Piping

INTRODUCTION

- An essential part of a power plant is the piping used to transfer steams, water, gas oil, compressed air, chemicals, etc.
- This piping must be properly designed so that it will be of sufficient size and strength to adequately handle the service for which it is required.

INTRODUCTION

- It must be installed in the proper manner with the necessary valves and fittings and with provision made for expansion and contraction, drainage, support and insulation.
- These consideration are discussed in this lesson.

DEFINITION

Pipe is mechanical component of round shape, and

- Hollow from inside which is used to transfer liquid/ vapors, gas from one point to another, like house water pipes. Normally available from 1/4 inches diameter to 40” inches diameter.
- Large size than 40 inches are also available on request
- Pipes size normally used are 1/4″,1/2″,3/4″,1″,1-1/2″, 2″,3″,4″,6″,8″,10″,12″,14″,16″,18″,20″ & 24″.

DEFINITION

- Size 1-1/4″, 2-1/2″, 3-1/2″ & 5″are seldom used. 1/8, 1-1/4″, 3/8″ & 1/2″ pipe is restricted to instrument lines pipe.
- 1/2″pipe is extensively used for steam tracing of lines.
- Straight pipe is supplied in random lengths (20 ft. – 36 ft). The ends of these length are normally beveled for welding (BE), Plain (PE) or threaded and supplied with one coupling per length (T&C)

MANUFACTURING

- Pipes are manufactured to meet various conditions and requirements of services.

❖ Following are some methods of manufacturing.

1. SEAMLESS STEEL PIPE

- Seamless steel pipe is made from a solid billet of steel, which is pierced and rolled to obtain the required diameter and wall thickness.
- Although this is a most expensive method to manufacture pipe, seamless pipe is stronger than welded pipe and suitable for higher pressure and temperature service.
- When a piping system is subjected to pressures above 600 psi the pipe should be of seamless construction.

2. SEAM/ WELDED STEEL PIPE

- Welded steel pipe is made from flat steel plates that are rolled into tubular shape and the edges then welded together by one of three methods
  1. But welded, the edges are bevelled and parallel to each other (no filler metal added)
  2. Lap welded the edges are not bevelled and overlapped at each other .

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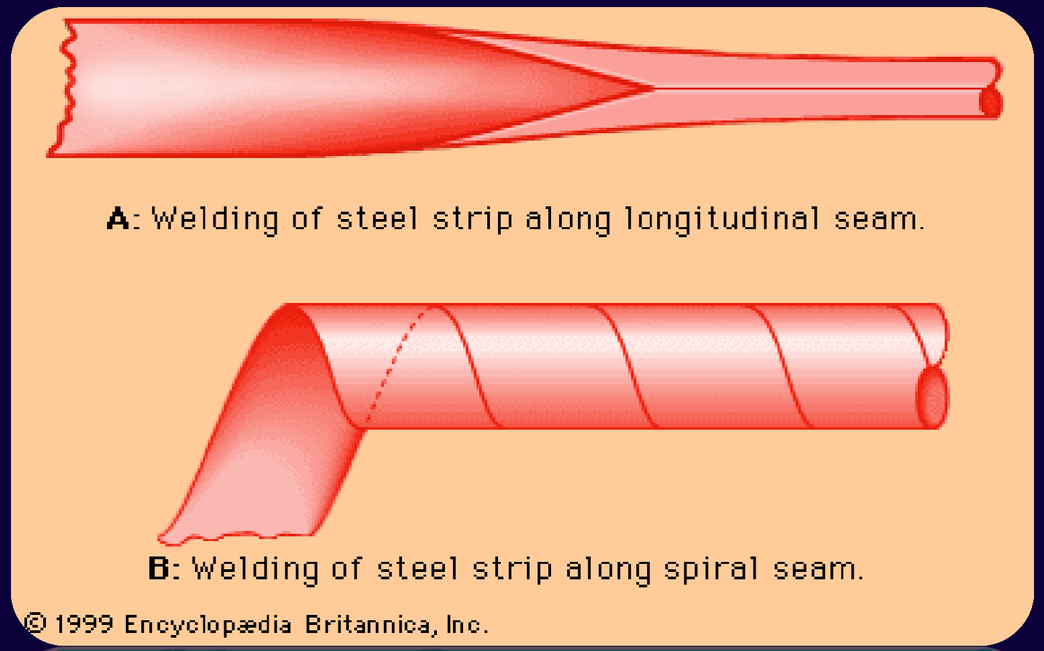
2. SEAM/ WELDED STEEL PIPE

