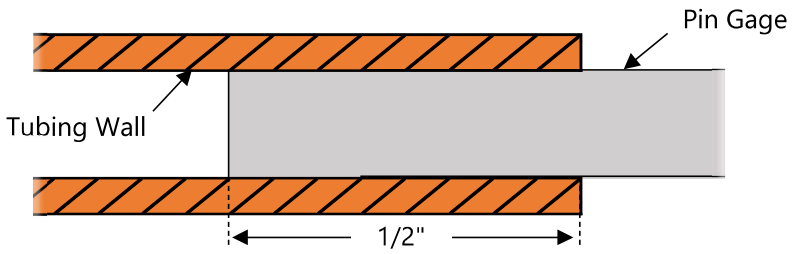
Standard Inspection Methods

Due to MicroLumen's tight tolerances, aligning measurement methods with customers is critical to ensuring agreement in product conformance. To increase the success of alignment and meet customer expectations, we are sharing our standard inspection methods.

Unless otherwise specified MicroLumen will verify conformance to print specifications using the methods detailed below. Measurement methods for characteristics not considered within this document are documented within MicroLumen's Quality Management System and are available upon request.

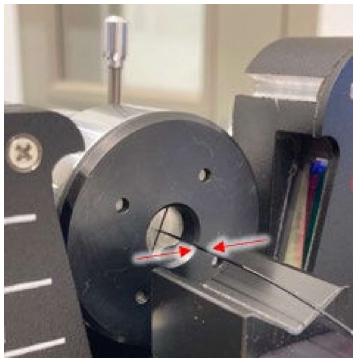
Inner Diameter

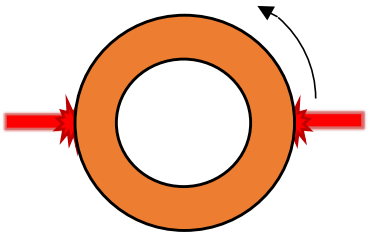
A Class X (+) pin gage that is verified prior to use should offer slight resistance and only fit into at most approximately 1/2" of the tube's entry point. 0.0001" is added to the pin gage size used to compensate for the distance it was able to freely travel into the tube.



Outer Diameter

A snug fit Class X (+) pin gage is inserted into the tubing and a calibrated single-axis laser micrometer is used to automatically take multiple measurements at a single point of cross section, equally distributed. These measurements are then averaged together for a final result.





Wall Thickness

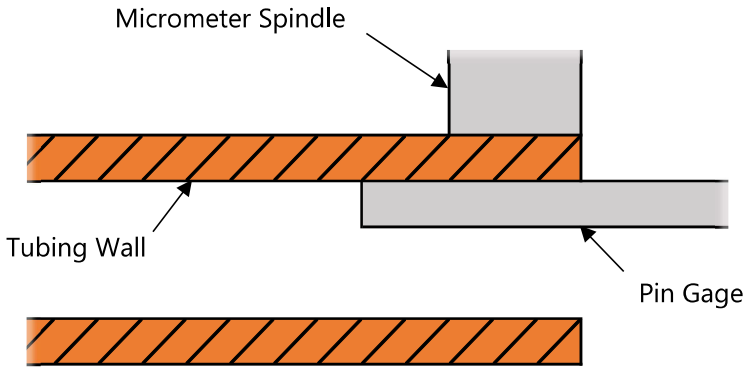
The wall thickness of product is calculated using the formula shown to the right:

$$Wall\ Thickness = \frac{Outer\ Diameter - Inner\ Diameter}{2}$$

Concentricity Ratio

For tubing with an an inner diameter ≥ 0.0212" a calibrated pin micrometer is used to take 8 wall thickness measurements equally distributed about 360° for four samples and the highest reading is then divided by the lowest reading.

For tubing with an inner diameter < 0.0212" a vision system is used instead of a pin micrometer.



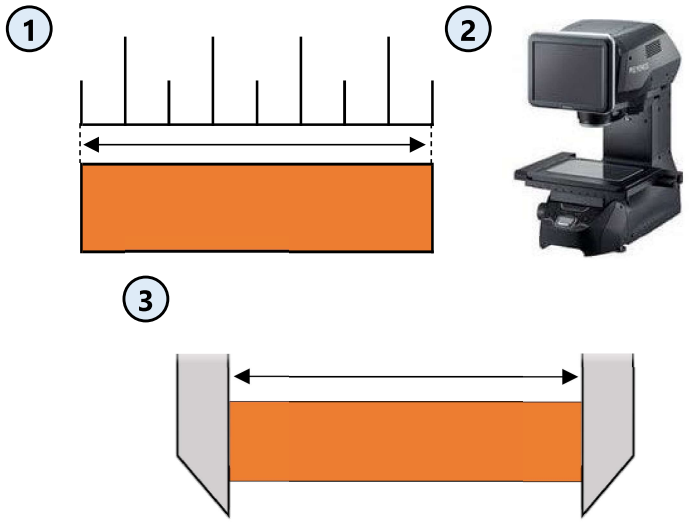
Standard Inspection Methods

Length Inspection

(1) If the product's length is > 5" and the tolerance is > ± 0.010" it is measured using either a calibrated ruler or calipers.

(2) If the product's length tolerance is ≤ ± 0.010" and the overall length is ≤ 5" it is measured using a vision system.

(3) If the product's length tolerance is ≤ ± 0.010" and the overall length is between 5" and 12" it is measured using calipers.



Cosmetic Inspection

(1) Parts are observed using the unaided eye in ambient lighting at a viewing distance of approximately 18" and undergo a **(2)** tactile inspection along their entire length using bare hands.

Trained operators can detect imperfections approximately 0.2 mm² on a referenced TAPPI chart.

