



AEROSPACE MATERIAL SPECIFICATION

AMS2546™**REV. A**

Issued 2004-08
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Revised 2020-05

Superseding AMS2546

(R) Laser Peening

RATIONALE

AMS2546A is a general revision resulting from a Five-Year Review and update of this specification.

NOTICE

ORDERING INFORMATION: The following information shall be provided to the plating processor by the purchaser.

1. Purchase order shall specify not less than the following:

- AMS2546A
- Part number
- Quantity of parts
- Material and condition
- Peening and transition zones (3.1.1)
- Laser peening process effect (3.1.2)
- Alternative method to 3.3.1 if required
- Optional: Opaque processing overlay (3.2.4)

2. Parts manufacturing operations such as heat treating, forming, joining, NDI and media finishing can affect the condition of the substrate for laser peening, or if performed after laser peening, could adversely affect the peened part. Specifically, all machining of areas to be laser peened shall be completed, all fillets shall be properly formed, and all burrs and sharp edges shall be removed. The sequencing of these types of operations should be specified by the cognizant engineering organization or purchaser and is not controlled by this specification.

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Full document details: SAE AMS2546A

For more information on this standard, visit
<https://www.sae.org/standards/content/AMS2546A>

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1. SCOPE

1.1 Purpose

This specification covers the requirements for computer-controlled laser peening of metal part surfaces to induce residual compressive stresses at and beneath the surface.

1.2 Application

Laser peening is utilized to induce compressive residual stresses at and beneath the surface of metal parts to depths of 0.040 inch (1 mm) and greater depending on the metal properties and the laser peening processing parameters. These residual stresses can provide improved fatigue life and stress corrosion resistance as well as forming and correction of distortion, although usage is not limited to such applications.

1.3 Safety-Hazardous Materials

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue 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.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

ARP1917 Clarification of Terms Used in Aerospace Metals Specifications

SAE J442 Test Strip, Holder and Gage for Shot Peening

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM E18 Rockwell Hardness of Metallic Materials

ASTM E140 Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness

2.3 ANSI Accredited Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ANSI Z1.4 Sampling Procedures and Tables for Inspection by Attributes

3. TECHNICAL REQUIREMENTS

3.1 Designation of Laser Peening Requirements

- 3.1.1 The zone (area) on the part to be laser peened and the transition zone separating the area not to be laser peened shall be identified on the engineering drawing (see 8.2.1). Alternatively, the zone on the part to be laser peened can be designated with a tolerance rather than explicitly depicting a transition zone.
- 3.1.2 The engineering drawing shall specify the required effect of the laser peening process on the part by the following method or by an alternative method acceptable to the cognizant engineering organization:
 - 3.1.2.1 By reference to a desired reading to be achieved on a process verification gauge (such as the deflection of an Almen strip) when specified laser peening parameters are utilized on the process verification gauge. The laser spot size (but not pulse energy or pulse width) and coverage for Almen strips may be different from those used on the actual part to optimize the Almen strip response and reduce the impact of measurement system variability. Example 1: Spot size may be reduced on an Almen strip to achieve a measurable deflection when low irradiance is to be used in production, such as with aluminum parts. Example 2: Coverage may be reduced to 1 layer on an Almen strip when several layers are used in production, such as with very thick parts.

3.2 Equipment and Materials

- 3.2.1 The laser peening machine shall provide a means of generating a shock wave in a consistent and controlled manner on the surface of the part to be laser peened. The machine shall also provide a means of precisely moving the part or the laser spot on the part to achieve the required laser peening coverage.
 - 3.2.1.1 Positioning of the part (or the laser beam spot) shall be controlled to a tolerance of ± 0.020 inch (± 0.5 mm) unless otherwise specified by the cognizant engineering organization.
- 3.2.2 The laser beam quality shall be capable of being measured and documented on a periodic basis to be approved by the cognizant engineering organization. The laser beam quality may include energy, temporal profile, and/or spatial profile.
- 3.2.3 Machine preventative maintenance and verification of 3.2.1.1, 3.3.4.1, and 3.3.4.2, shall be performed at least annually. A record of maintenance and results of verification shall be maintained. Verification as noted in this section is relative to the general tolerances noted and is not intended to require part specific verification for each component that is qualified for the equipment noted.
- 3.2.4 Processing Overlays

If specified, an opaque processing overlay (e.g., paint or tape) shall be applied to the surface of the metal part to be laser peened. The opaque overlay is used for absorption of the laser energy and subsequent generation of the shock wave. The specific overlay to be used shall be approved by the cognizant engineering organization and identified in the processor's work instructions.

- 3.2.4.1 Only opaque processing overlays containing less than 30 ppm halogenated compounds shall be used on titanium alloys, unless otherwise accepted by the cognizant engineering organization. Product documentation or cognizant engineering organization approval of the specific overlay material is sufficient when certifications are not available from the material supplier.
- 3.2.4.2 A transparent overlay (e.g., water or other optically transparent material) shall be applied to the surface of the opaque overlay or to the part surface if peening without an opaque overlay is specified, during the laser peen process. This overlay is required to generate and direct the high-pressure shock wave into the component surface.