



TECHNICAL TIP: Passivation of Austenitic Stainless Steels

Passivation is a process used to remove iron from the surface of stainless steel. The iron is deposited from cutting tools and microscopic iron particles in the coolants used during the machining process. If passivation is not done, the parts may discolor, rust where iron is present, or change critical surface dimensions.

It should be noted that modern ceramic cutting tools have helped to eliminate this iron surface problem. However, if CNC machines are not dedicated to stainless steel machining only, there is likely to be contamination of iron in the cooling fluid. In addition, passivation is required to maximize the natural corrosion resistance of the stainless steel. This is critical when turbine flowmeters are used in water or other corrosive fluid applications.

Properly passivated parts will automatically acquire a protective oxide film from exposure to oxygen in the atmosphere. Under ideal conditions, this oxide film, although only 0.0000001” thick, completely covers all surfaces of the part. To reach this ideal condition, the parts surfaces must be thoroughly cleaned. Improper cleaning of the part can actually induce corrosion, as contaminants cover the iron that needs to be exposed to the process.

The traditional passivation process used on austenitic stainless steel is a 20 percent mixture of nitric acid by volume at 120°/140°F (49°/60°C) for 30 minutes. A neutralizer and a thorough spray rinse follows. Citric acid is a more environmentally friendly process for passivation. Because citric acid efficiently removes iron from the surface, much lower concentrations are required than when using nitric acid. Typical solutions range from 4 to 10 percent citric acid by weight. Due to the high reactivity with free iron and low reactivity with other metals, it is generally safe to leave the parts in the bath longer than necessary.

Flow meter companies, employing application engineers, will help to define the proper materials for the fluid being measured. If an application includes a potentially corrosive fluid, the user may wish to verify that the flowmeter supplier passivates all the stainless steel wetted parts. COX Instruments and Exact Flow routinely employ plating companies to properly clean and passivate stainless steel parts.

For more information, refer to ASTM A967 “Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts,” found at <http://www.astm.org/>.

[Read related Flow Measurement white papers.](#)

Copyright 2009 COX Instruments. All rights reserved.

COX Instruments
15555 N 79th Place
Scottsdale, AZ 85260
tel: (480) 922-7446
www.cox-instruments.com