



AEROSPACE MATERIAL SPECIFICATION

AMS2453™**REV. A**

Issued 2010-08
Reaffirmed 2015-11
Revised 2022-09

Superseding AMS2453

Low Stress Grinding of Steel Parts Heat Treated to 180 ksi or Over,
and Low Stress Grinding of Chrome Plating Applied to Steel Parts
Heat Treated to 180 ksi or Over

RATIONALE

AMS2453A is the result of the need to clarify etch inspection (3.3.6) requirements within the document. Formatting updates have also been performed.

1. SCOPE

1.1 Purpose

The purpose of this specification is to establish requirements of a grinding method and to provide grinding parameters that will eliminate or minimize overheating, cracking, high residual tensile stresses, and/or other metallurgical changes that decrease structural integrity of steel parts or chrome plated steel parts (see 8.3). This standard establishes requirements for low stress grinding of martensitic high strength steel heat-treated to 180 ksi (1241 MPa) minimum ultimate tensile strength (UTS) and above, and requirements for low stress grinding of chromium plating applied to such high strength steel.

1.2 Application

This process has been used typically to grind chrome plating on high strength steel and high strength steel parts heat treated to 180 ksi (1241 MPa) ultimate tensile strength and above for applications requiring wear, heat, and corrosion resistance or dimensional restoration, such as aircraft landing gear and hydraulic actuator components. However, usage is not limited to such applications (see 8.3).

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 that 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.

SAE Executive Standards Committee Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2022 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
http://www.sae.org

SAE WEB ADDRESS:

Full document details: SAE AMS2453A

For more information on this standard, visit
<https://www.sae.org/standards/content/AMS2453A/>

Documents

Document Sharing Hub

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.

AMS2440	Inspection of Ground, Chromium Plated Steel Parts
AMS2442	Magnetic Particle Acceptance Criteria for Parts
AMS2649	Etch Inspection of High Strength Steel Parts
AMS2759	Heat Treatment of Steel Parts, General Requirements
AMS2759/1	Heat Treatment of Carbon and Low-Alloy Steel Parts, Minimum Tensile Strength Below 220 ksi (1517 MPa)
AMS2759/2	Heat Treatment of Low-Alloy Steel Parts, Minimum Tensile Strength 220 ksi (1517 MPa) and Higher
AMS2759/9	Hydrogen Embrittlement Relief (Baking) of Steel Parts
AMS2759/11	Stress Relief of Steel Parts
ARP4462	Barkhausen Noise Inspection for Detecting Grinding Burns in High Strength Steel Parts
AS7766	Terms Used in Aerospace Metals Specifications

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 B214	Sieve Analysis of Metal Powders
ASTM E1444	Magnetic Particle Testing

2.3 ANSI Accredited Publications

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

ANSI B7.1	Safety Requirements for the Use, Care and Protection of Abrasive Wheels
ANSI B74.13	Markings for Identifying Grinding Wheels and Other Bonded Abrasives

2.4 Department of Defense Publications

Available from the Document Automation and Production Service (DAPS), Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6257, <https://assist.daps.dla.mil/quicksearch/>.

MIL-STD-866	Grinding of Chrome Plated Steel and Steel Parts Heat Treated to 180,000 PSI or Over
MIL-STD-867	Temper Etch Inspection

2.5 Definitions

Terms used in AMS are defined in AS7766 and as follows:

2.5.1 BALANCE (DYNAMIC)

Dynamic balance is the balancing of the complete rotating assembly; grinding wheel, mounting arbor, and the machine spindle. Depending on the balancing machine, the balance condition is measured and corrected at wheel speed.

2.5.2 BALANCE (STATIC)

Static balance is the balance of the grinding wheel mounted on an arbor, typically balanced on a pair of knife-edges.

2.5.3 BARKHAUSEN NOISE ("ROLLSCAN") INSPECTION (BNI)

Barkhausen noise inspection detects changes in magnetic domains within the material when subjected to an alternating magnetic field, applied by a probe at the surface. This technique is very sensitive to localized changes in microstructure and residual stress gradients. BNI is primarily used for nondestructive testing of heat treated, high strength low-alloy steel parts that have been ground, in accordance with MIL-STD-866, commercial standard, or this specification, before or after chromium plating. This test method may be used as an independent test or to confirm grinding damage detected in accordance with AMS2440 or MIL-STD-867/AMS2649 of bare unplated components.

