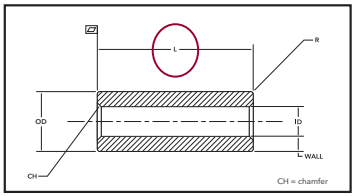
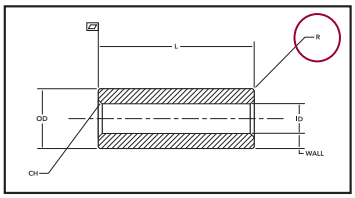
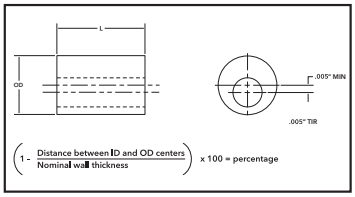
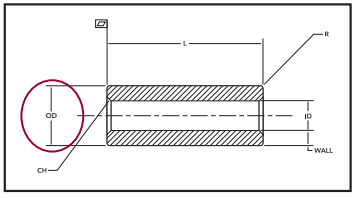
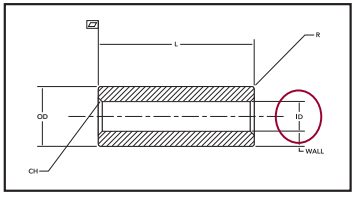
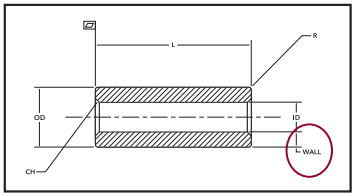
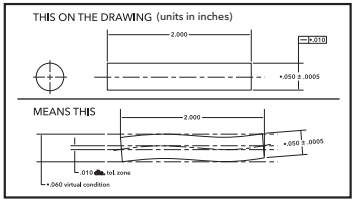
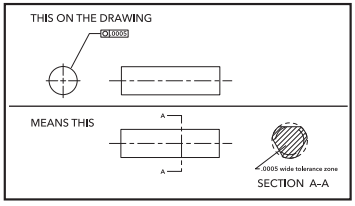
Miniature Stainless Steel Tubing Measurements

A guide to basic measurement principles and associated measuring devices

Parameters	Measurement Device/Technique	
Length (L)	The overall length (OAL) is often the most critical dimension of a cut job. Measurements can be taken with calipers, flat-head micrometer, optical comparator or precision electronic slide rules. The length of tubing will determine the proper instrument to use.	
Radius (R)	An optical comparator measures radius. Customer specification for radius determines the appropriate process, such as tumbling. Most radii are achieved through vibratory tumbling of short lengths of tubing. For longer lengths, a radius can be achieved with machining or grinding.	
Concentricity	The relationship between the outer diameter (OD) and inner diameter (ID) position is rapidly becoming a critical requirement. This measurement is taken on a RAM optical scope where the center point of both the ID and the OD can be determined. It is calculated by measuring the dimensional difference of the relationship between the OD and ID centers.	
Outside Diameter (OD)	Often the first and most critical dimension specified, the OD can be measured using a laser micrometer, mechanical micrometer or optical measurement on a RAM® optical scope. Precautions should be taken not to deform thin-wall tubing during mechanical measurement.	
Inside Diameter (ID)	Class X plus pin gauges are typically chosen and verified on a laser micrometer before each use. Based on insertion results, additional pin gauges are chosen until the pin gauge inserts 1/16 inch and is tight. This pin represents the ID. Smaller IDs may also be verified on a RAM optical scope. Wall specification will indicate the manufacturing process to be used.	

Parameters	Measurement Device/Technique	
Wall Thickness	A mechanical point micrometer or calculation based on OD and ID measurements may be used for wall measurements. For point micrometer measurements, tubing must be ground in half and is measured at 45 degree increments (4 places) around the diameter of the tube. Precautions must be taken to prevent indenting the tubing wall during measurement.	
Straightness	Although tubing is easily inspected visually for straightness, an optical comparator may be used to measure deviation of deflection from a straight line. Other methods may include using a drop gauge or incline table for roll testing.	
Roundness/Ovality	Using a laser micrometer, 100% of the outside diameter is measured by rotating the tube and taking the total indicator readings (TIR). The highest value OD minus the lowest value OD equals TIR.	
Hardness	Hardness is defined as the resistance to deformation (either plastic or elastic). Actual hardness is measured on the HM-112 Mitutoyo® Hardness Tester. Hardness is reported in Rockwell HRC or HRB units of measure.	
Surface Finish	Surface finish is defined as the texture of a surface as determined by measured surface profile characteristics, of which surface roughness is one component. The two parameters typically used are Ra and RMS (Rq). Ra is the arithmetical mean of the absolute values of the profile departures within the evaluation length. RMS (Rq) is the root mean square value corresponding to the Ra.	