



SPECIFICATION GUIDE Electropolished Tubing for Sample Transport

Not all electropolished tubing is equal when used for sample transport.

Electropolished Tube Selection for Analyzer Sample Systems

Selecting the optimum process tube for use in analyzer sample transport systems requires critical consideration of process conditions. O'Brien provides a wide variety of in house services including chemical passivation, thermocouple cleaning and cleaning for oxygen service. We also furnish silicon coated commercial tubing. O'Brien was the first to develop a process capable of electropolishing long continuous coils of tubing to semiconductor standards for analytical sample transport.

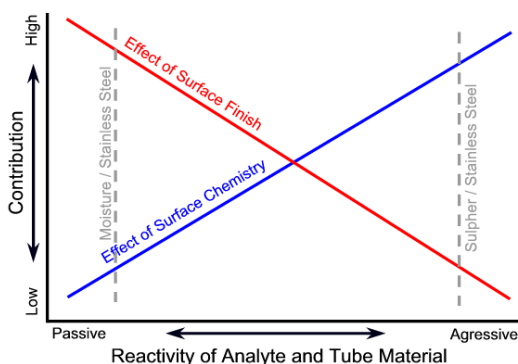
TrueTube® is a family of tubing products developed to provide best-of-breed performance in sample transport for process and emissions analyzers. O'Brien Analytical starts with select ASTM grade tubing and enhances its physical characteristics to improve dry-down, adsorption and corrosion resistance. We do this by controlling surface roughness, cleanliness, surface chemistry and reactive contaminants.

The advantages of O'Brien TrueTube EP have been verified by independent laboratory testing and industry acceptance.

Cleanliness and Reactive Contaminants

The O'Brien TrueTube process removes drawing oils and other contaminants that are often present in commercial grade tubing. At the same time surface iron is removed and the tube is left with an enriched Cr/Fe and CrO/FeO ratio which contributes to corrosion.

Surface Finish vs. Surface Chemistry



Selecting Tube Material

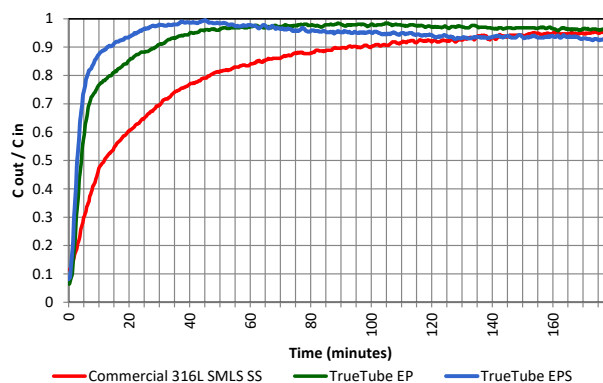
Consider the corrosion, porosity, and adsorption as well as the size, wall thickness and metallurgy (or coating) of the tubing.

Adsorption

When utilizing stainless steel tubing adsorption and desorption will exhibit itself as a delay in detecting changes of trace amounts of component (especially moisture and sulfur compounds, H₂S and SO₂.) The structure of commercial stainless steel tubing is such that compounds may be caught up in the "crevices" and not reach the analyzer. Once the tube is saturated the levels will equalize relative to the process as long as the process composition, temperature and pressure remain constant. Any change in composition, temperature or

pressure will cause compounds to be adsorbed at a different rate by the tube or released at different rates from the tube surface and "spike" the sample to the analyzer. As a result, adsorption and desorption create inconsistent and unpredictable results. This is sometimes referred to as the "memory effect". This problem can often be solved by the use of electropolished or SilcoNert coated tubing.

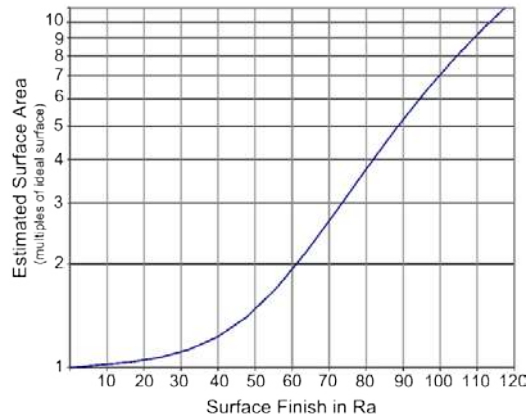
Moisture in Gas
(Wet Up / Adsorption)



Surface Roughness

Surface roughness contributes to adsorption / desorption problems associated with analyzer sample lines. The microphotographs below illustrate one of the differences in tube material and selection. Surface roughness is only one factor to consider when specifying sample tube material. However, like other choices in sample system components, it can improve or limit the repeatable accuracy of the entire system.