2.5.4 COOLANT

Coolant is a fluid that is directed onto the workpiece and tool to dissipate heat, to provide lubrication for the cutting process (machining process), and to carry away chips and debris from the cutting zone. Coolant is the industry standard term used to describe water-based cutting fluids. The coolant (cutting fluid) not only cools; it also lubricates and washes away chips and debris.

2.5.5 CUTTING FLUID

Cutting fluid is the fluid used to cool, lubricate, and wash clean a machining process. Cutting fluids may be oils, soluble oils, or water-based synthetic. Oil based products are commonly referred to as cutting fluids. The industry standard and widely accepted term commonly used to describe water-based cutting fluids is coolant.

2.5.6 DRESSING

Dressing is the process of removing bond material from around the cutting grains or diamonds in order to expose new, sharp cutting edges and to provide chip clearance for the material removal process.

2.5.7 GRADE

The grade of a grinding wheel usually refers to the hardness of the bond system. This is determined by the size, type, and amount of filler materials incorporated in the plastic binder material. For the standard code for grinding wheel grades, refer to ANSI B74.13.

2.5.8 GRAIN SIZE

The grain size refers to a number that corresponds to the U.S. standard wire mesh size screen used for sizing the abrasive grain. This size is also defined by average particle diameter in accordance with ASTM B214.

2.5.9 GRIT SIZE

Another term for abrasive grain size.

2.5.10 HIGH STRENGTH STEEL

The term "high strength steel" as used in this specification includes low alloy steels, alloy steels, carburizing steels, and tool steels heat treated to an ultimate tensile strength of 180 ksi or higher.

2.5.11 HIGH STRENGTH STAINLESS STEELS

The term “high strength stainless steel,” as used in this specification, covers all of the 400 series martensitic stainless steels and all of the precipitation hardening stainless steels, e.g., Type 15-5PH, 17-4PH, and PH13-8Mo.

2.5.12 IN-FEED

The in-feed or down-feed is the feed motion of the grinding wheel into the workpiece.

2.5.13 LOW STRESS GRINDING (LSG)

A special combination of grinding parameters that reduces the heat shock and plastic deformation inherent in grinding operations and promotes the production of defect-free, high-integrity workpiece surfaces. LSG minimizes metallurgical change in the near-surface of the part that could be caused from sudden heating above critical temperatures of the hardening heat treatment or of detrimental changes to the controlled residual stress pattern (e.g., shot peened condition underneath chrome plating) imparted by conventional or other grinding methods.

2.5.14 LOW STRESSED SURFACE

A low stressed surface is one containing a residual stress less than 20 ksi (138 MPa) or 10% of the yield strength, whichever is lower, at depths greater than 0.001 inch (0.025 mm) below the surface.

2.5.15 RESIDUAL STRESS

Residual stress is defined as those stresses that remain in a material after all externally applied stresses or influences have been removed.

2.5.16 SPARK-OUT

This is the grinding of a workpiece at the end of the stock removal cycle without engaging any further down-feed (in-feed). The grinding forces are allowed to subside with time, ensuring a precision surface.

2.5.17 SURFACE FINISH

Surface finish is the smoothness of the machining marks and the resulting topography on the surface of a workpiece. Surface finish is measured by moving a precision stylus across the surface and measuring the amplitude of the fluctuations of the stylus.

2.5.18 SWARF

Swarf is the mass of chips and debris remaining after a grinding process.

2.5.19 THERMAL DAMAGE

Thermal damage is a sudden overheating (locally) that causes a change in metallurgical microstructure of the near-surface (e.g., over-tempering, over-aging, phase change) of the part being ground. The result is a local change in the steel properties of strength, ductility, and fracture toughness. Thermal damage is referred to as a “burn” event in the steel near-surface (or beneath the chrome plating). A local burn area in the steel substrate is subject to crack formation subsequently followed by sudden fracture of the part (at a later time after grinding) when operating in service under design stresses. Causing a burn must be prevented by careful attention in all stages of grinding and by doing so can avoid, at a later time, sudden catastrophic failure of the steel part (or chrome plated steel part).

2.5.20 TRUING

Truing is the process of forming the grinding wheel cutting surfaces so that they are the correct geometrical shape for the application and to eliminate runout (i.e., ensure that the grinding wheel is rotating concentric to the center line of the spindle).