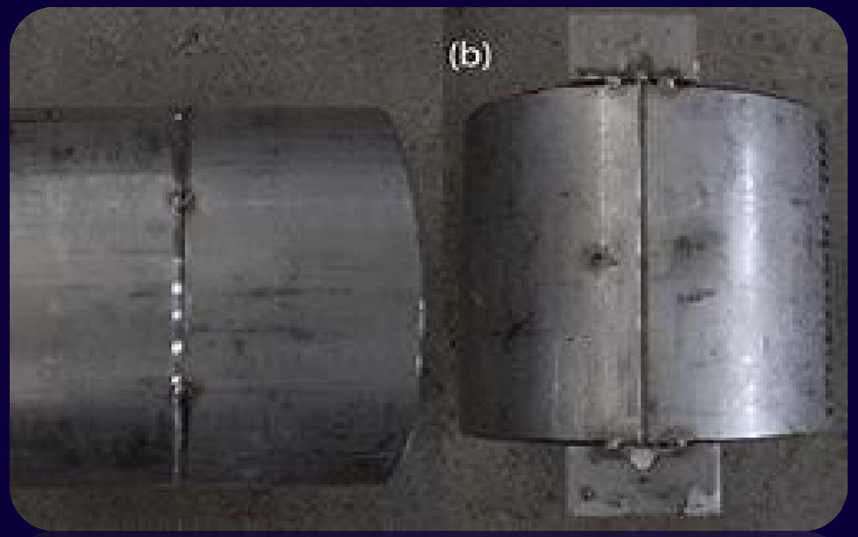
- Fusion welded, the edges are bevelled prior to rolling and the groove formed filled with filler metal This method is used in pipe size over 6 dia.
- Welded pipe is less costly than the seamless type but can only be used due to its inherent weakness, for relative low-pressure applications

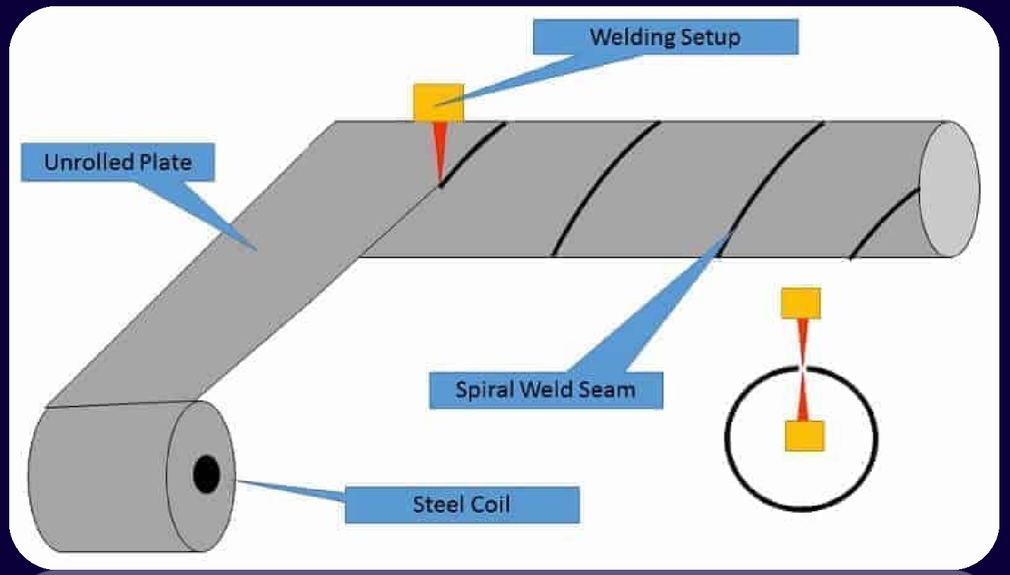


2. SEAM/ WELDED STEEL PIPE

a) Welding a bended metal plate in a straight line Parallel to the axis.

b) Welding a spiral bended plate.





3. CASTED

- One of the oldest pipe materials cast iron is still in use today.
- They are casted from cast iron used for low pressure and corrosive service such as sewer pipe.
- All above three types of pipes are used at our plant.

