

Industrial Piping — Materials & Applications

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The commonly used materials used for industrial piping are ferrous metallic pipes, non-ferrous metallic pipes, lined pipes & non-metallic pipes. In this articles we shall discuss about these different materials and their applications because, after all, material selection plays a major role in powerplant and process piping.

I. Ferrous Materials Pipes

These are the most common piping materials used in industries. In fact, piping systems comprising of wrought carbon and alloy steels including stainless steel and cast iron are the most widely used and the most completely covered by ASTM Standards.

Carbon Steel pipes are used for moderate pressure and for steam temperature upto 410°C. Carbon Steel pipes show a tendency of graphitization at temperature more than 410°C. Therefore, at a temperature exceeding 410°C carbon molybdenum steels are used for main steam pipes, though, graphitization takes place in these types of steels also, after a prolonged use.

Lately, to prevent the tendency of graphitization at higher temperature, chromium molybdenum (Cr-Mo) steels are being used.

I. Carbon Steel Piping

The most widely used C. S. Piping materials in Steam Services are ASTM A106 and A53 or ASME SA106 and SA53. Both the materials have got almost identical chemical composition except the fact that deoxidation process applies only to A106. Both of them are subject to physical tests, but those applied

to A106 are more rigorous. A53 and A106 are made in grades A and B. Grade B has got higher strength properties but is less ductile. Grade A is permitted only for cold bending or close coiling. Grade A shall not be used for steam, high temperature liquid, hazardous liquid or gas. Use of A53 pipes shall generally be avoided for piping in Steam Service. For Boiler feed discharge piping, carbon steel piping of ASTM A106 Gr. B or C is normally used.

II. Cr-Mo Steel Piping

This type of piping material is generally adopted for Steam Piping of working temp. $\geq 410^{\circ}\text{C}$. This type of material has been used upto 593°C. In small diameter ranges, pipes of Cr-Mo Steel are generally available in the Seamless Construction.

For diameters above 400 mm WB, expensive hollow forged or forged and bored piping has to be used for high temperature and pressure application. This mode of manufacture achieves some reliability at a lower thickness compared to ERW pipes.

The recommended temperature range for respective material specification is as follows :

Code	%Cr.	%Mo	%V	Temp. range°C
ASTM A335 P11	1.00-1.50	0.44-0.65	—	410-510
ASTM A335 P22	1.90-2.60	0.87-1.13	—	510-540
ASTM A335 P91	8.00-9.50	8.00-1.05	0.18-0.25	540-593

III. S. S. Piping

For Stainless Steel piping, popularly used materials are :

ASTM A312 Gr TP 304 (16% Cr – 8% Ni)

ASTM A312 Gr TP 316 (18% Cr – 12% Ni–3% Mo)

Type 304 finds wide application in Cryogenic Service upto temperature as low as (—) 200°C, as well as in handling of average corrosive chemicals. Type 316 is more corrosion resistant and suitable for some specific applications like certain fertilizer effluent lives urea water solution etc.

IV. CI and ductile iron Piping :

CI and ductile iron provide more metal for less cost than Steel in the piping systems and are used in low pressure services in which internal and external corrosion may cause considerable loss of metal. They are widely used for underground water distribution.

2. Non-ferrous metallic Pipes :

Copper and Copper alloys like bronze, brass, Cu-Ni alloy tubes are commonly used for heat-exchangers in various power plants and other utility plants. But one has to be careful not to use copper or copper alloy pipes in fertilizer plants as ammonia has a corrosive action on copper and copper-bearing alloys.

3. Lined Pipe Systems :

Rubber lined steel pipe is made in lengths upto 6m with Seamless, straight seamwelded and some types of neutral and synthetic adhering rubber. The pipe spool pieces for rubber lining are provided into flanged joints at each end. Inside rubber lining extends upto face of such flanges.

It is advisable, however, to avoid use of rubber lined pipes and use stainless steel pipe of suitable grade, wherever practicable, to minimise maintenance problems.

Steel Pipes lined with cement on the inside by centrifugal casting process find wide use in contamination free cold water, crude petroleum oil and some dilute acid applications.

Underground Steel Pipes buried in highly corrosive soil are sometimes protected by centrifugally cast cement lining on the inside and cement sand mortar with steel wire mesh reinforcement (sprayed into position by air pressure) on the outside.

4. Non-metallic Pipes :

Non-metallic flexible pipe of plastic origin is less prone to internal and external corrosion in comparison to other metals. These pipes can be easily cut and joined and does not cause galvanic corrosion when coupled to other materials like Polyethylene (PE), Polyvinyl Chloride (PVC), Polypropylene (PP), Reinforced Thermosetting Resin (RTR) etc. This type of pipe, however, due to their inherent non-rigidity, requires continuous support throughout its run length.

In seawater applications, epoxy coating on C. S. or rubber based materials on carbon steel is sometimes applied. Alternatively, coating by 90-10 Cu-Ni alloy or SS316L Plate or Precrete (a variety of aluminium cement having same co-efficient of expansion as Steel) on C. S. may be used. PVC or PP pipe reinforced with fibreglass is often used for seawater applications. This type of pipe also requires continuous support throughout its run length.

These are, in a nutshell, different materials and their applications in piping. Material selection is the most important and fundamental aspect of industrial piping.