends can be of single or double Vee or square butt depending on the thickness of plates and will withstand longitudinal extension loading caused by settlement or other disjointed forces.

Flanged Joint

Dimensions usually to B.S. 4504. Provide rigid joint and suitable for permanent or temporary installation and can be assembled faster. Used in joining pipes to valves, flowmeters, terminal connections or pipes which are to be installed vertically, in steeply inclined position or above ground on widely spaced supports.

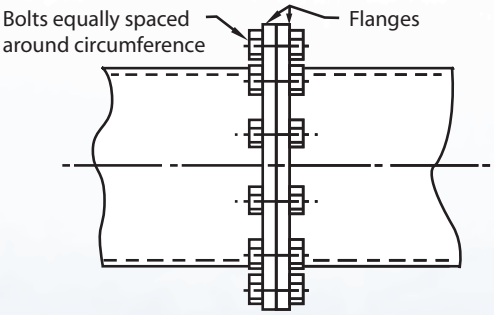


FIGURE 13 . FLANGED JOINT

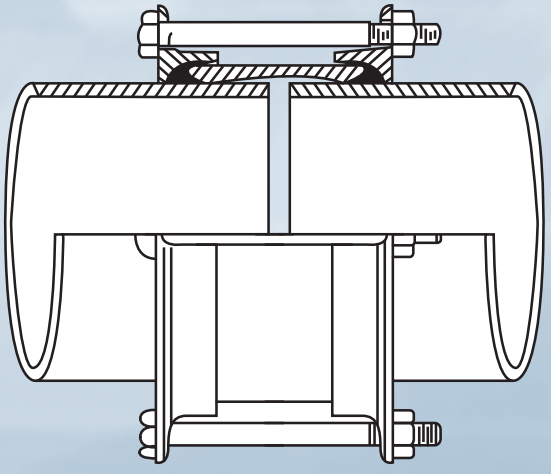


FIGURE 14 . SLIP-ON FLEXIBLE COUPLING

Slip-On Flexible Coupling

Available for all sizes of steel pipes. It is especially suitable for smaller diameter pipes which are difficult or impossible for cement lining to the inside of the pipes. It provides tightness and strength with flexibility and relieve expansion and contraction forces in a pipeline.

Negotiating Long Radius Curves

Using Spherical Spigot & Socket Welded Straight Pipes

Long radius curves can be negotiated by deflecting the joints of spherical spigot and socket steel pipes. The radius of curves for given angles of deflection or the angle of deflection required to produce a given radius may be calculated from the following formula.

$$R = \frac{L}{2 \sin \frac{\emptyset}{2}} \quad \text{or} \quad \emptyset = 2 \sin^{-1}\left(\frac{L}{2R}\right)$$

