Evaluation of Multiaxial Fatigue Models for Ti-6Al-4V

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Background

Ti-6Al-4V is commonly used in turbine engines.

Multiaxial fatigue is a design consideration for turbine engines.

AFRL recently purchased the MTS 809 Axial-Torsional Test System.

This test system produces reliable multiaxial fatigue data, which can be used to evaluate multiaxial fatigue life prediction models.

Testing

Axial fatigue tests were completed in a previous project.

Torsional fatigue tests used polished torsional fatigue specimens.

Torsional fatigue specimens were subjected to cyclic shear stress in MTS 809 until they fractured.

Modeling

Findley Model

\[ \text{Findley Parameter} = \frac{\Delta \tau}{2} + k \sigma_{\text{max}} \]

Sines Model

\[ \text{Goodman Parameter} = \sigma_a \left( \frac{S_y}{S_u - \sigma_m} \right) \]

SWT Parameter

\[ \text{SWT Parameter} = \sqrt{\sigma_a (\sigma_a + \sigma_m)} \]

Evaluation of Models

Fractography

SEM images of the fracture surface confirm that fracture did not occur due to a stress concentration or surface defect.