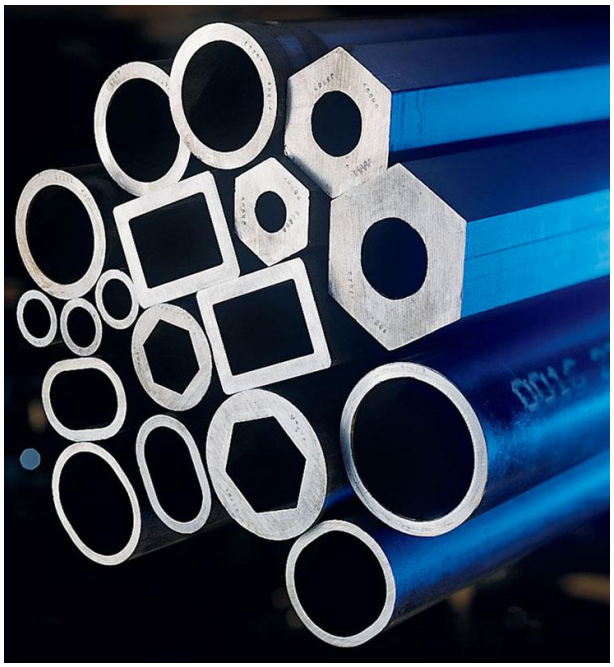
Material Specification



Material Specification and properties

for a better selection

Material Specification

✓ Principle

When you want to select a material for construction, you need to have some important considerations such as Erosion and Corrosion in the ambient, the working temperature either pressure, Mechanical Force, Torque and allowable Elongation.

To make this process easier, there are several handbooks for material selection for different application and specification and properties for famous materials.

✓ Technical Data

You can find a short list of the most usual materials and their properties.

Carbon Steels (Group)

Low cost materials with little corrosion resistance. Used in low temperature and stress applications where the measured medium protects it from corrosion, oils, petroleum, tars etc. Maximum temperature: 530^{o} C.

Chrome/Moly Steels (F11, F22)

High strength steels used in pressure vessels and industrial boiler plant; Resistant to chloroform, cleaning agents, food products and carbon disulphide.

Maximum temperature: 600^{o} C.

304 Stainless Steel

Low cost corrosion resistant material, used extensively used in food, beverage and chemical processing where good corrosion resistance is required. A low carbon grade, 304L is available which can be welded without impairing it's corrosion resistance.

Maximum temperature: 900^{o} C.

310 Stainless Steel

Heat resistant material, which can be used up to 1150^{o} C with useful resistance in sulphur bearing atmospheres. Corrosion resistance is slightly better than 304SS, but not as good as 316SS. Can be welded with caution.

316 Stainless Steel

Best corrosion resistance of the austenitic stainless steels due to the addition of molybdenum, widely used in chemical processing, offers useful resistance to H S. As with 304, a low carbon grade, 316L is available for welded applications.

Maximum temperature: 900^{o} C.

321 Stainless Steel

Similar properties to 304SS above, except that this grade is titanium stabilized to prevent intergranular corrosion when welded.

446 Stainless Steel

Ferritic stainless steel with excellent resistance to sulphurous atmospheres at high temperature, however due to its low strength at high temperature, thermowells made from this material should be mounted vertically. Used in heat treatment processes, iron and steel furnaces, gas production plant and it has some useful resistance to molten lead. Good corrosion resistance to nitric acid, sulphuric acid and most alkalis gives it some limited use in chemical plant.

Maximum temperature: 1150^{o} C.

Duplex Stainless Steel

These grades combine high strength with excellent corrosion resistance, especially to chloride stress corrosion cracking, however a tendency to brittleness limits their use to approx. 300 to 315^{o} C maximum, sub-zero use is also restricted to approx 50^{o} C because of brittleness due to the ferrite content. Main uses include offshore piping, chemical tanks, flue gas scrubbers and chimneys.

Super Duplex Stainless Steel

Similar qualities and limitations to duplex grades above. These grades are widely used to handle seawater and other brackish waters, marine pumps, oil and gas production and desalination plants are typical applications.

Inconel 600

A very wdely used nickel-chromium-ion alloy with excellent high temperature strength and oxidation resistance, however it is very vulnerable to attack in sulphurous atmospheres above 500^{o} C. Good resistance to chloride-ion stress corrosion cracking and nitriding environments. Use extensively chemical Industries for its strength and corrosion resistance. Easily welded, can normally be used without post weld heat treatment.

Maximum temperature: 1212^{o} C.