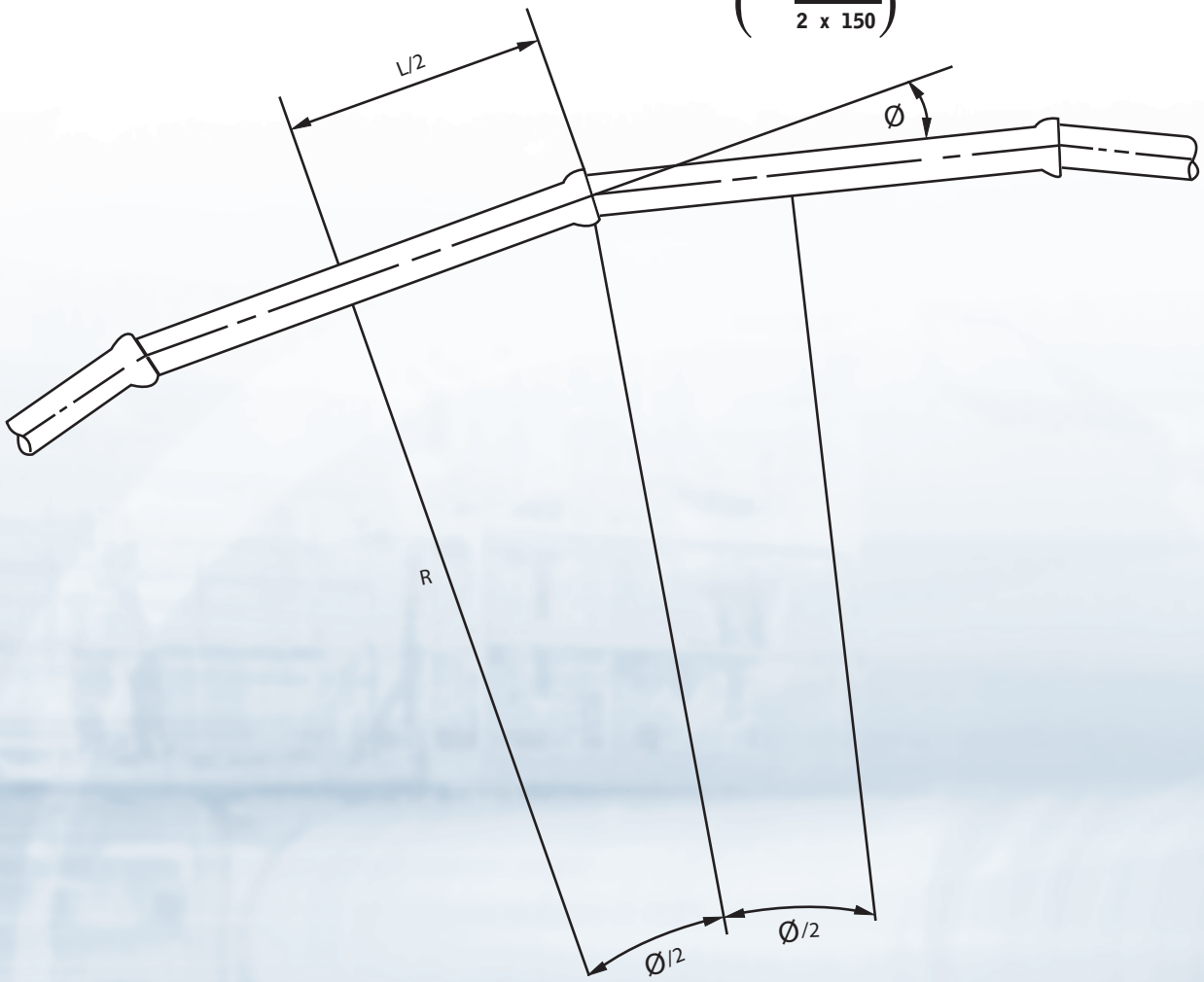
Examples

1. What radius of curvature would result if the joints of standard 10 m long pipes are deflected 5^0?

$$R = \frac{10}{2 \sin \frac{5}{2}} = \frac{10}{2 \sin 2.5} = \frac{10}{2 \times .04362} = 114.6 \text{ m}$$

2. What angle of deflection is required at the joints of standard 10 m long pipes to produce a radius of 150 m?

$$\emptyset = 2\left(\sin^{-1}\frac{10}{2 \times 150}\right) = 2(\sin^{-1} 0.0333) = 2 \times 1.91 = 3.82^0$$



Formula For Weight Of Steel Pipes

Wpe	=	0.02466 x (OD - Ts) x Ts
Wcl	=	0.00728 x (FID + Tc) x Tc
Wbw	=	0.00424 x (OD + Twb) x Twb
Wbl	=	0.00424 x (FID + Tbl) x Tbl

Note:

OD	=	Specified outside diameter of steel shell (mm)
FID	=	Specified finished internal diameter of pipe (mm)
Ts	=	Specified thickness of steel plate (mm)
Tbw	=	Specified thickness of bitumen coating (mm)
Tbl	=	Specified thickness of bitumen lining (mm)
Tcl	=	Specified thickness of concrete lining (mm)
Wpe	=	Calculated weight of plain ended steel shell (Kg/M)
Wbw	=	Calculated weight of bitumen coating (Kg/M)
Wcl	=	Calculated weight of concrete lining (Kg/M)
Wbl	=	Calculated weight of bitumen lining (Kg/M)

Brief Theoretical Aspects

To Be Considered In The Design Of Steel Pipes

The famous Hazen-Williams Formula determining the mean velocity of flow V and the head loss (hf) in a pipeline are given as follow:-

$$V = 1.318\, Cr^{0.63} S^{0.54} \quad (1)$$

$$hf = \frac{4.72\, Q^{1.852} L}{C^{1.852} D^{4.57}} \quad (2)$$

Where
- **C** = **Hazen-Williams Coefficient**
- **D** = **diameter of pipe (ft)**
- **L** = **length of pipe (ft)**
- **Q** = **discharge (Cfs)**
- **r** = **hydraulic radius of pipe (ft)**
- **S** = $\frac{H}{1000\, L}$ = **Slope of hydraulic gradient**
- **H** = **head loss (ft) in 1000 ft. of pipe**
- **D** = **diameter of pipe (in)**

Flow measurements show that for new pipe with smooth interior linings the average value of C may be approximately by the formula

$$C = 140 + 0.17d \quad (3)$$

However, in view of long-term lining deterioration a lower design value is recommended

$$C = 130 + 0.16d \quad (4)$$

Having established the required diameter on hydraulic and economic factors the wall thickness has to be determined.

When designing for internal pressure, the minimum wall thickness of a pipe should be selected to limit the hoop stress to a certain level. A design stress equals to 50 percent of the specified minimum yield strength is often accepted for steel water pipe

$$T = \frac{Pd}{20s}$$

- **t** = **wall thickness (mm)**
- **P** = **pressure (bar)**
- **D** = **outside diameter of pipe (mm) (excluding coating thickness)**
- **S** = **Allowable hoop stress (N/mm²)**

For steel pipes manufactured from plates conforming to B.S. 4360 Grade 43A which has a minimum yield stress of 275 N/mm² the maximum working pressure P_{wmax} based on internal pressure only is :-

$$P_{wmax} = \frac{20\, t\, S}{D}$$

$$= \frac{20 \times t \times 0.5 \times 275}{D}$$

$$= 2750\, \frac{t}{D} \text{ Bar}$$

And hydraulic test pressure P tmax according to BS3601 - 1987 is :-

$$P_{tmax} = 20 \times t \times 0.8 \times \frac{275}{D} \text{ Bar}$$

$$= 4400\, \frac{t}{D} \text{ Bar}$$

A table of recommended maximum working and test pressures based on the above is listed on Page 21 but it should be remembered that these figures are given as guide only and due considerations must be given to other factors like surge, external loading, external pressure in actual design.