PIPING MATERIAL

- The material to be used for pipe manufacture must be chosen to suit the operating conditions of the piping system.
- Guidance in selecting the correct material can be obtained from standard piping codes.
- The object being to ensure that the material used is entirely safe under the operating conditions of pressure temperature, corrosion and erosion expected.

PIPING MATERIAL

- The most frequently used materials for power piping systems are:
  1. Low carbon steels
  2. Alloy steels
  3. Austenitic stainless steels

CLASSIFICATION OF PIPE

- Many kinds of pipe are manufactured to meet the varied and requirements of service.
- The major classifications are according to the material used, the process of manufacture, and the type of joint used.

1. WROUGHT IRON

- Wrought iron pipe is identified by a painted or knurled spiral marking on each section.
- It is made of about 97% iron and 3% slag.
- This composition makes it more resistant to certain types of corrosion than ordinary steel pipe, and it is therefore sometimes specified for heating systems.
- It is not strong as wrought steel pipe and yet costs more because it is manufactured in small quantities.
- Very little wrought iron pipe is seen in refinery and it should never be used for any process piping.

2. WROUGHT STEEL

- This is the common carbon steel pipe that is so widely used it contains about 99:1/2% iron.
- While normally used black (that is, without any coating), steel pipe for drinking water lines is purchased with a bright zinc coating called galvanizing which gives added protection against rusting.
- This pipe is used in low-pressure steam, liquid, and gas line service at temperatures ranging up to750 to 1100 °F

3. CARBON-MOLY

- Carbon steel pipe that contains a very small percentage of metal molybdenum is referred to as carbon-moly pipe.
- It is stronger than common steel pipe at high temperatures.
- A preheat is generally necessary when welding this type of material P-1.

4. CHROME STEEL

- Chromium added to steel adds strength and increases its resistance to corrosion Pipe in this classification is usually identified by the amount of chromium involved, such as 1%, 2%, 4 to 6% or 6 to 8%..

4. CHROME STEEL

These alloys all require preheating and stress relieving when welded construction is used.

- P- 11 1 ¼ % chromium and ½ % molybdenum.
- P -12 1% chromium and ½ % molybdenum.
- P- 22 2 ¼ % chromium and 1% molybdenum.

5. STAINLESS STEEL

- This is a broad classification of material that retains its strength and resistance to corrosion at high temperatures.
- The chromium content is usually 11 to 30% and in some cases up to 20% nickel is also added to the alloy.
- Some stainless steels are not magnetic so this cannot be used as a test for this material.
- (Stainless steels without nickel require preheating and stress relieving when welded).

6. CAST IRON

- Cast iron contains a high percentage of carbon and is a very brittle metal.
- It will break if subjected to much pulling or bending. It has, however, good resistance to corrosion such as rusting) and it is cheap

6. CAST IRON

- For these reasons, it is commonly used for condenser box coils and for underground piping such as low-pressure water, fire water, drinking water mains, and sewer lines.
- It cannot be used if the piping system is expected to withstand expansion or bending loads, high temperatures, or high pressures.

