



AEROSPACE MATERIAL SPECIFICATION

AMS2453™

Issued 2010-08
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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

AMS2453 has been reaffirmed to comply with the SAE five-year review policy.

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 8.2). 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.

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Documents
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2.1 SAE Publications

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

AMS2440	Inspection of Ground, Chromium Plated Steel Parts
AMS2442	Magnetic Particle Acceptance Criteria for Parts
AMS2644	Inspection Materials, Penetrant
AMS2649	Etch Inspection of High Strength Steel Parts
AMS2759, /1, /2, /9, /11	Heat Treatment of Steel Parts
ARP4462	Barkhausen Noise Inspection for Detecting Grinding Burns in High Strength Steel Parts

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 E 1417	Liquid Penetrant Testing
ASTM E 1444	Magnetic Particle Testing
ASTM B 214	Sieve Analysis of Metal Powders (See 8.5.7)

2.3 ANSI Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.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, <http://assist.daps.dla.mil/quicksearch/>.

MIL-STD-867	Temper Etch Inspection
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3. TECHNICAL REQUIREMENTS

3.1 Materials and Equipment

3.1.1 Materials

3.1.1.1 Cutting Fluids (Coolants)

A suitable cutting fluid that does not have an adverse effect on the part being ground shall be used.

3.1.1.2 Grinding Wheels

Grinding wheels shall be labeled with the complete grinding wheel specification including abrasive type, grit size, grade, structure, bond type, and maximum operating speed in accordance with ANSI B74.13. Unless otherwise specified, aluminum oxide vitrified bonded, grinding wheels shall be used. Care and protection of grinding wheels, including proper storage, handling and mounting, shall be in accordance with ANSI B7.1.

3.1.2 Equipment

3.1.2.1 Grinding Equipment

Grinding equipment shall be capable of maintaining grinding speed, work speed (spindle or traverse), cross feed and down feed in increments necessary to avoid surface degradation of the part. Provisions shall be made to supply a constant application of cutting fluid (coolant) to the working surface of the wheel at the grinding zone interface. Unless otherwise specified, a filter mesh size of 40 microns or better shall be used. A coolant nozzle sufficiently wide to flood the entire width of the grinding wheel shall be used. Unless otherwise specified, coolant supply equipment for grinding shall be capable of continuously supplying coolant to the work piece at a minimum rate of 2 gallons per minute per inch (4 liters per minute per 25.4 mm) of wheel width. The equipment shall be capable of gravity separation of contaminants from coolant before recirculation, or a suitable continuous filter shall be provided to minimize recirculation of grinding residue and swarf. Coolant supply flow rates less than the minimum specified above shall be acceptable for use provided the requirements of 3.4 are met.

3.1.2.2 Furnaces

Furnaces (ovens) shall be controlled in accordance with AMS2759 as applicable when used for baking (/9) and stress relieving (/2 or /1 or /11).

3.2 Processing

3.2.1 Cleaning

Protective coatings (other than chrome plating) and other foreign materials shall be removed from parts prior to grinding to preclude contamination of cutting fluids and wheels. Cutting fluids (coolant) and grinding residuals that have a deleterious effect on the part shall be removed after grinding. Cleaning materials shall not corrode or otherwise degrade the surface of the part. Where process delay time is such that corrosion might occur, parts shall be adequately protected after cleaning.

3.2.2 Grinding Process Control

3.2.2.1 For a list of representative alloys that require low stress grinding see Table 1. Parts made from steels other than those specified in Table 1, or parts heat treated to less than 180 ksi (i.e., AISI 4130 HT to 125 ksi (862 MPa)) may be ground in accordance with the applicable requirements using processing parameters listed in Tables 2 or 3, or other processing parameters recommended by the material producer, unless otherwise specified by purchaser. The grinding process shall be performed in accordance with Tables 2 or 3, as applicable, and Figure 1 or equivalent, to result in metallurgically sound parts. All feeds, speeds, and stock removal parameters are actual and not necessarily machine or indicator readings (See 8.4.5). Prior to grinding, clean all surfaces to be ground in accordance with 3.2.1. Prior to grinding, locate high spots on chrome plating in order to avoid accidental or excessive infeed during the grinding process. Caution should be exercised when grinding chrome plate since it is possible to cause damage in the substrate (See 8.2). Damage is difficult to detect through the chrome plate.