Table 4-Dimension Of Steel Pipes

OD of pipe (mm)	Wall thick-ness (mm)	Cement lining thickness (mm)	APPROXIMATE MASS PER METRE			Maximum test pressure (BAR)	Maximum working pressure (BAR)
			Bare steel shell (KG)	Cement lining (KG)	Bitumen enamel wrapping (KG)		
114.3	3.6	6	9.83	4.42	1.49	70.0	70.0
139.7	3.6	6	12.1	5.53	1.82	70.0	70.0
168.3	3.6	6	14.6	6.77	2.18	70.0	58.8
193.7	4.0	10	18.7	12.8	2.50	70.0	56.8
219.1	4.0	10	21.2	14.6	2.83	70.0	50.2
244.5	4.0	10	23.7	16.5	3.15	70.0	45.0
273.0	4.0	10	26.5	18.6	3.51	64.5	40.3
323.9	4.0	10	31.6	22.3	4.16	54.3	34.0
355.6	4.5	13	39.0	31.6	4.56	55.7	34.8
406.4	4.5	13	44.6	36.4	5.21	48.7	30.5
457.0	5.0	13	55.7	41.1	5.85	48.2	30.1
508.0	5.0	13	62.0	45.9	6.50	43.4	27.1
559.0	6.3	13	85.9	50.5	7.15	49.6	31.0
610.0	6.3	13	93.8	55.3	7.80	45.4	28.4
660.0	6.3	19	102.0	86.9	8.43	42.1	26.3
711.0	6.3	19	109.0	94.0	9.08	39.0	24.4
762.0	6.3	19	117.0	101.0	9.73	36.3	22.7
813.0	7.1	19	141.0	108.0	10.40	38.4	24.0
864.0	7.1	19	150.0	115.0	11.0	36.2	22.6
914.0	7.1	19	159.0	122.0	11.70	34.2	21.4
1016.0	7.1	19	177.0	136.0	13.0	30.7	19.2
1219.0	8.0	19	239.0	164.0	15.6	28.8	18.0
1420.0	8.8	25	306.0	251.0	18.1	27.2	17.0
1626.0	10.0	25	398.5	287.0	20.6	27.0	16.9
1829.0	11.0	25	493.2	323.0	23.2	26.4	16.5
2032.0	12.5	25	622.5	356.0	25.7	27.0	16.9
2235.0	14.2	25	777.7	394.0	28.3	28.0	17.5

Note:

(1) OD, wall thickness are based on Table 1 of B.S. 534 - 1990

(2) The wall thickness given are the minimum considered suitable for general use under normal conditions

(3) Cement lining thickness is based on Table 13 B.S. 534 - 1990

(4) Mass for bitumen enamel is based on thickness of 3mm as specified by Clause 26.4 of B.S. 534 - 1990

(5) Other outside diameters and wall thickness of steel pipes can be manufactured

Steel Pipe Piles

The Steel pipe piles are manufactured in accordance with British Standards, JIS, DIN, ASTM or other applicable National Standards. The diameter range available is from 100mm to 2500mm. Normal thickness ranges from 5mm to about 38mm or as per specified.

These tubular steel piles are used extensively as foundation piles for high rise buildings, machinery structures, bridges, wharf pier, breakwaters berth construction, offshore marine structures and other construction projects.

The pipe piles are normally manufactured from steel plates, which comply with Grade S275JR or S355JR of BS EN 10025, Grade 43 or 50 of BS 4360, SS 41 or 50 of JIS G3101 or St. 44 or St. 52 of DIN 17100 with properties in accordance with the specifications as listed in Table 1.

These steel pipe piles are usually supplied in length of 10 or 12m but longer length of up to 60M can be supplied. We can fabricate a 200 ton capacity rotator-manipulator of our own design that is capable of jointing up pipe piles up to 90M length at site by employing automatic submerged arc welding.

The use of automatic submerged arc welding for pile lengthening at site will ensure consistent good quality welding as factory welding compares with the normal manual arc welding at site. Furthermore there will be a substantial time saving in joining extension piles especially for pipes with thick walls.

The pipe piles are normally supplied bare and uncoated unless otherwise specified. Depending on the client's specification for protection against corrosion, the following can be applied.

Protective Coating Systems:

