NCAMP-DRAM

National Center for Advanced Material Performance
Defense Rapid Advanced Manufacturing

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NCAMP-DRAM Additive Material Specification

This specification is generated and maintained in accordance with NCAMP-DRAM Standard Operating Procedures

Standard Specification for Additive Manufacturing Low Cycle Fatigue Testing with As-Printed Surfaces

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1. Scope

This standard is intended to be used in conjunction with ASTM E606. It defines the additively manufactured as-printed surface low cycle fatigue testing specific methods not addressed within the scope of ASTM E606.

2. Applicable Documents

The following documents are used as reference materials for this program. The user shall use the most recent revision of these documents unless a specific document revision is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

Document No.	Document Title
ASTM E606	Standard Test Method for Strain-Controlled Fatigue Testing
ASTM E8	Standard Test Methods for Tension Testing of Metallic Materials

3. Abbreviations and Acronyms

LCF	Low Cycle Fatigue

4. Technical Requirements

4.1. Printed Net Shape E606 Specimens

When the impact of the as-printed surface finish is required, E606 net shape specimens must be produced. Typically these are printed in the vertical (parallel to the build) direction. A nominal E606 Figure 1(a) diameter (d) of 0.25 inch should be used.

4.2. Printed Specimens to Include Downward Facing Surface

Downward facing surface features can be evaluated using a modification to the E606 specimen. It is typical that these are produced in the horizontal (perpendicular to the build) direction. The E606 Figure 1(a) geometry modification is a 0.10 through hole along the axis of the specimen with an outside diameter (d) of 0.35 inch. The center hole shall remain as-printed and will not be circular due to sagging downward facing surface. The outside diameter shall be machined to a maximum Ra surface finish of 8 micro inch.

4.3. Cross Sectional Area Determination.

Determination of the true cross-sectional area is difficult due to the surface condition of the as-printed specimens. Therefore, a calculated effective area will be determined using an E8 reference coupon. The effective area is defined as the area of material which is carrying load through the gage section of the specimen. The E8 coupon shall be printed in the same direction (axis parallel) as the E606 coupon. Reference Figure 1.

Using elastic data:

Effective cross-sectional area: $\boldsymbol{A_{E606}} = A_{E8}\frac{F_{E606}\times\varepsilon_{E8}}{F_{E8}\times\varepsilon_{E606}}$

A = Area
F = Force
ε = strain

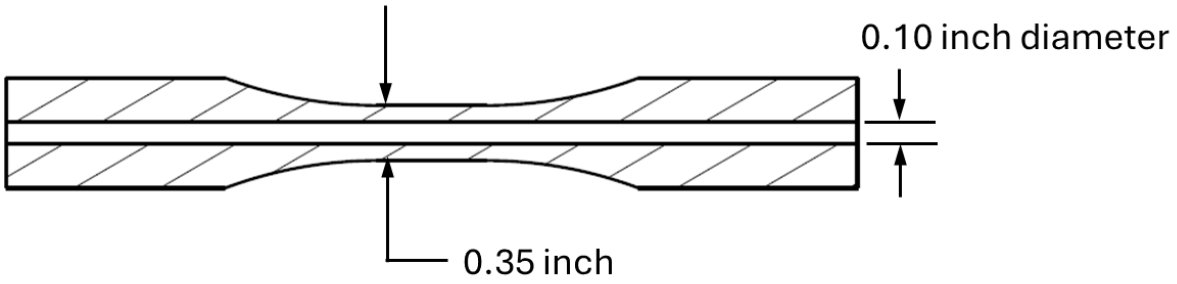

Figure 1 – Horizontal E606 coupon with as-printed center hole.