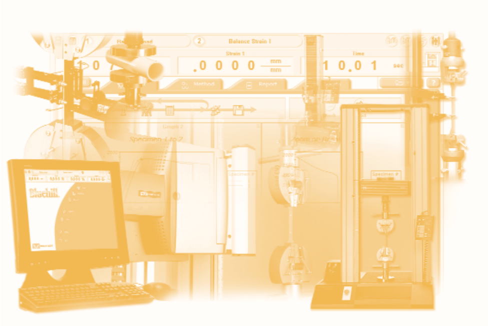


Calculation of Poisson's Ratio for Foam Used in Space Shuttle Construction

Application Report

Introduction

Characterization of the mechanical properties of materials used in space flight is at the forefront of research and development activities for NASA. One such test required the calculation of Poisson's Ratio, a measure of a material's compressibility, on foam material used in the construction of space shuttles. Eleven foam specimens were tested to investigate the capabilities of the Advanced Video Extensometer (AVE) to accurately measure axial and transverse strain and calculation of Poisson's Ratio. They were tested according to ASTM D 1623, standard test method for tensile and tensile adhesion properties of rigid cellular materials with a custom fixture designed specifically for the application.

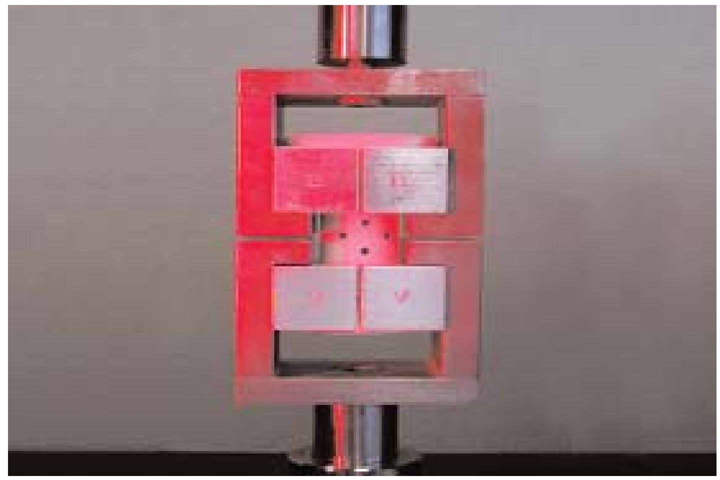


Figure 1:
Type A specimen in fixture with four black marks for measurement of axial and transverse strain using the AVE.

Test Configuration

An Instron® 5582 universal testing system configured with a 1 kN load cell, a self-aligning fixture designed accommodate Type A foam specimens, and the AVE with a 60 mm FOV lens. The foam specimens were cylindrical at the gauge area with and increasing diameter towards the gripped ends. A black paint pen was used to draw four circular dots, marking the axial and transverse gauge areas, as shown in Figure 1. A test speed of 1.3 mm/min was used and the calculations were made using the Bluehill® software.

Results

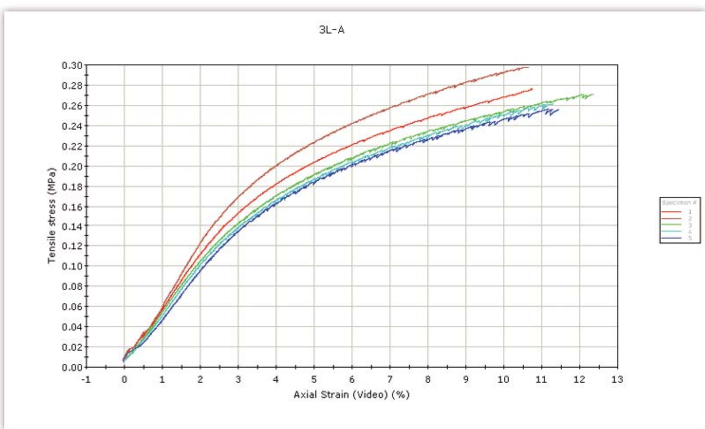


Figure 2:
Tensile stress vs. axial strain for foam Sample #1.

