MULTIDISCIPLINARY SENIOR DESIGN PROJECT
GE 498
COLLEGE OF ENGINEERING
VALPARAISO UNIVERSITY
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System Design Requirements for Biaxial Tensile Tester

TEAM TENSILE TESTER
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Revisions (initials in columns indicate approval of revision)						
Letter	Date	Revisor	Advisor	Customer	Team Leader	Reason for Revision
A	9/7	Team	GH	BL	MS	1st revision
B	9/7	Team	GH	BL	MS	Fix requirements
C	9/16	Team	GH	BL	MS	Professor/Customer
D	11/9	Team	GH	BL	MS	Specification Adjust.
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Honor Code Statement

I have neither given or received, nor have I tolerated other's use of unauthorized aid.

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Goal Statement

The Biaxial Tensile Tester is a device that will test and record the strength of skin, organs and other organic tissues while pulling on the tissue simultaneously in two orthogonal directions.

Objectives

In order to achieve success, the system shall

1. Be able to pull tissue with the same velocity from all 4 sides simultaneously
2. Be able to measure and record the force and displacement
3. Be able to be set up easily and operated safely
4. Be lightweight and portable

System Requirements

1. TEST REQUIREMENTS

    1.1 The tissue sample shall be suspended in the air or a fluid during the test to avoid friction on a surface that would distort the measurements.
    1.2 The system shall apply 0.1 Newtons (in tension) to remove slack from the specimen and threads (if using) before deforming the tissue
    1.3 The data shall be zeroed after the slack is removed.
    1.4 The system shall deform tissue in 2 orthogonal directions simultaneously, where the angle between the two directions is within 1 degree of 90.
    1.5 The tissue shall deform at a constant velocity of 50 +/- 0.1 mm/min in both the x axis and the y axis, which are two orthogonal directions in the horizontal plane.
    1.6 The system shall maintain an even distribution of forces across each edge of the tissue every 0.1 to 0.5 +/- 0.1 cm each side.
    1.7 The system shall be able to apply at least 80 Newtons (in tension) of force in both the x direction and the y direction.
    1.8 The initial size of the specimen shall be between 1 cm by 1 cm and 4 cm by 4 cm.
    1.9 The maximum positive displacement in both the x and y direction shall be at least 6 cm.

2. DATA REQUIREMENTS

   2.1 The system shall record the actual forces applied within +/- 0.1 Newtons in the x direction and in the y direction.
   2.2 The system shall record the displacement of the tissue within +/- 0.2 mm in the x direction and in the y direction.
   2.3 The data shall be exported to a spreadsheet on a computer, SD card, or flash drive.

3. SAFETY AND EASE OF OPERATION REQUIREMENTS

   3.1 [1] The electronics shall have an IPX-1 rating.
   3.2 The system shall have a start and stop button for collecting data.
   3.3 The system shall have an emergency stop function.
   3.4 An untrained student shall be able to learn how to set up the device and perform tests after 30-60 minutes of training.

4. PORTABILITY REQUIREMENTS

   4.1 The system footprint shall be smaller than 3x3ft
   4.2 The system shall not exceed 6 feet in the vertical direction.
   4.3 The system shall be powered by a 110V wall outlet.

Desired Criteria

   5.1 The velocity may be adjusted to 20 mm/min in the x and y axis.
   5.2 The velocity may be adjusted to 100 mm/min in the x and y axis.
   5.3 The velocity may be adjusted to a constant velocity entered by the user (mm/min) in the x and y axis.
   5.4 The system may include a fluid bath around the specimen at a temperature of 37 degrees C.
   5.5 The system may record displacement with a camera above, where the frames are synchronized with the force data.

Works Cited

[1] Alam, Noor, 2020, “IPX WaterProof Rating” [Online] Available: https://speakersmag.com/ipx-waterproof-rating-ipx4-ipx5-ipx6-ipx7-ipx8-ratings [Accessed: 7-September-2021]