

The Mechanical Properties of Titanium and its Alloys

The range of grades and alloys of titanium available to the designer makes possible the selection of a combination of properties appropriate both to fabrication and end use. A convenient and widely used system for identification of the various grades of commercially pure titanium and titanium alloys used for engineering and corrosion resisting applications is provided by ASTM:-

Grades 1,2,3,4 are commercially pure titanium, used primarily for corrosion resistance. Strength and hardness increase, and ductility reduces with grade number. Grade 2 is the most widely used specification in all product forms. Grade 1 is specified when superior formability is required. Grades 3 and 4 are used where higher levels of strength are necessary.

Grades 7, 11 and 12 are alloys possessing superior corrosion resistance in particular to reducing acid chlorides. The mechanical properties of grades 7 and 11 are identical to those of Grades 2 and 1 respectively. Grade 12 is stronger and retains useful levels of strength up to 300°C.

Grades 5 and 9 are alloys with good corrosion resistance and medium levels of strength. They are frequently limited in use to specific products.

Beta-C is included as an important high strength corrosion resistant alloy for sea water application, which has not yet received an ASTM grading.

The range of ASTM specifications cover all the forms supplied in titanium and its alloys:-

ASTM B 265 - Strip Sheet and Plate

ASTM B 337 - Seamless and Welded Pipe

ASTM B 338 - Seamless and Welded Tube

ASTM B 348 - Bars and Billets

ASTM B 363 - Seamless and Welded Fittings

ASTM B 367 - Castings

ASTM B 381 - Forgings

Welding consumables are covered by AWS Specification A5.16.

A summary of key properties appears in Table 1, over. (1)

The comparative strength to weight ratios with other corrosion resistant alloys are given in Table 2. (2)