CLEANING METHODS AND TESTING OF CUT TUBING

Cleanliness of stainless steel parts is becoming increasingly important to medical device and other manufacturers. Problems caused by inadequate or improper cleaning can result in increased process costs for fabricators of metal tubing.

CLEANING PROCESS

K-Tube's cleaning process primarily consists of:

Tumbling – Parts are placed inside a tumbler with a mild soap solution at 70-90°F for 30 minutes. The continuous vibration of the tumbler causes the parts to move up the curved bottom of the tub. This continuous part-on-part tumbling action removes oils from the parts. This process is only for shorter parts.

Ultrasonic – Parts are placed inside an ultrasonic tank with a mild phosphoric soap solution at 90-120°F for 30 minutes. Cavitation bubbles induced by the vibration act on contaminants by penetrating blind holes, cracks and recesses. The process loosens tightly adhered or embedded particles from the metal surfaces. Contaminants can include metal shavings, dust, dirt, oil, pigments, grease, polishing compounds, flux agents and fingerprints.

Power Wash – Parts are bundled and passed under water jets at high pressure (approximately 800-1,000 psi). As the parts move under the jets, water penetrates the ID of the tubing and rinses the parts.

Flushing – Parts are bundled and secured in a rinse/flush station. A mixture of water and air is flushed through the ID of parts at approximately 100 psi. This removes residual contaminants such as metal shavings, dust, dirt, oil, pigments, grease, polishing compounds, flux agents and fingerprints. This process is used on longer parts.

These aqueous-based cleaning processes remove most contaminants from all cut and open-end tubing. K-Tube selects the process(es) required to meet customer expectations.

CLEANLINESS TESTING METHODS

There is no industry standard for the cleanliness of stainless steel tubing. This can lead to confusion and differing cleanliness expectations. To ensure cleanliness, K-Tube performs a surface examination and backlight inspection. Other, more sophisticated tests such as particle extraction (gravimetric) and Fourier transform spectroscopy (FTS) analysis are used when necessary for analysis and validation.

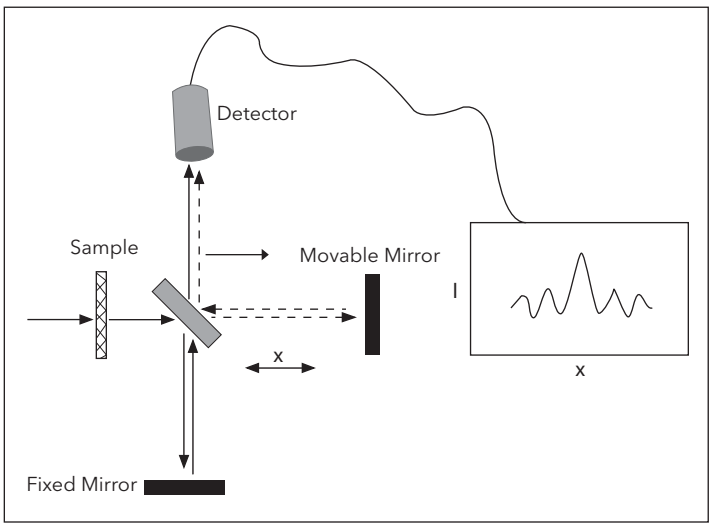
Wipe Test – A simple test for cleanliness is to wet a soft cloth such as Kimwipes® with IPA (isopropyl alcohol) and then wipe the tubing. The cloth is then visually inspected for residue. If higher magnification is required, an eyepiece or stereomicroscope can be used for the inspection.

Surface Examination – An alternative to the wipe test is to examine the surface of the tubing under a stereo zoom microscope at 10-20X. The parts are inspected for any contamination.

Backlight Examination – A backlight can be used during surface examination of the ID surface of the tubing to identify clogs or contamination. This method is ideal for inspecting bundles of tubing.

Particle Extraction – In the particle extraction test, three grams of tubing are immersed in fresh or deionized water in an ultrasonic bath and then strained using filter paper. The particulate is then closely examined and measured under a microscope. The cut tubing specifications will determine the acceptable particle count for each sample.

Fourier Transform Spectroscopy (FTS) – FTS analysis is a failure analysis technique that provides information about the chemical bonding or molecular structure of materials, whether organic or inorganic. It is used in failure analysis to identify unknown materials present in a specimen.



"The technique works on the fact that bonds and groups of bonds vibrate at characteristic frequencies. A molecule that is exposed to infrared rays absorbs infrared energy at frequencies which are characteristic to that molecule. During [FTS] analysis, a spot on the specimen is subjected to a modulated [infrared] beam. The specimen's transmittance and reflectance of the infrared rays at different frequencies is translated into an [infrared] absorption plot consisting of reverse peaks. The resulting [FTS] spectral pattern is then analyzed and matched with known signatures of identified materials in the [FTS] library."[1]

Kimwipes is a registered trademark of Kimberly-Clark Corporation.

[1] FTIR spectroscopy. SiliconFarEast.com Web site. http://www.siliconfareast.com/FTIR.htm. Accessed November 5, 2010.