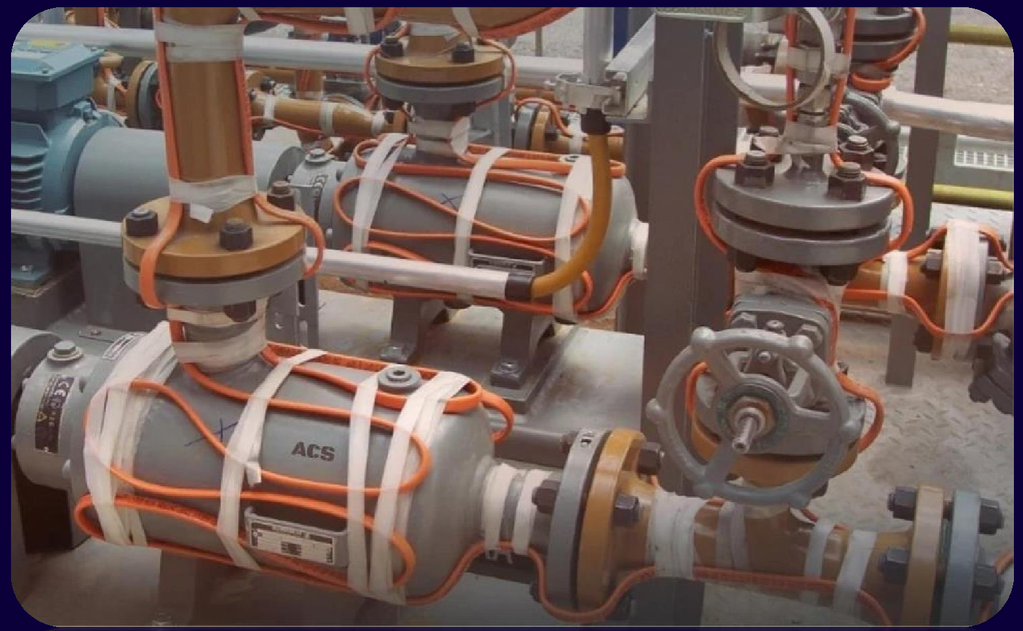
7. COPPER

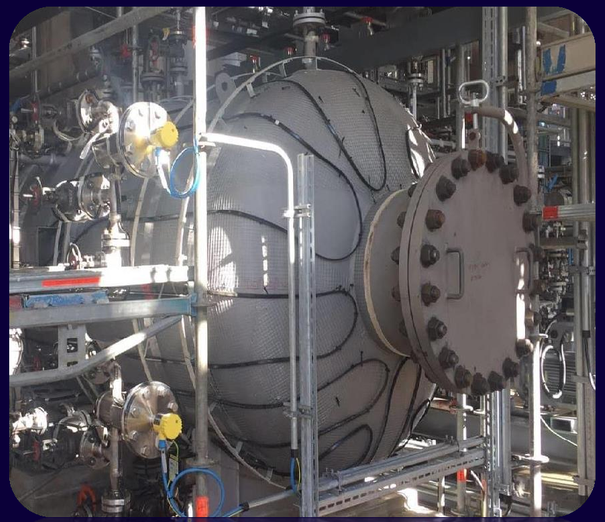
- Although it is very resistant to most types of corrosion (including rusting), copper pipe is not used very extensively, in the plant.
- It is expensive and not as strong as steel

7. COPPER

- Copper pipe is made in regular iron pipe sizes, and fittings can in either screwed or brazed Soft copper pipe and tubing is supplied in coils instead of straight lengths.
- Tubing with flared fittings is used quite bit for lubricating oil connections on compressors.
- It is also widely used for steam tracing lines because it can easily bend to shape by hand.

STEAM TRACING





8. BRASS

- Brass is an alloy of copper and zinc that is highly resistant to corrosion.
- Pipe material is made in standard iron pipe sizes and is used mainly for acid lines can usually be identified by its bright yellow color.

9. LEAD

- Lead is a very soft Gray colored metal that does not rust, resists most acids, bends very easily.
- It melts at the fairly low temperature of about 620 F and not good in caustic service.
- Lead pipe must be joined by soldered or wiped joint because the material is not strong enough for threads.

10. NON-METALLIC

- A broad new field of piping material has opened in recent years with development of many plastics.
- Non-Metallic Pipes are corrosion resistant light weight smooth inner and outer & easy to join.
- Thermoplastics such as PVC, PE, PP & ABS (Acrylonitrile styrene) are most used for low pressure, corrosive service

10. NON-METALLIC

- Asbestos cement pipes are used for water lines.
- It is corrosion resistant with smooth inner. Salt water, corrosive soils will not harm it.
- Epoxy, polystyrene and phenolic resins with glass reinforcement are also wide used (they are generally called fiberglass or RTRP)

MATERIALS USED IN PIPING

Different types of material used in PIPING.

CARBON STEEL

MATERIAL SPECS	NORMAL COMPOSITION	PRODUCT
ASTM A53	Carbon Steel	Pipe for petroleum and Refiner services
ASTM A53	Carbon Steel	Pipe for General use.
ASTM A 106	Carbon Steel	Pipes for high temp. service
ASTM A 105	Carbon Steel	Forged CS flanges and fitting
ASTM A 234 Gr WPB	Carbon Steel	Seamless and welded fittings
ASTM A 179	Carbon Steel	Cold drawn heat exch. & condenser tubes
ASTM A-333 Gr 1	Killed Carbon Steel	Pipe for low temp Service
ASTM A-350 Gr. LF1/LF2	Killed Carbon Steel	Flanges fittings for low temp. Service