(a) Coal tar enamel coating with white wash

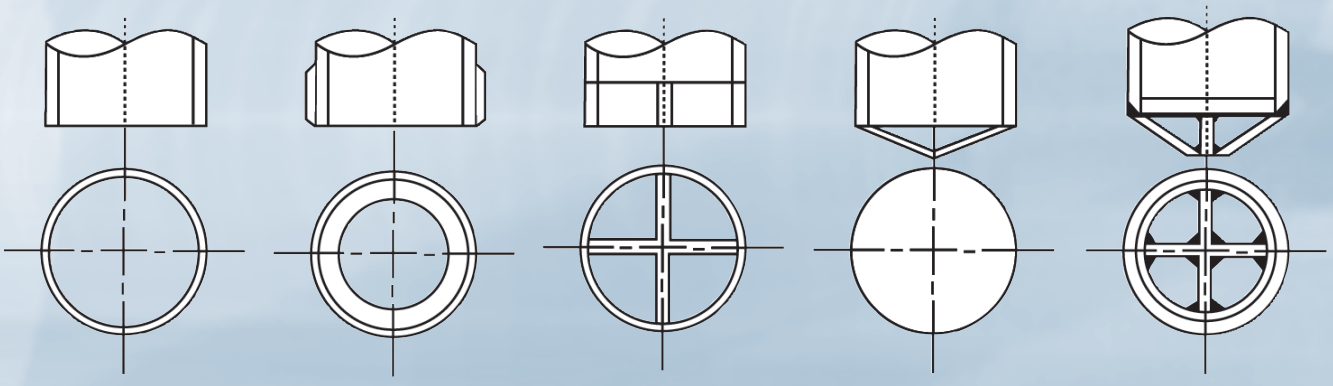
(b) Slip layer coating to reduce negative friction

(c) Inorganic zinc rich coating followed by epoxy or coal tar epoxy coating systems or polyurethane system

(d) Organic zinc rich coating followed by sealer coats

(e) Or any other coating systems specified by clients or recommended by coating manufacturers

Typical Of Pile Shoes:



TYPE I TYPE II TYPE III TYPE IV TYPE V

Formula For Section Propertiesa

Unit Weight $W = 0.02466 (D - t) t$ kg/m.

Cross Sectional Area $A = \varpi t (D - t)$ cm^2

Bearing Area $A^1 = \frac{\varpi D^2}{4}$ cm^2

Circumferential Length $CL = \varpi D$ m

Modulus of Sectional $Z = \frac{\varpi}{32D} (D^4 - d^4)$ cm^3

Radius of Gyration $K = \frac{1}{4} \sqrt{D^2 + d^2}$ cm

Moment of Inertia $I = \frac{\varpi}{64} (D^4 - d^4)$ cm^4

STEEL PIPES FOR STRUCTURES - SECTION PROPERTIES

OD	Thickness	ID	Unit Weight		Section area	Bearing area	CL	Modulus of Sectional	Radius of Gyration	Moment of Inertia
D mm (inch)	t (mm)	d (mm)	w (kg/m)	(m/t)	A (cm^2)	A^1 (cm^2)	(m)	Z (cm^3)	K (cm)	I (cm^4)
254 (10″)	4.5	245	27.7	36.1	35.3	507	0.798	216	8.82	2,746
	6.0	242	36.6	27.3	46.7	507	0.798	283	8.77	3,596
	7.0	240	42.6	23.5	54.3	507	0.798	326	8.74	4,146
304.8 (12″)	4.5	295.8	33.3	30	42.5	730	0.958	314	10.6	4,786
	6.0	292.8	44.2	22.6	56.3	730	0.958	412.6	10.6	6,288
	8.0	288.8	58.6	17.1	74.6	730	0.958	539.4	10.5	8,220
355.6 (14″)	4.5	346.6	39.0	35.7	49.6	993	1.12	430	12.4	7,650
	6.0	343.6	51.7	19.3	65.9	993	1.12	566.4	12.3	10,071
	8.0	339.6	68.6	14.0	87.4	993	1.12	742.5	12.3	13,201
406.4 (16″)	6.0	394.4	59.2	16.9	75.47	1,297.2	1.277	744.5	14.16	15,128
	7.0	392.4	68.9	14.5	87.83	1,297.2	1.277	862.2	14.12	17,520
	8.0	390.4	78.6	12.7	100.13	1,297.2	1.277	978.1	14.09	19,875
	9.0	388.4	88.2	11.3	112.4	1,297.2	1.277	1,082	14.05	22,193
457.2 (18″)	6.0	445.2	66.8	15.0	85.05	1,641.7	1.437	946.9	15.95	21,646
	7.0	443.2	77.7	12.9	99.00	1,641.7	1.437	1,097.5	15.92	25,089
	8.0	441.2	88.6	11.3	112.90	1,641.7	1.437	1,246	15.88	28,484
	9.0	439.2	99.5	10.1	126.70	1,614.7	1.437	1,392.6	15.85	31,834
508 (20″)	6.0	496.0	74.3	13.5	94.62	2,026.8	1.596	1,173.7	17.75	29,812
	7.0	494.0	86.5	11.6	110.18	2,026.8	1.596	1,361.2	17.71	34,574
	8.0	492.0	98.6	10.1	125.66	2,026.8	1.596	1,546.5	17.68	39,281
	9.0	490.0	111	9.0	141.09	2,026.8	1.596	1,729.5	17.65	43,929
558.8 (22″)	6.0	546.8	81.8	12.2	104.20	2,452.5	1.755	1,424.8	19.55	39,809
	7.0	544.8	95.3	10.5	121.35	2,452.5	1.755	1,653.3	19.51	46,193
	8.0	542.8	109	9.2	138.43	2,452.5	1.755	1,879.3	19.48	52,508
	9.0	540.8	122	8.2	155.45	2,452.5	1.755	2,102.9	19.44	58,755
	10.0	538.8	135	7.4	172.41	2,452.5	1.755	2,323.9	19.41	64,930
	11.0	536.8	149	6.7	189.31	2,452.5	1.755	2,542.5	19.37	71,037
	12.0	534.8	162	6.2	206.14	2,452.5	1.755	2,758.7	19.34	77,078
609.6 (24″)	7.0	595.6	104	9.6	132.52	2,918.4	1.915	1,973.7	21.31	61,158
	8.0	593.6	119	8.4	151.20	2,918.4	1.915	2,244.6	21.27	68,415
	9.0	591.6	133	7.5	169.82	2,918.4	1.915	2,512.7	21.24	74,587
	10.0	589.6	148	6.8	188.37	2,918.4	1.915	2,778.1	21.20	84,676
	11.0	587.6	162	6.2	206.86	2,918.4	1.915	3,040.7	21.17	92.681
	12.0	585.6	177	5.6	225.29	2,918.4	1.915	3,300.7	21.13	100,605
660.4 (26″)	7.0	646.4	113	8.8	143.69	3,425.4	2.075	2,322.6	23.10	76,692
	8.0	644.4	129	7.8	163.97	3,425.4	2.075	2,642.3	23.07	87,249
	9.0	642.4	145	6.9	184.18	3,425.4	2.075	2,959.1	23.03	97,709
	10.0	640.4	160	6.3	204.33	3,425.4	2.075	3,272.9	23.00	108,071