Inconel 625

A nickel-chromium alloy with excellent resistance to pitting and crevice corrosion, unaffected by radiation embrittlement, widely used in aerospace applications and in marine environments. Good weldability, can be used in the as-welded condition.

Maximum temperature: 1093^{o} C.

Incoloy 800

Superior to alloy 600 in sulphur, cyanide salts and neutral salts. Extensively used in Steam / hydrocarbon reforming plants for pigtail piping, manifolds and waste heat boilers and in the internal components of secondary reformers. Widely used in heat treatment equipment and as a heater sheath material.

Maximum temperature: 1093o C.

Incoloy 825

A nickel-iron-chromium alloy with exceptional resistance to many corrosive environments, it is superior to almost all metallic materials for handling sulphuric acid and shows excellent resistance to phosphoric acid. It is widely used in chemical processing, oil and gas recovery acid production, pickling operations, nuclear fuel reprocessing and handling of radioactive wastes. Maximum temperature: 540o C.

Incoloy MA956

An iron-chromium-aluminum alloy produced by mechanical alloying, it features great strength at high temperatures with excellent resistance to oxidation, carburization, and hot corrosion. These properties make it especially suitable for gas- turbine combustion chambers and other aggressive environments containing sulphur and chloride salts.

Maximum temperature: 1350^{o} C.

Monel 400

Nickel-copper alloy with very good corrosion resistance commonly used to handle sea water, hydrofluoric acid, sulphuric acid, hydrochloric acid and most alkalis. Typical applications include marine fixtures, chemical processing equipment, gasoline and water tanks, process vessels and piping and boiler feed water heaters.
Maximum temperature: 538o C.

Hastelloy C276

Nickel-molybdenum-chromium alloy with excellent corrosion resistance especially in chlorinated environments.Widely used in chemical plant where it tolerates ferric and cupric chlorides, solvents, chlorine, formic acid, acetic acid, brine, wet chlorine gas and Hypochlorite. Can be easily welded and maintains its properties in the as-welded condition.

Maximum temperature: 1093^{o} C.

Hastelloy B3

A development of the well-established B2 alloy with improved thermal stability, fabricability and stress corrosion cracking resistance. It is the alloy of choice for handling hydrochloric acid in all concentrations and temperatures; it also withstands hydrogen chloride, sulphuric, acetic, hydrofluoric and phosphoric acids.

Maximum temperature: 538^{o} C, up to 816^{o} C in reducing or vacuum environment.

Hastelloy C22

A Nickel-chromium-molybdenum-tungsten alloy with outstanding resistance to pitting, crevice corrosion and stress corrosion cracking. It shows exceptional resistance to a wide range of chemical process environments, such as ferric and cupric chlorides, chlorine, hot contaminated solutions, formic and acetic acids and seawater or brine solutions. The material has superior weldability, and retains its properties in the as-welded state.

Hastelloy X

A high temperature alloy with-excellent resistance to oxidising, reducing and neutral atmospheric conditions. Is widely used in aircraft jet engine components. Very good high temperature strength makes it ideal for furnace applications. Resistant to stress corrosion cracking in petrochemical applications.

Maximum Temperature: 1204^{o} C.

Titanium

A lightweight material with good strength in the

150 to 470^{o} C range. Excellent resistance to oxidising acids such as nitric or chromic, it is also resistant to inorganic chloride solutions, chlorinated organic compounds and moist chlorine gas. Its good resistance to seawater and salt spray allows it to be used in offshore installations. Can be welded with special precautions to protect from atmospheric contamination.

Tantalum

Refractory metal that is very ductile. Use only in inert atmospheres or very good vacuums. <10(-3) torr. Hydrogen and nitrogen will react with tantalum above 750° F (400° C) resulting in nitride and hydride formation that will affect life. Tantalum is almost completely immune to chemical attack at temperatures below 150^{o} C, and is attacked only by hydrofluoric acid, acidic solutions containing the fluoride ion, and free sulfur trioxide. Alkalis attack it only slowly.

At high temperatures, tantalum becomes much more reactive. It is normally used by cladding a thin layer onto a less expensive material, such as steel or stainless steel Tantalum's corrosion resistance is similar to that of glass, making it the material of choice in critical chemical and pharmaceutical processes requiring maximum corrosion resistance and minimum contamination.

Typical applications are: Chemical production (HCL, H_2SO_4, insecticides, pharmaceuticals, fine chemicals, explosives, plastics, dyestuffs, condensation of phosgene derivatives, synthetic fibers, chromic acid plating solutions and operations involving chlorine, bromine, iodine and their compounds, high purity product manufacturing (cosmetics, soaps, perfumes) and separation of high boiling organic acids.