LOW ALLOY STEEL

MATERIAL SPECS	NORMAL COMPOSITION	PRODUCT
ASTM A-335 Gr. P1	0.5 Mo (P1)	Pipe for high temp. service
ASTM A-335 Gr. P11	1.25 Cr – 0.5 Mo (P11)	Pipe for high temp. service
ASTM A-335 Gr. P12	1 Cr – 0.5 Mo (P12)	Pipe for high temp. service
ASTM A-335 Gr. P22	2.25 Cr – 1 Mo (P22)	Pipe for high temp. service
ASTM A-182 Gr. WP1/11/22	For P1, P11 & P22 respectively	Fitting for high temp. service
ASTM A-217 Gr. WC1/6/9	-do-	Casting for high temp. service
ASTM A-209 T 1/T 11	Equiv. to P1 and P11	Tubes for high temp. service

STAINLESS STEEL

MATERIAL SPECS,	NORMAL COMPOSITION	PRODUCT
ASTM A-312 TP- 304/304L	18Cr – 8 Ni	Austhentic SS Pipes
ASTM A-312 TP- 316/316L	18Cr – 8 Ni – 2 Mo	Austhentic SS Pipes
ASTM A-312 TP- 321/321H	18Cr – 8 Ni - Ti	Austhentic SS Pipes
ASTM A-312 TP- 347/347H	18Cr – 8 Ni + Cb + Ta	Austhentic SS Pipes
ASTM A-213 TP- 304/316	SS - 304/ SS - 316	Aust. SS tubes for heat exchange
ASTM A-182 F-304/F-316	SS - 304/ SS - 316	Austhentic SS forging/ fittings and valves
ASTM A-403 Gr WP-304/316	SS - 304/ SS - 316	Welded or seamless fittings
	For SS - 304/ 304L / 316 / 316L / 321 / 347 respectively	Castings and cast valves
SS Urea Grade	25Cr – 22Ni – 2Mo	For Highly corrosive Urea and Carbamate Solution

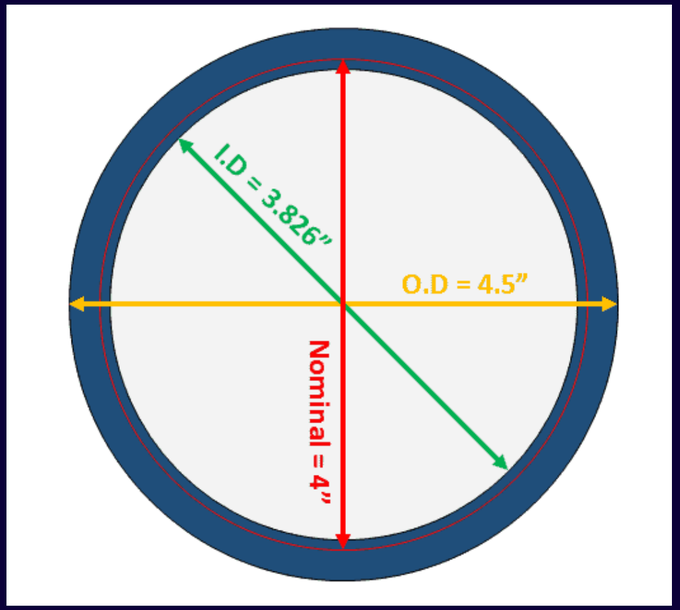
NON-METALLIC

MATERIAL SPECS.	NORMAL COMPOSITION	PRODUCTS
Fiber- glass pipe	RTRP	Highly corrosive low-pressure service
ACC Pipe Class B	SR Resist cement + Asbestos	Pipe for drinking water and plant for waste lines
PVC	Polyvinyl Chloride	For moderate temperature and pressure service

NOMINAL SIZE

- Pipe is usually called by its nominal size which means that it is not exactly that size but that it is sufficient for identification.
- For instance, when we say 6" pipe we are actually referring to pipe which has an ID of 6.065" in the standard wall thickness

NOMINAL PIPE SIZE 6"



OD = 6..625"
ID = 6.065"