Please feel free to contact us for sizes other than those listed above.

STEEL PIPES FOR STRUCTURES - SECTION PROPERTIES

OD	Thickness	ID	Unit Weight		Section area	Bearing area	CL	Modulus of Sectional	Radius of Gyration	Moment of Inertia
D mm (inch)	t (mm)	d (mm)	w (kg/m)	(m/t)	A (cm^2)	A^1 (cm^2)	(m)	Z (cm^3)	K (cm)	I (cm^4)
660.4 (26″)	11.0	638.4	176	5.7	224.42	3,425.4	2,075	3,583.8	22.96	118,337
	12.0	636.4	192	5.2	244.44	3,425.4	2,075	3,891.8	22.93	128,507
711.2 (28″)	8.0	695.2	139	7.2	176.73	3,972.6	2,234	3,072.4	24.86	109,255
	9.0	693.2	156	6.4	198.54	3,972.6	2,234	3,441.9	24.83	122,394
	10.0	691.2	173	5.8	220.29	3,972.6	2,234	3,808.1	24.79	135,416
	11.0	689.2	190	5.3	241.97	3,972.6	2,234	4,171.2	24.75	148,328
	12.0	687.2	207	4.8	263.59	3,972.6	2,234	4,531.2	24.72	161,129
762.0 (30″)	8.0	746.0	149	6.7	189.50	4,560.4	2,394	3,535.0	26.66	134,684
	9.0	744.0	167	6.0	212.91	4,560.4	2,394	3,961.2	26.63	150,922
	10.0	742.0	185	5.4	236.25	4,560.4	2,394	4,384.0	26.59	167,030
	11.0	740.0	204	4.9	259.53	4,560.4	2,394	4,803.3	26.55	183,006
	12.0	738.0	222	4.5	282.74	4,560.4	2,394	5,219.3	26.52	198,855
812.8 (32″)	8.0	796.8	159	6.3	202.23	5,188.7	2,553	4,030.0	28.46	163,779
	9.0	794.8	178	5.6	227.28	5,188.7	2,553	4,517.0	28.42	183,571
	10.0	792.8	198	5.1	252.21	5,188.7	2,553	5,000.3	28.39	203,212
	11.0	790.8	217	4.6	277.08	5,188.7	2,553	5,480.0	28.35	222,707
	12.0	788.8	237	4.2	301.90	5,188.7	2,553	5,956.0	28.32	242,052
863.6 (34″)	8.0	847.6	169	5.9	215.04	5,857.5	2,713	4,557.4	30.25	196,789
	9.0	845.6	190	5.3	241.63	5,857.5	2,713	5,109.3	30.22	220,620
	10.0	843.6	210	4.8	268.17	5,857.5	2,713	5,657.2	30.18	244,278
	11.0	841.6	231	4.3	294.64	5,857.5	2,713	6,201.2	30.15	267,768
	12.0	839.6	252	4.0	321.05	5,857.5	2,713	6,741.9	30.11	291,094
	12.7	838.2	266	3.8	339.49	5,857.5	2,713	7,117.3	30.09	307,325
914.4 (36″)	8.0	898.4	179	5.6	227.80	6,566.9	2,873	5,117.3	32.05	233,963
	9.0	896.4	201	5.0	256.00	6,566.9	2,873	5,738.2	32.01	262,351
	10.0	894.4	223	4.5	284.13	6,566.9	2,873	6,354.6	31.98	290,532
	11.0	892.4	245	4.1	312.19	6,566.9	2,873	6,967.1	31.94	318,539
	12.0	890.4	267	3.7	340.20	6,566.9	2,873	7,575.5	31.91	346,352
	12.7	889.0	282	3.5	359.76	6,566.9	2,873	7,998.9	31.88	365,710
965.2 (38″)	9.0	947.2	212	4.7	270.36	7,316.8	3,032	6,403.3	33.81	309,023
	10.0	945.2	236	4.2	300.09	7,316.8	3,032	7,092.5	33.77	342,289
	11.0	943.2	259	3.9	329.75	7,316.8	3,032	7,777.5	33.74	375,342
	12.0	941.2	282	3.5	359.35	7,316.8	3,032	8,458.2	33.70	408,193
	12.7	939.8	298	3.4	380.03	7,316.8	3,032	8,932.0	33.68	431,058
	13.0	939.2	305	3.3	388.69	7,316.8	3,032	9,134.5	33.68	440,831