- 3.2.2.2 The processor shall maintain in-house documents designed to establish control of the grinding process and inspection procedures used (grinding process control sheets, part-specific inspection technique sheets, etc.) to assure that parts produced are within acceptable design criteria. Grinding process control shall be documented and shall be used for processing of parts. Grinding Process Control Sheet (Figure 1) provides an example for process control documentation. The processor shall be able to demonstrate that they are applying such controls. In-house control documents are those documents used by each processor to control part configuration and quality. They include engineering drawings, engineering process specifications, process orders, manufacturing process specifications, inspection procedures, grinding process control sheets, part-specific inspection technique sheets, and any other documents designed to control manufacturing and inspection techniques. Such documents are to be based upon proven techniques (See 3.4).
- 3.2.2.3 Practices defined in this specification are not intended to restrict the processor from developing technology or methodology other than described herein provided the resulting part meets prescribed criteria (See 3.4) when approved by Cognizant Engineering Organization.
- 3.2.2.4 Balance the grinding wheel assembly at the time the wheel is mounted. If the grinding wheel remains on the machine arbor it will not need to be balanced again. If the grinding wheel is removed from the machine/arbor it shall be re-balanced at the next mounting. True the wheel face so that it is geometrically correct for the application and runs concentric with the centerline of the arbor assembly.
- 3.2.2.5 Flood the entire width of the grinding wheel at the wheel-work interface with a clean continuous flow of cutting fluid. Coolant concentration shall be maintained in accordance with the manufacturer's instructions. A coolant nozzle sufficiently wide to flood the entire width of the grinding wheel shall be used. Unless otherwise specified, minimum cutting fluid flow rate shall be 2 gallons per minute per inch (7.6 liters per minute per 25.4 mm) of wheel width. Cutting fluid shall be liberally applied by flooding the wheel surface during all grinding passes, including the final "clean-up" or "spark out" passes. Never use a dry "spark out" pass during grinding of any heat treated steel or chromium plated steel surface. Coolant supply flow rates less than the minimum specified above shall be acceptable for use provided the requirements of 3.4 are met.

3.2.2.6 Wheel Dressing

Dress the grinding wheel as required during use to keep the wheel open with sharp grit exposed to freely cut the work material and to prevent grinding with a dull or "loaded" wheel that causes smearing or glazing of metal and generates a large amount of frictional heat. Dress the wheel at a minimum frequency of 0.010 inch (0.254 mm) maximum of stock removal. Wheels should be dressed frequently and before the start of the final grinding passes to prevent grinding with a dull or loaded wheel. During grinding, constantly observe cutting action of the abrasive wheels. Chatter, smearing, glazing, high part surface temperatures, excessive coolant vaporization, and higher than normal spindle amperage are good indications that grinding wheels require redressing (See 8.4.3).

3.2.2.7 Wheel Speed

During grinding operations, the processor shall not exceed the manufacturer's maximum rated speed for any grinding wheel (refer to ANSI B7.1), or those in accordance with Tables 2 or 3, whichever is less (See 8.4.4). Some precipitation hardened alloys (e.g., Ferrium S53, AerMet 100, AerMet 310, AerMet 340, A-286, Custom 455, Custom 465, MLX-17, AF1410 and others, including the majority of PH stainless grades) may achieve high integrity ground surfaces using wheel speeds other than those listed in Tables 2 or 3 (e.g., 6500 SFPM) and shall be acceptable for use provided it does not exceed the manufacturer's maximum rated speed for the grinding wheel being used and the requirements of 3.4 are met.

3.2.2.8 Work Speed

Work speeds shall be in accordance with Tables 2 or 3, as applicable. A rotating wheel (non-traversing) shall never contact a stationary part.