

## TrueTube<sup>®</sup>

### TrueTube<sup>™</sup>

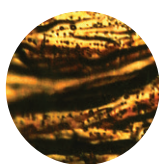
TrueTube is a family of tubing products developed to provide best-of-breed performance in sample transport for process and emissions analyzers. O'Brien Analytical starts with select grade tubing and enhances its physical characteristics to improve dry-down, adsorption and corrosion resistance. We do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

### 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.

### Cleanliness and Reactive Contaminants

The O'Brien Analytical 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 resistance.



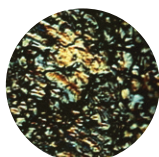
### Commercial Grade

There are no cleanliness or surface finish requirements in the standard specification for commercial grade seamless tubing. Consequently commercial grade tubing may contain drawing oils and contaminants from the manufacturing process causing problems with the accuracy of sample analysis until the system is flushed and cleaned. The surface finish can vary widely and may be very rough. These conditions do not affect most non-analytical applications; however, when transporting process fluids and gasses for analysis commercial grade tubing can cause severe loss of performance.



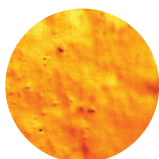
### TrueTube<sup>®</sup> CP

Select seamless 316L stainless steel tubing is chemically polished and passivated to produce a surface finish with improved characteristics. During the process free iron molecules are removed from the inner surface of the tubing and all hydrocarbon drawing compounds are removed. TrueTube CP<sup>®</sup> also meets the requirements of ASTM A632-S3 for thermocouple cleaning and CFOS per ASTM G93 Level A and CGA g-4.1. It contributes to improved sample transport times by reducing surface roughness and eliminating contaminants.



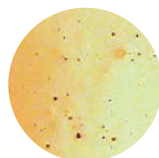
### TrueTube<sup>®</sup> FS

A secondary process adds a SilcoNert<sup>™</sup> 2000 elemental silicon coating on the inside diameter of chemically polished and cleaned seamless 316L stainless steel tubing. The silicon coating improves the corrosion resistance and reduces the affinity of stainless steel to many compounds such as H<sub>2</sub>S. SilcoNert 2000 coated tubes have found acceptance for transporting low concentration sulfur samples.



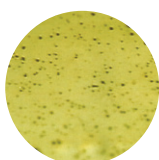
### TrueTube<sup>®</sup> EP

The photo illustrates the superior surface finish achieved by O'Brien electropolished TrueTube<sup>®</sup> EP. Electropolishing not only improves surface roughness but also provides enhanced corrosion resistance by leaving a chromium enriched surface layer. The Cr:Fe ratio will be a minimum of 1.5:1 and CrO:FeO ratio will be a minimum of 3:1. With a maximum surface roughness of 10 μm (0.25 μm) and fewer than 40 distinguishable pits, inclusions or defects visible at 3500X magnification, this is the smoothest tube in the TrueTube family. O'Brien TrueTube EP provides improved corrosion resistance and reduced dry-down time.



### TrueTube<sup>®</sup> HCR

A secondary process adds a Dursan<sup>™</sup> carboxysilicon coating on the inside diameter of chemically polished and cleaned seamless stainless steel tubing. This hard scratch-resistant coating improves the corrosion resistance and inertness of stainless steel. It is pH stable in exposure to both acid and base solutions. While not as inert as the SilcoNert 2000 coating, it is resistant to base compounds and exhibits excellent corrosion resistance.



### TrueTube<sup>®</sup> EPS

The ultimate product for inertness and aversion to sulfur compounds. TrueTube<sup>®</sup> EPS combines the advantages of electropolished and SilcoNert<sup>™</sup> 2000 elemental silicon coated tubing to produce a superior tube. Electropolishing provides the ideal surface for the CVD applied coating by improving the adhesion and producing a superior, uniform sample transport tube. In tests TrueTube EPS has demonstrated the lowest adsorption and desorption of moisture and organo-sulfur compounds, outperforming both electropolishing and SilcoNert coating.

## TrueTube®

### CFOS

O'Brien Analytical can also supply tubing which has been cleaned for oxygen service per ASTM G93A Level A and CGA G-4.1 requirements. After cleaning the tubing is capped to prevent contamination.

### Orbital Weld Fittings and Tubing

We also offer specialty tube and orbital weld fittings from our sister company Cardinal Systems. Cardinal is a provider of high purity and ultra high purity tubing and fittings to the biopharm, medical, pharmaceutical and semiconductor industries. These products are available in sizes from 1/4" through 6". Tubing is provided in 20' straight sticks.

Orbital weld fittings eliminate the dead space and crevices associated with compression fittings so there is no place for sample stream components to collect and become entrapped.

O'Brien Analytical also offers specialty tube and orbital weld fittings through our sister company Cardinal Systems a provider of high purity and ultra high purity tubing and fittings to the biopharm, medical, pharmaceutical and semiconductor industries. These products are available in sizes from 1/4" through 6". Tubing is provided in 20' straight sticks.

### Tech 5 Tubing

- Surface roughness of 40µin / 1.0µm Ra.
- High quality seamless and welded 316L SS.
- Thermocouple cleaned per ASTM 632 Supplement S3.
- Purged with filtered nitrogen and capped.

### Tech 10 Tubing

- Surface roughness of 25µin / 0.63µm Ra.
- High quality seamless 316L SS.
- Exceeds CFOS CGA G4.1 cleaning.
- Fully passivated with nitric acid.
- Rinsed with DI water, purged with filtered nitrogen and capped.

### Tech 20 Tubing

- Chemically polished with a surface roughness of 15µin / 0.20µm Ra.
- High quality seamless 316L SS.
- Low particulate cleaning.
- Fully passivated with nitric acid.
- Final rinse with heated 18 megohm DI water, purged with filtered nitrogen until dry and capped.
- Final cleaning and packaging performed in a cleanroom.

### Tech 25 Electropolished Tubing

- Electropolished to 10µin / 0.µm Ra.
- 316L SS tubing meets ASTM specifications for consistent physical, dimensional and chemical composition.
- Restricted sulfur content insures low non-metallic inclusions.
- Final cleaning and packaging performed in a Federal Standard 209 Class 10 cleanroom.
- 0.1µ filtered 18 megohm 60°C deionized water rinse until effluent surpasses 17.5 megohm.
- Dried with 0.005 µ filtered 120°C nitrogen and capped.