Markel

Quality Department **TSR #: Q06-001B**

TECH SERVICE REPORT

Date: 11 March 2009

Nature of Request:	Analysis:		Information:	X	Quote:		Other:	

Requested Evaluation: Recommended AR Liner / "Soft" Tubing Measurement Technique

Customers: AR Liners / PTFE Tubing Customers

Application: Push-pull cable control conduit, etc.

Objective:

To achieve accurate measurement results on AR Liner, PTFE or other soft tubing.

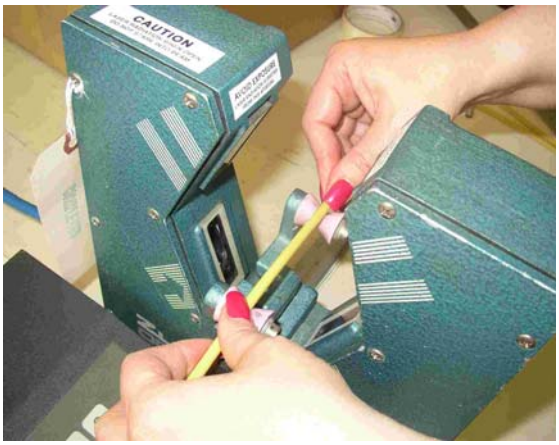
Background:

Non-standard technique can yield inaccurate assessment and unnecessary rejection of acceptable tubing. Typically, improper ID measurement technique will give a smaller-than-actual result.

Recommended Measurement Techniques

OD / Ovality - Simple or “Reference Only” method

- Cut 6” to 8” sample piece.
- Lightly hold each end and rotate level and slowly in the measurement position of the non-contact laser gage.
- Note the high and low OD reading.
- Average OD = (High OD + Low OD) ÷ 2
- Ovality value = High OD-Low OD
- Ovality % = ((High OD-Low OD) ÷ High OD) × 100



Note: Accurate ovality measurement is not able to be obtained with contact gauging (i.e. calipers, etc.) on soft tubing. If non-contact laser gage is not available, slice of unsupported tube can be measured on an optical comparator (procedure described below). Contact gauge measurement is acceptable to gauge average OD, while rounding / supporting the tube with the correct ID pin. However, ovality cannot be measured in this manner.

ID measurement

- On a straightened section of tubing, use your fingers to round out the end of a clean-cut tube (cut with new razor, taking care to not induce ovality when cutting).

- Insert calibrated ID pin gage, ensuring no air gaps between pin gage and inner tube surface.

- Correct ID pin size will offer slight resistance without scraping or showing deformity on the OD of the tube.

- Improper technique or un-rounded tubing will yield a false smaller ID result.

- It is important that the tube be cut without crushing the end - we find that a sharp new razor works best.

- An alternate method for “stiffer” tubing: Using a sharp razor, cut a "sliver" or "ring" from the end of a clean-cut tube about 3/16" to 1/4" in length. You can then measure the "ring" ID by slipping it over the largest ID pin possible that provides for no gaps and that offers some resistance when you slide it over the pin.

Wall thickness / Concentricity

- Utilize handheld wall micrometer or bench top wall indicator to measure wall thickness in several locations around circumference of tube, noting the high and low wall thickness measurement.

- Concentricity Value = High Wall - Low Wall

- Concentricity % = (Low Wall ÷ High Wall) x 100

- Note: To prevent mis-measurement from torquing or excess drag, sample length should be no longer than:
    - 1” – 2” for handheld wall micrometer measurement
    - ¼” – 3/8” for bench top wall indicator – pin end should protrude beyond sample end.

OD / Ovality / Wall - Precision Method

- On a straightened section of tubing, use a clean razor to cut off a slice off the tube end, 1 to 2mm in thickness. Take care to not induce ovality when slicing the tubing.

- Place the slice of tubing in the center of the comparator, adjusting the position of the tubing so it will be properly aligned and centered on the axes lines.

- Use your X and Y adjustments to place your points on the high OD and the low OD, or the high or low walls as needed.

- Mark off your points for the sections you are measuring using the comparators results box, in mm or in inches as appropriate, and continue with the calculations.

- Note the high and low OD reading.

- Average OD = (High OD + Low OD) ÷ 2

- Ovality value = High OD-Low OD

- Ovality % = ((High OD-Low OD) ÷ High OD) × 100

Jonathan Faia
Director of Quality
Markel Corporation