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STEEL PIPES FOR STRUCTURES - SECTION PROPERTIES

OD	Thickness	ID	Unit Weight		Section area	Bearing area	CL	Modulus of Sectional	Radius of Gyration	Moment of Inertia
D mm (inch)	t (mm)	d (mm)	w (kg/m)	(m/t)	A (cm^2)	A^1 (cm^2)	(m)	Z (cm^3)	K (cm)	I (cm^4)
	10.0	996	248	4.0	316.05	8,107.3	3,192	7,871.1	35.57	399,852
	11.0	994	273	3.7	347.30	8,107.3	3,192	8,632.6	35.53	438,536
	12.0	992	297	3.4	378.50	8,107.3	3,192	9,389.5	35.50	476,987
1,016.0 (40″)	12.7	990.6	314	3.2	400.30	8,107.3	3,192	9,916.6	35.47	503,763
	13.0	990.0	322	3.1	409.63	8,107.3	3,192	10,141.8	35.46	515,203
	14.0	988.0	346	2.9	440.70	8,107.3	3,192	10,889.6	35.43	553,192
	10.0	1,046.8	261	3.8	332.00	8,938.2	3,351	8,690.1	37.37	463,530
	11.0	1,044.8	286	3.5	364.86	8,938.2	3,351	9,532.4	37.33	508,458
	12.0	1,042.8	312	3.2	397.65	8,938.2	3,351	10,369.5	37.30	553,109
1,006.8 (42″)	12.7	1,041.4	330	3.0	400.57	8,938.2	3,351	10,952.7	37.27	584,217
	13.0	1,040.8	338	2.9	430.38	8,938.2	3,351	11,201.9	37.26	597,509
	14.0	1,038.8	363	2.8	463.05	8,938.2	3,351	12,029.6	37.23	641,659
	10.0	1,097.6	273	3.7	347.96	9,809.8	3,511	9,549.7	39.16	533,637
	11.0	1,095.6	300	3.3	382.41	9,809.8	3,511	10,476.4	39.13	585,421
	12.0	1,093.6	327	3.1	416.80	9,809.8	3,511	11,398.1	39.09	636,926
1,117.6 (44″)	12.7	1,092.3	346	2.9	440.84	9,809.8	3,511	11,994.4	38.99	670,247
	13.0	1,091.6	354	2.8	451.13	9,809.8	3,511	12,314.7	39.05	688,145
	14.0	1,089.6	381	2.6	485.39	9,809.8	3,511	13,226.3	39.02	739,086
	10.0	1,148.4	286	3.5	363.92	10,721.8	3,671	10,449.8	40.96	610,477
	11.0	1,146.4	314	3.2	399.97	10,721.8	3,671	11,465.2	40.92	669,797
	12.0	1,144.4	342	2.9	435.95	10,721.8	3,671	12,475.3	40.89	728,807
1,168.4 (46″)	12.7	1,143.0	362	2.8	461.10	10,721.8	3,671	13,179.3	40.86	769,935
	13.4	1,140.4	370	2.7	471.87	10,721.8	3,671	13,480.2	40.85	787,513
	14.0	1,140.4	399	2.5	507.73	10,721.8	3,671	14,479.7	40.82	845,904
	10.0	1,199.2	298	3.4	379.88	11,674.4	3,830	11,390.4	42.75	694,359
	11.0	1,197.2	328	3.0	417.52	11,674.4	3,830	12,498.6	42.72	761,915
	12.0	1,195.2	357	2.8	455.10	11,674.4	3,830	13,601.2	42.68	829,129
1,219.2 (48″)	12.7	1,193.8	378	2.6	481.37	11,674.4	3,830	14,369.8	42.66	875,983
	13.0	1,193.2	387	2.6	492.62	11,674.4	3,830	15,466.9	43.75	942,862
	14.0	1,191.2	416	2.4	530.08	11,674.4	3,830	15,789.9	42.61	962,552
	11.0	1,248.0	342	2.9	435.08	12,667.6	3,990	13,576.6	44.51	862,114
	12.0	1,246.0	372	2.7	474.26	12,667.6	3,990	14,775.8	44.48	938,263
1,270.0 (50″)	12.7	1,244.6	394	2.5	501.64	12,667.6	3,990	15,611.8	44.45	991,349
	13.0	1,244.0	403	2.5	513.37	12,667.6	3,990	15,969.2	44.44	1,014,044
	14.0	1,242.0	434	2.3	552.42	12,667.6	3,990	17,156.9	44.41	1,089,463