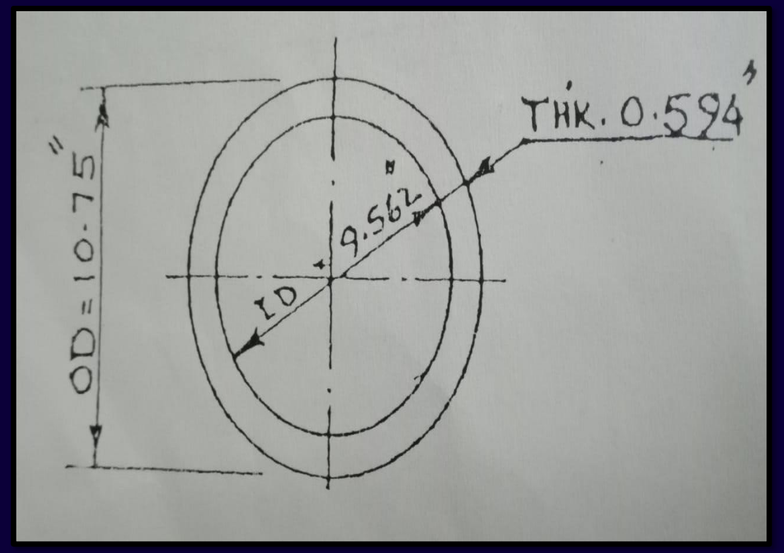
NOMINAL SIZE

- Pipe 12″ and smaller is known by its nominal inside diameter, while pipe 14″ and larger is known by its outside diameter Tubing and boiler tubes are always known by their outside diameters.

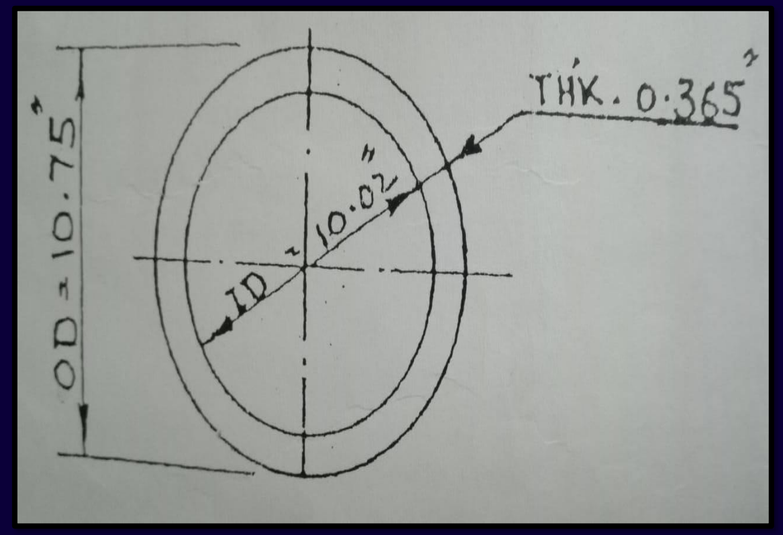
EXAMPLE

From this table No 1 you will see that Outside diameter of a pipe remains constant bot side diameter changes according to wall thickness of pipe schedule.

TABLE NO. 01



10" Sch. 80	10" Sch. 40
OD = 10.75"	OD =10.75"
WT = .594"	WT = .365"
ID = 10.75 – 2x.594	ID = 10.75 – 2x.365
= 9.562"	=10.02"



WALL THICKNESS

- For any given size of pipe there is a choice of wall thickness.
- The thickness of metal required for a particular service is determined by the job engineer after consideration of the temperature and possible corrosion allowance involved.

WALL THICKNESS

- The differences in wall thickness for a given size pipe are always made by changing the inside diameter (I.D.).
- The reason for this, of course, is that the outside diameter (0.D.) must be a standard size for threading and for matching all types of fittings.
- Thus, the O.D is usually measured to identify the size of the pipe.

WALL THICKNESS

- In the past, wall thickness has been specified by the terms standard, extra strong and double extra-strong, which are usually written as Std, XS and XXS.
- To meet industrial requirements in recent years, manufacturers of pipes have been supplying many additional wall thicknesses that could not be specified by these three terms.
- A system of using schedule number to specify wall thickness was developed and is now in use by practically all industries.

WALL THICKNESS

- The schedule is a number that is actually related to the strength of the pipe.
- The numbers were arranged to match the old system as much as possible, and in IPS (iron pipe size) up to and including 10", schedule 40 has the same dimensions as the old standard wall.
- The same is true of schedule 80 and XS up to and including 8" IPS, There is no relationship between the old XXS and any schedule number.

MEASURING PIPE

- It is important to be able to measure pipe properly and identify it in terms of nominal size and weight (wall thickness or schedule).
- When pipe is received for a job, it should be measured to make sure it is the same as the drawing calls for.

