BioDur 108 alloy and Custom 465 stainless, two stainless steel alloys, have been designed for small-diameter applications that require high strength and corrosion resistance, and in the case of BioDur 108 — no interference with magnetic fields. They have been successful in such industries as medical, pharmaceuticals, nuclear energy, aerospace and avionics, food and beverage, and various other “clean room” sterile and critical environments.

BioDur 108 alloy
An essentially nickel-free austenitic wrought stainless steel, BioDur 108 has mostly been considered for medical devices that require high levels of strength and corrosion resistance, as well as non-magnetic properties. It is provided in the cold-worked condition, and does not require heat treating.

Produced by electroslag remelting to improve microstructural integrity and cleanliness, BioDur 108 is essentially free of ferrite. Due to its high nitrogen content, the alloy has higher tensile and fatigue strength than nickel-containing alloys such as 316L (ASTM F138), 22Cr-13Ni-5Mn (ASTM F1314), and 734 alloy (ASTM F1586). Also, its resistance to pitting and crevice corrosion is superior to that of Type 316L stainless, and is equivalent to that of the 22Cr-13Ni-5Mn and 734 alloys.

“The main benefits of BioDur 108 are its strength coupled with its non-magnetic properties,” says Humberto Raposo, a regional metallurgist for Carpenter Technology. “It could achieve a hardness of 50 Rockwell C, and be totally non-magnetic at the same time.” He adds that BioDur 108 is one of the highest-strength tooling alloys on the market.

It meets the requirements of ASTM F2229, which calls for a minimum of 200 ksi (1380 MPa) UTS, a minimum of 180 ksi (1240 MPa) yield strength, a minimum of 12% elongation, and a minimum of 40% reduction of area. Its nominal properties tend to be 258 ksi (1780 MPa) UTS, 201 ksi (1385 MPa) YS, 18% elongation, and 43% RA.

BioDur 108 was originally designed to replace 316L for medical implants, such as bone plates, bone screws, spinal fixation components, and hip and knee components, because it is essentially nickel-free. About 5% of the general population is allergic to nickel.

The alloy is also being selected for applications requiring high strength, corrosion resistance, and low magnetic permeability. For example, it is suitable for tools for MRI equipment, which has very strong magnetic fields.

BioDur 108 may be machined by procedures similar to those for 22Cr-13Ni-5Mn (ASTM F1314) and 734 (ASTM F1586) alloys. A continuous positive cutting action can avoid work hardening. Slow to moderate speeds, moderate feeds, and rigid tools are suggested.

ASTM F2229 calls out various work-hardened conditions for BioDur 108 (i.e., Condition B and C). Therefore, based on hardness, tooling selection and feed/speed rates need to be adjusted. Synthetic water-based coolants are suggested to control tooling temperatures, although mineral oil-based coolants have been successful as well.

Custom 465 stainless
This is a premium melted, precipitation-hardenable, magnetic stainless steel capable of ultimate tensile strength in excess of 250 ksi (1720 MPa) in the aged condition. In the cold-worked and aged condition, Custom 465 stainless is capable of close to 300 ksi (2070 MPa) UTS, and a Charpy V-notch impact energy of over 50 ft-lb (68 N-m).

Its combination of properties includes superior notch toughness, fracture toughness, and stress corrosion cracking resistance compared with other
High-strength PH stainless alloys, such as Custom 455 stainless or Carpenter 13-8 stainless. The general corrosion resistance of Custom 465 stainless approaches that of Type 304 stainless.

Originally developed for aerospace applications, Custom 465 stainless has been selected for structural components for many commercial and military aircraft, including the Joint Strike Fighter and the Boeing 787 Dreamliner. Other applications include equipment and tools for the medical and process industries, and for firearms.

It is a realistic substitute alloy for components currently made from 4340, 4140, 410, 15-5, 17-4, Custom 455 stainless, and PH 13-8 stainless. It provides potential benefits in terms of weight savings (strength-to-weight ratio), cost savings, corrosion resistance, fracture toughness, and stress corrosion cracking resistance. However, these benefits are component-specific, and should be considered by the OEM as to their applicability.

With its relatively low yield strength and low work-hardening rate, Custom 465 stainless can be readily cold formed by drawing or stamping. In addition, because it is so workable it is available as thin-gauge wire and strip and shaped bar, in addition to round bar, plate, and forging bar.

Cold-worked Custom 465 stainless aged at 900°F (482°C) can provide maximum achievable tensile strengths approaching 300 ksi (2070 MPa) for parts with diameters less than 0.75 in. (20 mm). This capability has been useful for making surgical and dental instruments and needle wire. For example, these properties have facilitated the design of the longer and smaller-cross-section instruments that are typically required for minimally invasive surgical procedures.

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