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Tensile Testing of Thin-Walled Surgical Tubing | With a Long Travel Extensometer

Surgical tubing is used in a wide variety of applications, such as drains, feeding tubes, irrigation and surgical procedures, and therefore comes in many shapes and sizes. The mechanical performance of the material used is critical, as failure could seriously endanger a patient. Tensile tests are frequently performed in product development and quality control to evaluate properties of material strength and strain at break.

In this application, the specimens used were thin walled surgical tubes (outer diameter = 0.062 in, wall thickness = 0.01 in and length = 2.5 in). The tubes were manufactured with a surface coating, and after many tests performed daily for quality assurance of the product, the coating builds up on the grip faces and causes an unknown amount slipping of the specimen over time. Despite regular changing of the grip faces, this slipping is the cause for discrepancies in strain measurements between testing sites and users. An extensometer would allow for more consistent and accurate measures of strain between data sets.

Test Configuration and Sample Preparation

As shown in Figure 1, the Instron® 3345 electromechanical testing frame with a 100 lb load cell, 250 lb capacity pneumatic side action grips with 1 in x 1 in rubber-coated faces and a long travel extensometer were used to test this material. The rubber-coated faces provided enough gripping strength, friction and cushioning to prevent excessive slipping of the specimen in the grips. Further, these faces did not tear into the material as would serrated faces or increase the stress concentration under gripping pressure as would flat metallic faces.

Because the material was know to yield under tension inconsistently over the length of the specimen, the largest gauge length possible was recommended. The grips were lowered to a position that allowed at least 0.5 in of material to be gripped between each set of faces, and the arms of the extensometer were positioned in between the faces, allowing for a gauge length of 1.0 in. After automatic calibration of the extensometer, the arms were attached to the specimen as shown in Figure 2. The test was run for nine different tubing specimens at a speed of 20 in/min.

Figure 1:
The long travel extensometer was able to accurately measure strain of the tubing specimens through material break.

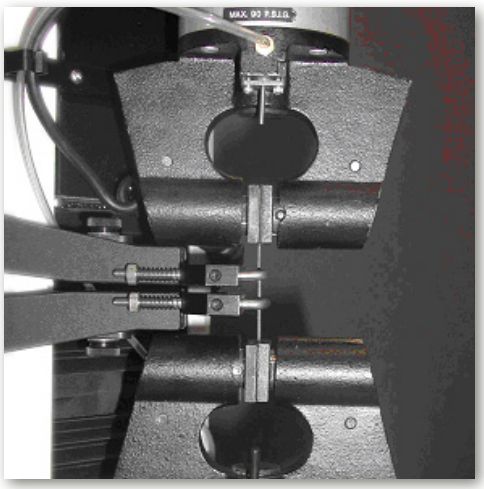

Figure 2:
Surgical tubing specimen loaded into grips with the arms of the long travel extensometer set at gauge length.

Conclusions

The graph and results show repeatability of the test configuration. Comparing these values with known material values ensures the reliability of these measurements. It can be concluded from this data that a long travel extensometer is appropriate for accurately measuring strain in thin-walled medical tubing and would be recommended for future testing applications.

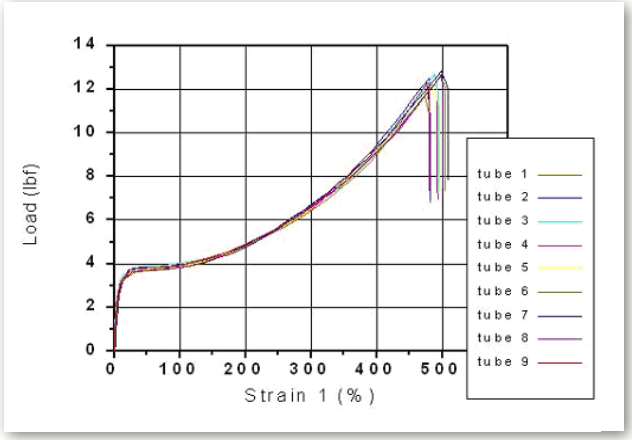

Figure 3:
Graphical results for nine surgical tubing specimens tested to failure

Sample Number	Tensile Strength	Load at Break	Extension at Break	Strain at Break	Maximum Load	Strain at Maximum Load
	psi	lbf	in	%	lbf	%
1	6561.759	10.719	4.813	481.347	11.680	472.545
2	7640.280	12.481	4.799	479.850	12.481	479.850
3	7252.015	11.847	4.929	492.868	12.701	488.951
4	7077.489	11.562	4.920	492.022	12.186	483.442
5	6903.537	11.278	4.948	494.809	12.174	483.878
6	7334.280	11.981	5.031	503.082	12.611	498.628
7	7339.240	11.990	5.088	508.764	12.837	499.174
8	7366.809	12.035	5.004	500.396	12.666	498.667
9	6915.740	11.298	4.805	480.462	12.288	476.536
Mean	7154.572	11.688	4.926	492.622	12.403	486.852
S.D.	322.931	0.528	0.105	10.451	0.359	10.094

Table 1:
Results for nine tubing specimens tested to failure

Configuration Table

Catalog Number	Configuration Options	Description
3345	Frame	Single column frame
2519-8104	Load Cell	112 lb (500 N) capacity
2712-003	Fixture	1 kN (200 lb) pneumatic side action grips
2702-107	-	25 mm x 25 mm (1 in x 1 in) rubber-coated faces
2603-084	Extensometer	Long travel extensometer
2210-869	-	Strain input module
2210-257K1	Software	MerlinTM software
2210-257C1	-	Tension application

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