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Data Article

Cyclic deformation and fatigue data for Ti–6Al–4V ELI under variable amplitude loading

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A R T I C L E I N F O

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A B S T R A C T

This article presents the strain-based experimental data for Ti–6Al–4V ELI under non-constant amplitude cyclic loading. Uniaxial strain-controlled fatigue experiments were conducted under three different loading conditions, including two-level block loading (i.e. high-low and low-high), periodic overload, and variable amplitude loading. Tests were performed under fully-reversed, and mean strain/stress conditions. For each test conducted, two sets of data were collected; the cyclic stress–strain response (i.e. hysteresis loops) in $\log_{10}$ increments, and the peak and valley values of stress and strain for each cycle. Residual fatigue lives are reported for tests with two-level block loading, while for periodic overload and variable amplitude experiments, fatigue lives are reported in terms of number of blocks to failure.

Specifications Table

Subject area	Engineering
More specific subject area	Fatigue of Metals
Type of data	Table (Microsoft Excel file format)

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How data was acquired	Strain-controlled fatigue experiments (laboratory)
Data format	Raw and analyzed
Experimental factors	The material used was mill-annealed wrought Ti–6Al–4V ELI bar, manufactured in compliance with ASTM standard F136-13 [1]. Cylindrical fatigue specimens with uniform gage section were designed following ASTM standard E606/E606M-12 [2]. The specimens were polished to achieve 0.5 μm surface finish in the gage section. Three coats of acrylic M-coat D were applied on the gage section to protect the specimens surface from the extensometer blades during testing.
Experimental features	Strain-controlled fatigue experiments were conducted following ASTM E606/E606M-12 [2]. All fatigue tests were conducted at room temperature (~23 °C), and 38% relative humidity. The applied test frequencies were adjusted to minimize any strain rate effects on the test results.
Data source location	Center for Advanced Vehicular Systems (CAVS), Mississippi State University, MS, USA
Data accessibility	https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/SUCU5X

Value of the data

- Fatigue damage in most applications is commonly caused by variable and complex loadings. In some applications such as aerospace and biomedical, where Ti–6Al–4V ELI has been widely used as a structural material, understanding the fatigue behavior of the material is extremely important since majority of failures in structural components are attributed to fatigue damage.
- The presented data offers a representation of Ti–6Al–4V ELI mechanical behavior in a controlled environment, thus contributing to the fundamental knowledge about this structural material. The data is also valuable as a baseline for other special applications (i.e. additive manufactured medical implants and aerospace components), or to compare with newly developed/improved materials.
- The data presented in this article can be used for fatigue behavior and cyclic deformation related research on Ti–6Al–4V ELI under more realistic loading conditions. This data can be used to develop/calibrate constitutive models, cumulative fatigue damage models, and cycle counting methods.

1. Data

Strain-controlled block loading (i.e. high-low (H-L), low-high (L-H)), periodic overloading (PO), and variable amplitude (VA) fatigue data of Ti–6Al–4V ELI (a titanium alloy) is presented in this article. H-L, L-H, and PO experiments were conducted using fully-reversed ($R_\varepsilon = -1$), and pulsating

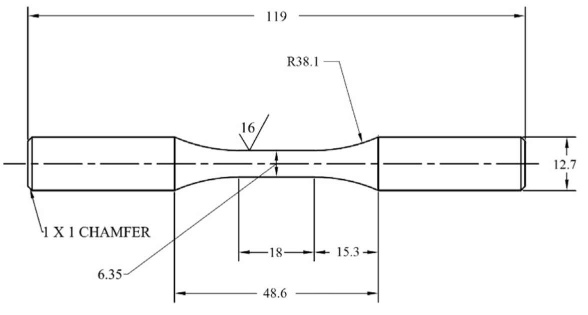

Fig. 1. Geometry and dimensions of round fatigue specimens with uniform gage section per ASTM standard E606/E606M-12 [2,3]. All dimensions are presented in mm.