MEASURING PIPE

- To find the wall thickness of schedule number of a piece of pipe, one must take two accurate dimensions, the O D and LD of the specimen.
- By subtracting the ID from the O.D and dividing by 2. you will have an approximation of the wall thickness.
- After you find the wall thickness, convert it to a decimal and then look at the pipe size indicated by the O.D and find the closest number for that size pipe in one of the schedule columns.

DIMENSIONS OF SEAMLESS AND WELDED STEEL PIPE

Nominal size		OD	Welded & Seamless Carbon Steel Pipe to ASME B36.10M All dimensions are in mm												
DN	NPS	mm	Schedule												
			10	20	30	40	Std	60	80	XS	100	120	140	160	XXS
6	1/8	10.3	1.24		1.45	1.73	1.73		2.41	2.41					
8	1/4	13.7	1.65		1.85	2.24	2.24		3.02	3.02					
10	3/8	17.1	1.65		1.85	2.31	2.31		3.20	3.20					
15	1/2	21.3	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47
20	3/4	26.7	2.11		2.41	2.87	2.87			3.91				5.56	7.82
25	1	33.4	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09
32	1 1/4	42.2	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70
40	1 1/2	48.3	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.15
50	2	60.3	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07
65	2 1/2	73.0	3.05		4.78	5.16	5.16		7.01	7.01				9.53	14.02
80	3	88.9	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24
90	3 1/2	101.6	3.05		4.78	5.74	5.74		8.08	8.08					
100	4	114.3	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12
125	5	141.3	3.40			6.55	6.55		9.53	9.53		12.70		15.88	19.05
150	6	168.3	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95
200	8	219.1	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.23
250	10	273.0	4.19	6.35	7.80	9.27	9.27	12.70	15.09	12.70	18.26	21.44	25.40	28.58	25.40
300	12	323.8	4.57	6.35	8.38	10.31	9.53	14.27	17.48	12.70	21.44	25.40	28.58	33.32	25.40
350	14	355.6	6.35	7.92	9.53	11.13	9.53	15.09	19.05	12.70	23.83	27.79	31.75	35.71	
400	16	406.4	6.35	7.92	9.53	12.70	9.53	16.66	21.44	12.70	26.19	30.96	36.53	40.49	
450	18	457	6.35	7.92	11.13	14.27	9.53	19.05	23.83	12.70	29.36	34.93	39.67	45.24	
500	20	508	6.35	9.53	12.70	15.09	9.53	20.62	26.19	12.70	32.54	38.10	44.45	50.01	
550	22	559	6.35	9.53	12.70		9.53	22.23	28.58	12.70	34.93	41.28	47.63	53.98	
600	24	610	6.35	9.53	14.27	17.48	9.53	24.61	30.96	12.70	38.89	46.02	52.37	59.54	
650	26	660	7.92	12.70			9.53			12.70					
700	28	711	7.92	12.70	15.88		9.53			12.70					
750	30	762	7.92	12.70	15.88		9.53			12.70					
800	32	813	7.92	12.70	15.88	17.48	9.53			12.70					
850	34	864	7.92	12.70	15.88	17.48	9.53			12.70					
900	36	914	7.92	12.70	15.88	19.05	9.53			12.70					
950	38	965					9.53			12.70					
1000	40	1016					9.53			12.70					
1050	42	1067					9.53			12.70					
1100	44	1118					9.53			12.70					
1150	46	1168					9.53			12.70					
1200	48	1219					9.53			12.70					

ABBREVIATION USED BY PIPE FITTERS

ABBREVIATIONS

- API American Petroleum Institute
- ASA American Standards Association
- A.S.T.M American Society Of Testing Materials
- BB Bolted Bonnet
- EFW Electric Fusion Welded
  - ERW Electric Resistance Welded
- B.C Bolt Circle
- C.C Center To Center
- C.I Cast Iron
- C.s Carbon Steel
- C to f Center To Face
- C.W.P Cold Working Pressure
- M&F Male And Female
- Conc. Concentric
- Conn Connection
- Coup Coupling
- Diam. Diameter
- IPS. Iron Pipe Size
- E TO F End To Face
- FSS. Forged Stainless Steel
- Ex.Hy. Extra Heavy
- BW. But Weld