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STEEL PIPES FOR STRUCTURES - SECTION PROPERTIES

OD	Thickness	ID	Unit Weight		Section area	Bearing area	CL	Modulus of Sectional	Radius of Gyration	Moment of Inertia
D mm (inch)	t (mm)	d (mm)	w (kg/m)	(m/t)	A (cm^2)	A^1 (cm^2)	(m)	Z (cm^3)	K (cm)	I (cm^4)
1,371.6 (54″)	12	1,347.6	402	2.5	512.56	14,775.6	4,309	17,270.8	48.07	1,184,430
	14	1,343.6	469	2.1	597.11	14,775.6	4,309	20,061.1	48.00	1,375,785
	16	1,339.6	535	1.9	681.40	14,775.6	4,309	22,826.5	47.93	1,565,438
	18	1,335.6	601	1.7	765.44	14,775.6	4,309	25,567.2	47.86	1,753,401
	20	1,331.6	667	1.5	849.24	14,775.6	4,309	28,283.5	47.79	1,939,681
1,524 (60″)	12	1,500	447	2.2	570.01	18,241.5	4,788	21,378.1	53.46	1,629,014
	14	1,496	521	1.9	664.13	18,241.5	4,788	24,842.9	53.39	1,893,028
	16	1,492	595	1.7	758.01	18,241.5	4,788	28,279.9	53.32	2,154,796
	18	1,488	688	1.5	851.62	18,241.5	4,788	31,689.5	53.25	2,414,740
	20	1,484	722	1.4	944.99	18,241.5	4,788	35,071.7	53.18	2,672,460
1,625.6 (64″)	12	1,601.6	477	2.1	608.31	20,754.8	5,107	24,359.6	57.05	1,629,014
	14	1,597.6	556	1.8	708.82	20,754.8	5,107	28,314.6	56.98	1,893,028
	16	1,593.6	635	1.6	809.08	20,754.8	5,107	32,239.9	56.91	2,154,796
	18	1,589.6	714	1.4	909.08	20,754.8	5,107	36,135.8	56.84	2,414,740
	20	1,585.6	792	1.3	1,008.83	20,754.8	5,107	40,002.5	56.77	2,672,460
1,778 (70″)	12	1,754	523	1.9	665.77	24,828.7	5,586	29,196.6	62.44	2,595,579
	14	1,750	609	1.6	775.85	24,828.7	5,586	33,947.7	62.37	3,017,950
	16	1,746	695	1.4	885.68	24,828.7	5,586	38,666.3	62.30	3,437,434
	18	1,742	781	1.3	995.26	24,828.7	5,586	43,352.6	62.23	3,854,045
	20	1,738	867	1.2	1,104.59	24,828.7	5,586	48,006.7	62.16	4,267,797
1,879.6 (74″)	12	1,855.6	553	1.8	704.07	27,747.4	5,905	32,664.5	66.03	3,069,811
	14	1,581.6	644	1.6	820.53	27,747.4	5,905	37,986.9	65.96	3,570,006
	16	1,847.6	735	1.4	936.75	27,747.4	5,905	43,274.8	65.89	4,066,970
	18	1,843.6	826	1.2	1,052.71	27,747.4	5,905	48,528.6	65.82	4,560,717
	20	1,839.6	917	1.1	1,168.42	27,747.4	5,905	53,748.2	65.75	5,051,260
1,981.2 (78″)	12	1,957.2	583	1.7	742.37	30,828.2	6,224	36,327.0	69.62	3,598,552
	14	1,953.2	679	1.5	865.22	30,828.2	6,224	42,253.1	69.55	4,185,588
	16	1,949.2	775	1.3	987.82	30,828.2	6,224	48,142.8	69.48	4,769,028
	18	1,945.2	871	1.1	1,110.17	30,828.2	6,224	53,996.5	69.41	5,348,888
	20	1,941.2	967	1.0	1,232.26	30,828.2	6,224	59,814.1	69.34	5,925,182
2,032 (80″)	12	2,008	598	1.7	761.52	32,429.4	6,384	38,231.2	71.42	3,884,289
	14	2,004	697	1.4	887.56	32,429.4	6,384	44,471.3	71.35	4,518,282
	16	2,000	795	1.3	1,103.35	32,429.4	6,384	50,674.1	71.28	5,148,489
	18	1,996	894	1.1	1,138.89	32,429.4	6,384	56,810.9	71.21	5,774,927
	20	1,992	992	1.0	1,264.18	32,429.4	6,384	62,968.6	71.14	6,397,610
2,540 (100″)	12	2,516	748	1.3	953.03	50,670.8	7,979	59,918.12	89.38	7,613,478
	14	2,512	872	1.2	1,110.99	50,670.8	7,979	69,774.79	89.30	8,861,399
	16	2,508	996	1.0	1,268.70	50,670.8	7,979	79,554.11	89.23	10,103,373
	18	2,504	1,120	0.9	1,426.16	50,670.8	7,979	89,286.75	89.17	11,393,418
	20	2,500	1,243	0.8	1,583.36	50,670.8	7,979	98,972.86	89.09	12,569,554

Please feel free to contact us for sizes other than those listed above.

