GM	WORLDWIDE ENGINEERING STANDARDS	Test Procedure	GMW3010

Determination of Tensile and Elongation Properties

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. This test procedure shall be used for determining:

- Force at rupture, breaking strength
- Maximum Force, tensile strength
- Elongation at specified forces and maximum force
- Elongation at rupture, and
- Force elongation curve for textiles, Plastic Roll Goods (PRG) supported and unsupported, leathers, threads and other materials

1.2 Applicability. Textiles, plastic roll goods, leathers, threads, and other materials requiring tensile properties in their application.

1.3 Remarks. Summary of Test Procedure. A tensile load is applied to test specimen(s), using an electronic Constant Rate of Extension (CRE) tensile testing machine, until the specimen will no longer withstand an increase in force. The forces and elongations measured are recorded.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

ASTM D76	ISO 7500-1	ISO 9513

2.2 GM Standards/Specifications.

GMW3221	GMW14231

2.3 Additional References.

- Epsilon Technology Corporation, Jackson, Wyoming, U.S.A., www.epsilontech.com
- Natural Markings Book, Thierry Corporation, Royal Oak, Michigan, U.S.A., www.thierry-corp.com

3 Resources

3.1 Facilities. Laboratory.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 Apparatus for conditioning to the appropriate requirements as described in GMW3221 Code A, unless otherwise specified in the relevant material specification.

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3.2.2 Tensile Test Machine. An electronic CRE tensile testing machine is required.

A CRE type tensile testing machine is an apparatus in which one (1) pulling clamp moves at a uniform rate, and the force-measuring mechanism (load cell) moves a negligible distance with the increasing force.

The machine shall include a force indicating mechanism which will indicate (or record) continuously, the force applied to the specimen and the accompanying elongation, when needed. Specimens tested shall have maximum load values that are measured within the load cell range from which there is written documentation of verification of calibration.

Local requirements for calibration and accuracy shall be satisfied (such as ASTM D76, or ISO 7500-1 and ISO 9513, class of extensometer one (1) or better).

This mechanism shall be capable of measuring force and elongation to the tolerances specified in this test procedure, as well as the following:

- The force-measuring system, including the recording mechanism, shall have a full scale pen response time < 2 s in either direction.
- The maximum allowable error in force indication shall be ± 1% of the reading.
- The maximum allowable error in recorded grip displacement shall be ± 1% of the recorded values.
- The maximum allowable variation in nominal gage length on repeated return of the clamps to their starting position shall be < 0.25 mm.
- The maximum allowable variation of the crosshead speed of the tester from the required testing speed shall be < 4%.

3.2.2.1 Clamps with dimensions of 25 mm × 50 mm minimum with the smaller dimension parallel to the direction of travel.

3.2.2.1.1 The clamping device of the tensile testing machine shall be able to securely hold the test specimen over its width without damage.

3.2.2.1.2 When testing specimens, which could be damaged by the clamps (e.g., fibers), the test specimens shall be protected at the clamps.

3.2.3 Extensometers.

3.2.3.1 Clip or Optical Extensometers. Use an extensometer of clip on or optical design graduated in millimeters and of sufficient length to measure change in gauge length during test for most materials.

3.2.3.2 Large Gage Length Extensometer for Rectangular Specimens such as Seatbelt Webbing. Use large gage length such as extensometer model: 3543-0800-400T-ST, available from: Epsilon Technology (see 2.3) or equivalent. Gage length is 200 mm, with a total travel of 100 mm. This is an extensometer suitable for testing seat belts, allowing testing based on preload in Code T to 100 mm of crosshead travel. See Appendix A, Figure A4.

3.2.4 Cutting dies or shears for preparation of test specimens.

3.3 Test Vehicle/Test Piece. Sufficient material (textile, leather, etc.), to prepare samples sized per Appendix A, Table A1.

3.4 Test Time.

Calendar time:	1 d
Test time:	1 h
Coordination time:	1 h

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Personnel trained in accordance with the laboratory accreditation and Standard Operating Procedure requirements.

- Trained Personnel/Cutting of Material
- Trained Personnel/Tensile Testing
- Material Engineer/Evaluation of Results

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4 Procedure

4.1 Preparation.

4.1.1 Test specimens shall be taken as directed in material specification or referring documentation. If not stated, sample material as in 4.1.1.1 thru 4.1.1.4.

4.1.1.1 Fabrics.

- **Woven material:** Along a warp yarn, a weft yarn, and a 45 degree direction to both.
- **Knitted material:** Along wales, courses, and a 45 degree direction to both.

4.1.1.2 Leather. From the available material, test specimens shall be taken from various areas according to the areas defined as usable for upholstery in accordance with the appropriate Natural Markings Book (see 2.3).

The first specimen shall be cut parallel to the backbone. The last specimen shall be cut perpendicular to the backbone. Each of the five (5) specimens shall be cut so that angle = 22.5 degrees (see Figure 1).

4.1.1.3 Other Material. Cut samples in machine direction and perpendicular to machine direction. If there is no machine direction, cut samples in a chosen direction and perpendicular to the chosen direction.

4.1.1.4 Thread. Select samples at least 9 m apart on the spool.

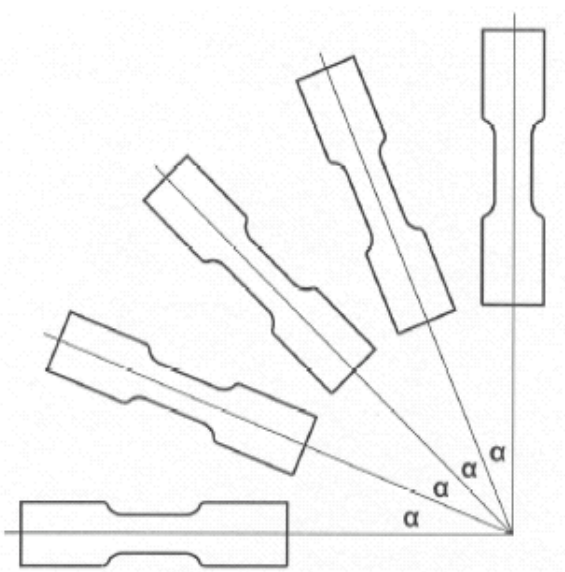

Figure 1: Sample Orientation

4.1.2 The size of the test specimen, if not specified, is to be 50 mm ± 0.5 mm × 250 mm minimum. There are two (2) acceptable ways to produce the correct sample size. The test sample can either be cut to the correct size or the material can be cut larger than required and unraveled to the correct size.

4.1.3 For each condition, a minimum of three (3) test specimens in each direction shall be prepared with the exception of leather and thread where a total of five (5) samples are to be tested.

4.1.4 Unless otherwise specified in the relevant material specification, condition specimens for a minimum of 24 h to the requirements of GMW3221 Code A prior to testing.

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

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