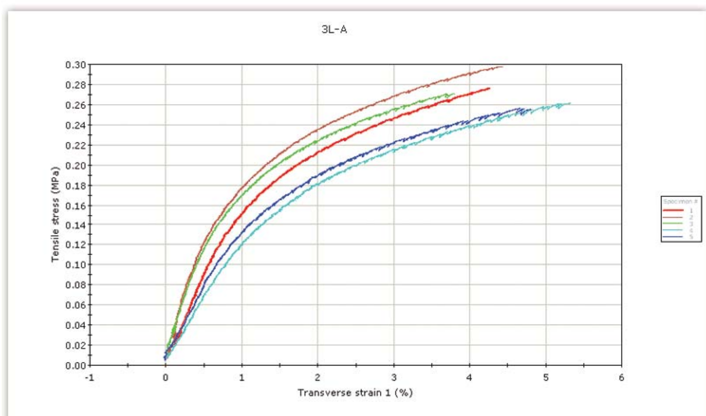
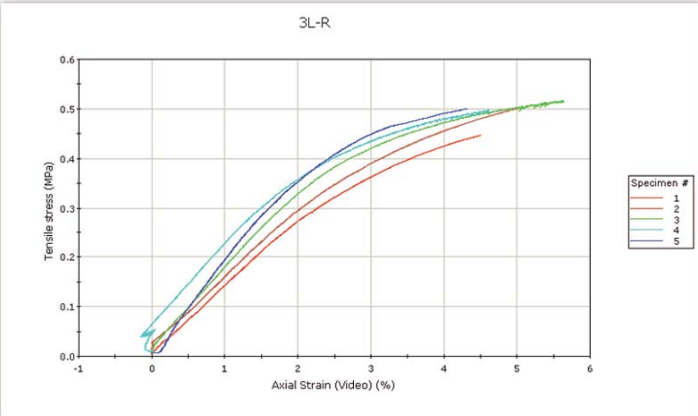


Figure 3:
Tensile stress vs. transverse strain for foam Sample #1.

Specimen Number	Maximum Load (lbf)	Tensile Stress at Max Load (psi)	Axial Strain (Video) at Max Load (in/in)	Transverse Strain (Video) at Max Load (in/in)	Modulus (Mpa)	Poisson's Ratio (Chord)
3L-A11	40.068	40.059	0.107	0.043	5.474	0.346
3L-A21	43.242	43.195	0.106	0.044	6.398	0.308
3L-A31	39.934	39.331	0.124	0.038	4.872	0.261
3L-A41	38.010	37.934	0.113	0.053	4.775	0.431
3L-A51	36.806	37.159	0.112	0.047	4.655	0.357

Table 1:
Summary of results for foam Sample #1.

Results



▲
Figure 4:
Tensile stress vs. axial strain for foam Sample #2.

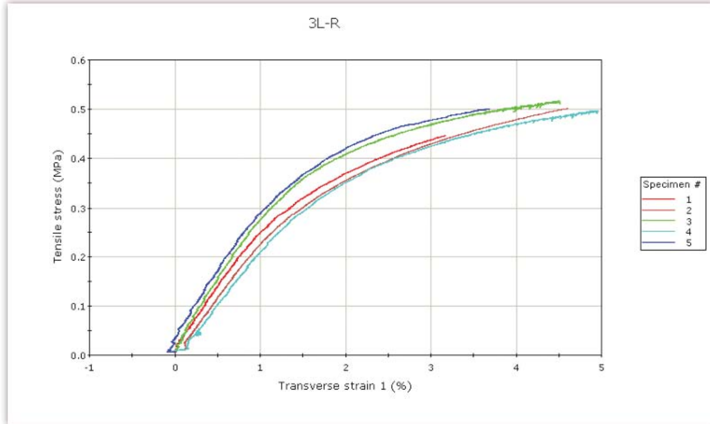


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Figure 5:
Tensile stress vs. transverse strain for foam Sample #2.

Specimen Number	Maximum Load (lbf)	Tensile Stress at Max Load (psi)	Axial Strain (Video) at Max Load (in/in)	Transverse Strain (Video) at Max Load (in/in)	Modulus (Mpa)	Poisson's Ratio (Chord)
3L-R6	64.673	64.774	0.045	0.032	12.900	0.713
3L-R7	72.763	72.812	0.050	0.046	13.828	0.826
3L-R8	74.579	74.961	0.056	0.045	15.866	0.724
3L-R9	72.150	72.134	0.046	0.050	15.921	0.926
3L-R10	71.955	72.581	0.043	0.037	18.569	0.819

▲
Table 2:
Summary of results for foam Sample #2

Configuration Table

Catalog Number	Configuration Options	Description
5582	Frame	Dual column machine
2519-105	Load cell	1 kN (200 lb) capacity
–	Fixtures	Type A grips (customer supplied)
2410-270	Software	Bluehill®

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