Steel Pipes Applications

CONSTRUCTION
- Water Pipe • Dewatering & drainage
- Well point deaders • Exhaust & intake
- Foundation Piling • Cassions & tank supports

MINING & QUARRYING
- Water Pipe • Ventilation pipe
- Tailings or Slurry Pipelines
- Sand, gravel & other product lines

DREDGING
- Available in abrasion resistant steel
- Shore pipe • Sand & gravel conveying lines
- All type of dredging connections

MATERIALS HANDLING
- Sludge lines • Fly ash disposal pipe
- Pneumatic Conveyors

POLLUTION CONTROL
- Filtration Plant Piping • Waste Water lines
- Air Purfication pipe

SEWAGE DISPOSAL
- Force mains
- Disposal plant aeration piping
- Siphons • Sewer by-pass lines

PAPER MILLS
- Stock lines • Pulp lines • Vacuum lines
- Hot & cold water lines white water lines
- Ventilating pipe • Exhaust steam
- Compressed air lines • Bark, chips & trim disposal

AGRICULTURE
- Surface & underground main lines for irrigation
- Water well casing
- Water supply & dewatering

INDUSTRIAL PLANTS
- Airlines • Water Supply • Ventilating lines
- Gas piping and manifolds • Chimney

PRODUCT COMPONENTS
- Pipe section furnished as component parts of manufactured products
- Structural members

FABRICATIONS
- Standard fittings
- Precision fabrications to met specifications for special or complex layout are available

HYDRO ELECTRIC STATION
- Penstocks for supplying hydro-electric turbines

TELECOMMUNICATION INDUSTRIES
- Pylons for transmission tones / telecommunications

AS PER REQUIREMENT
- Oil and gas • Land and subsea pipeline
- Water distribution • Large diameter water mains
- Power Generation
- Cooling Water Intake and Outfalls
- Marine and Civil Construction
- Piling for Jetties Berths and foundation

Some Useful Conversion Factors

LENGTH

1 Mil	=	0.001 Inch
1 Millimetre	=	0.03937 Inch
1 Metre	=	3.281 Feet
1 Metre	=	1.0935 Yard
1 Kilometre	=	0.6214 Mile

AREA

1 Sq. Metre	=	10.764 Sq. Feet
1 Sq. Metre	=	1.196 Sq. Yards
1 Sq. Metre	=	645.16 Sq. mm
1 Hectare	=	2.471 Acres
1 Sq. Km	=	247.105 Acres
1 Sq. Km	=	100 Hectares
1 Sq. Mile	=	640 Acres

VOLUME

1 litre	=	1000 cu.cm
1 litre	=	61.024 cu.in
1 litre	=	0.0353 cu.ft.
1 cu. Metre	=	35.315 cu.ft.
1 cu. Metre	=	1.308 cu.yd.
1 cu. inch	=	16.387 cu.cm.
1 cu. feet	=	28.317 litres

CAPACITY

1 litre	=	0.264 US Gal.
1 litre	=	0.220 Imp. Gal.
1 US Gallon	=	0.833 Imp. Gal.
1 Imperial Gallon	=	277.42 cu. in.
1 Fluid Ounce	=	28.414 cu.cm.
1 Acre Feet	=	1233.48 Imp. Gal.
1 Acre Feet	=	271327.52 Imp.Gal

WEIGHT

1 Kilogram	=	2.2046 Lbs.
1 Longton	=	2240 Lbs.
1 Metric ton	=	1000 Kgs.
1 Metric ton	=	0.9842 L/Ton
1 Hundred Weight	=	112 Lbs.
1 Hundred Weight	=	50.802 Kgs.

PRESSURE AND STRESS

1 Atmosphere	=	14.7 PSI
1 Kilopascal kPa	=	0.145 PSI
1 Megapascal MPa	=	145.033 PSI
1 MPa	=	1 N/mm^2
1 N/mm^2	=	10 Bar
1 Bar	=	100 kPa
1 Bar	=	14.504 PSI
1 Kg/mm^2	=	1422.33 PSI
1 ton/ft^2	=	15.556 PSI

TEMPERATURE

°C	=	5/9 (°F-32)

OTHERS

1 cu. ft/second	=	373.66 Imp Gal/min
1 cu. M/second	=	13203 Imp Gal/min
1 MGD	=	694.44 Gal/min
1 Kilowatt	=	1. 341 HP
1 Foot-Pound	=	1.356 Joules
1 Lb/Ft.	=	1.488 Kg/M
1 Ft. Head of Water	=	0.434 PSI
1 Ft. Head of Water	=	2.992 kPa
1 Kw hr	=	3.6 Megajoule
1 Oz	=	28.35 gr
1 pint	=	0.568 litre
1 Ib/ft3	=	16.02 Kg/m3
1 Kg/litre	=	10.02 Lb/Imp Gal
1 Sq.M/litre	=	48.93 Sq.ft/Imp Gal
1 Ib force	=	4.448 Newton
1 cu. M/Second	=	35.31 cu.ft/Sec
1 Knot	=	0.5148 m/sec
1 Kwhr	=	2.656 ft-1b
1 ft-1b	=	0.1383 kg-m
1 kilohertz	=	1,000 hertz
1 Megahertz	=	1,000 Kilohertz
1 Gigahertz	=	1,000 Megahertz
1 Terahertz	=	1,000 Gigahertz
1 Microsecond	=	1,000 Nanoseconds
1 Millisecond	=	1,000 microseconds

CERT. NO. 0047448

Certified Mild Steel Concrete Lined and Polyurethane Lined Pipe Manufacturer by IKRAM Quality and Certification Institute (IQCI)

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