ABBREVIATIONS

- F.S Forged Steel
- F TO C Face To Center
- F TO F Face To Face
- F & D Faced And Drilled
- F.W Field Weld
- Galv. Galvanize
- Horiz. Horizontal
- In. Inches
- I.D. Inside Diameter
- I.B.B.M Iron Body Bronze OR Brass Mounted
- Ecc. Eccentric
- E to C. End To Center
- N.R.S Non-Rising Stem
- No. Number
- O.D. Outside Diameter
- O.S&Y Outside Screw And Yoke
- Psi Pound Per Square Inch
- Press. Pressure
- P.G. Pressure Gauge
- R. Radius
- R.F. Raised Face
- Red. Reducer

ABBREVIATIONS

- Scrd. Screwed
- Ser. Series
- S.O.Flg. Slip On Flange
- Rad. Radius
- Sq.Ft. Square Foot
- Std. Standard
- PSB. Pressure Seal Bonnet
- STL. Steel
- Strg. Strong
- N.P.S. Nominal Pipe Size
- TBE. Threaded Bolt End
- THRD Threaded
- TOE Thread One End
- Vert. Vertical
- W.O.G. Water, Oil, Gas
- HDR. Header
- FW. Field Weld
- W.N. Flg. Weld Neck Flange

ABBREVIATIONS

- Blk Blank
- R.T.J Ring Type Joint
- SW Socket Weld
- TK Tank
- Temp Temperature
- Stg Strong
- X.H Extra Heavy
- XX.Hvy Double Extra Heavy
- Xx Stg Double Extra Strong
- Ch. VA Check Valve
- El Elevation
- Red Reducer
- Ecc Eccentric Reducer
- Flg Flange
- B.C Bolt Circle
- Conn. Connection
- Conc Concentric
- Ecc Eccentric

PIPING AND TUBING

- Nearly all industrial equipment now in service makes some of fluid lines.
- From an economic point of view the best fluid lines system is that which is easiest to maintain at the lowest original cost.
- The use of tubing and tube fitting on fines up to 2" (5.08 cm) diameter is almost in variable more economical than the use of pipe and pipe fittings in modern installations.

PIPING AND TUBING

- A few of the more important reasons following
  1. A common question is just what is the difference between pipe and tubing ?
  2. Many of the differences in physical characteristics methods of installation, an as the advantages and disadvantages of tubing will be come clear.

PIPE AND TUBING

- An example from the standardized codes for piping and tubing illustrates the difference between pipe and tubing.
- The wall thickness of two types of 8 inches iron pipe(one tone light and one heavy) are 0.250" light and 0.406" (heavy).
- A light wall 8 inch copper tube has a wall thickness of 0.170" and a heavy wall 8 inches tubes has wall thickness of 0.271".
- .

PIPE AND TUBING

- When you compare these figures, it is clear that tubing has a thinner wall than piping of the same general diameter.
  - ❑ Size for size, tubing is lighter weight, easier to handle and can be bent more easily than iron pipe.
  - ❑ The bendability of tubing reduces the number of connections requires, thus reducing material and labour costs.

PIPE AND TUBING

- The use of tube fittings makes every joint a union, permitting, easier, faster maintenance and repair work.
- Fewer joints means lower costs and fewer points of potential leakage
- Modern flared and flare less tube fittings eliminate the need for threading, soldering, or welding.

PIPE HANGERS AND SUPPORTS

- Piping must be supported in such a way as to prevent its weight from being carried by the equipment to which it is attached.
- The supports used must prevent excessive sagging of the pipe and at the same time must allow free movement of the pipe due to expansion or contraction.

Pipe Hangers And Supports

- The supporting arrangement must be designed to carry the weight of the pipe, valves, fittings and insulation plus the weight of the fluid contained within the pipe.
- Spring Hangers help absorb vibration. The roll types permit the pipe to move as it grows or shrinks in length because of temperature variations.

Pipe Hangers And Supports

- Routine preventive maintenance includes checking to be sure that hangers and sup ports remain properly fastened.
- Such inspections are especially important in pipe lines affected by vibration caused by the activity of the fluids being carried, or by machinery to which the pipes are attached.

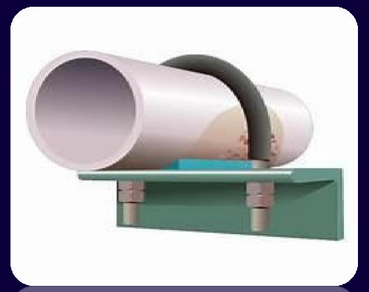












THANK YOU