Surface Area vs Surface Finish



Electropolished Tubing for Sample Transport

TrueTube EP

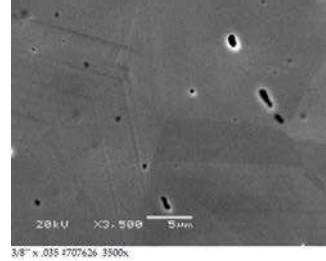
The photo illustrates the superior surface finish achieved by electropolished TrueTube. Electropolishing not only improves surface roughness but also provides enhanced corrosion resistance by leaving a chromium enriched Cr:Fe and CrO:FeO surface layer. With a maximum surface roughness of 20 μ and fewer than 4 distinguishable pits, inclusions or defects visible in a 0.5-inch square window, this is the smoothest tube in the TrueTube family. TrueTube EP provides improved corrosion resistance and reduced dry-down time.

Not All EP Tubing is Equal

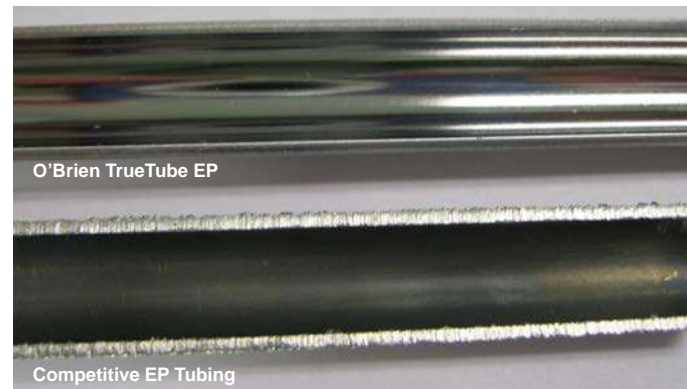
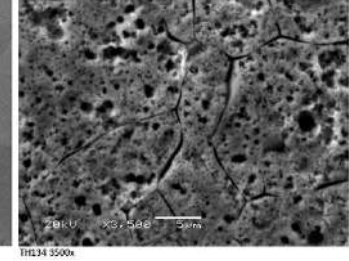
Specifying electropolished tubing without corresponding requirements for enriched Cr:Fe, CrO:FeO and defect count as well as surface roughness may not prove a tube surface capable of improving sample transport performance.

Following is a side-by-side comparison of TrueTube EP that meets the specification and a tube that was simply specified and supplied as electropolished. While the surface roughness is low, the SEM defect count was too high to measure.

O'Brien TrueTube EP
Average Ra 8



Competitive EP Tubing
Average Ra 14



Sample Specification:

Electropolished Tubing for Sample Transport

- 1.0 Electropolished tubing, TrueTube® EP as supplied by O'Brien, St. Louis, MO USA.
- 2.0 Tubing shall be processed and electropolished in a manner to obtain a maximum ID surface finish per ANSI/ASME B46.1 of 20 μ in.
- 3.0 Visual analysis shall verify less than 4 distinguishable defects in a 0.5 x 0.5 in window per ASME BPE2016 Part SF.
- 4.0 Processing shall provide a chromium enriched Cr:Fe and CrO:FeO surface layer.
- 5.0 Electropolished tubing shall be:
 - 5.1. Cleaned with deionized water to remove all traces of electrolyte and other contaminants after electropolishing.
 - 5.2. Dried with Nitrogen containing less than 1 ppm moisture and capped.
- 6.0 Continuous lengths of electropolished tubing shall be supplied up to the following lengths: 1/8" diameter 60M, 1/4" diameter 200M, 3/8" diameter 140M, 1/2" diameter by 115M. Orbital welded sticks are not acceptable.