10º off-axis test for in-plane shear strength measurement

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M.-J. Pindera, C. Herakovich, Shear characterization of unidirectional composites with the off-axis tensile test, Experimental Mechanics, 26 (1986) 103-112

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Mechanical analysis

- Real boundary conditions (T300/914 C/E UD)

F/A Normalized longitudinal stress $\sigma_{xx}$
Oblique tabs


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Experimental validation – grid method


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Experimental validation - displacements

10° OFF-AXIS TENSILE TEST ON CARBON/EPOXY

- No tabs
- Straight glass/epoxy tabs
- Oblique tabs

Longitudinal displacement in microns

- < à 0,00
- 0,00 à 4,28
- 4,28 à 8,56
- 8,56 à 12,84
- 12,84 à 17,12
- 17,12 à 21,40
- 21,40 à 25,68
- 25,68 à 29,96
- 29,96 à 34,24
- 34,24 à 38,52
- 38,52 à 42,80
- 42,80 à 47,08
- 47,08 à 51,36
- 51,36 à 55,64
- 55,64 à 59,92
- > à 59,92
Experimental validation - displacements

Comparison of strain fields:
Off-axis tensile test, unidirectional glass/epoxy
Different end conditions

Fibre direction

Microstrains

No end-tabs

[±45]_s glass/epoxy end-tabs

Oblique end-tabs
Failure

Mean fracture shear stress: 66 MPa

Mean fracture shear stress: 78 MPa


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Shear failure stress (MPa)
Not pure shear

- In the materials axes (normalized by F/A)
  \[ \sigma_{11} = 0.96; \sigma_{22} = 0.04; \sigma_{12} = -0.17 \]
  23% of the shear stress

- Need for a failure model
  - In [1], Tsai-Wu was used

\[ \sigma_{22} = -0.3; \sigma_{12} = -1.02 \]
  29%

- Io sipescu 0º shear test

\[ \sigma_{11} = 0.96; \sigma_{22} = 0.04; \sigma_{12} = -0.17 \]

78 MPa shear fracture stress \[\rightarrow\] 95 MPa shear strength

122 MPa shear fracture stress \[\rightarrow\] 98 MPa shear strength


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