

AEROSPACE RECOMMENDED PRACTICE

SAE ARP1755

REV.
B

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Superseding ARP1755A

Effect of Cleaning Agents on Aircraft Engine Materials Stock Loss Test Method

1. SCOPE:

- 1.1 This SAE Aerospace Recommended Practice (ARP) covers the determination of the amount of stock loss caused by use of chemical cleaning agents on aircraft turbine engine materials.
- 1.2 The evaluation is conducted on representative engine materials by determination of weight loss during total immersion in the cleaning solution with the weight-loss measurement converted to stock loss by calculation.
- 1.3 Test conditions are based upon manufacturer's recommended operating parameters for maximum concentration, maximum temperature, and twice the maximum immersion time.
- 1.4 Chemical cleaning solutions and compounds used for preinspection cleaning of aircraft turbine engine parts shall be subject to requirements of this test practice.
- 1.5 The test does not give consideration to cleaning performance of the compounds except as specified in 5.1.4.
- 1.6 Classification:

Examples of types of cleaning materials to be qualified under the requirements of this test procedure are:

- a. Category 1: Cold carbon and paint remover
- b. Category 2: Alkaline rust remover
- c. Category 3: Alkaline oxide conditioner
- d. Category 4: Acidic oxide conditioner
- e. Category 5: Alkaline permanganate oxide conditioner
- f. Category 6: Inhibited phosphoric acid
- g. Category 7: Hot carbon and paint remover
- h. Category 8: Silicone rubber remover
- i. Category 9: Antigalling compound remover

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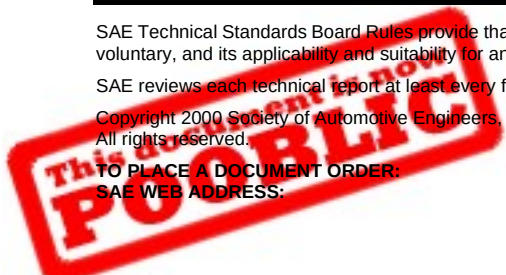
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1.6 (Continued):

- j. Category 10: Aqueous cleaner
- k. Category 11: Alkaline degreaser
- l. Category 12: Organic solvent cleaner

1.7 Safety - Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in this aerospace recommended practice may involve the use of hazardous materials, this aerospace recommended practice 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.

1.8 Significance:

This aerospace recommended practice establishes a test procedure for determining the metal removal characteristics of aircraft turbine engine cleaning materials when used on a representative list of aircraft turbine engine alloys and coatings. This test result shall be compared with the following maximum stock loss per surface to establish acceptability for overhaul shop evaluation of cleaning performance characteristics:

- a. Bare Panels or Disks: 0.000025 in (0.635 μ m)
- b. Electroplated Panels: 0.000025 in (0.635 μ m)
- c. Plasma Coated Panels or Bars: 0.000100 in (2.5 μ m)

2. APPLICABLE DOCUMENTS:

The following publications form a part of this aerospace recommended practice to the extent specified herein. The latest issue of SAE publications shall apply.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2400	Cadmium Plating
AMS 2406	Chromium Plating, Hard Deposit
AMS 2410	Silver Plating, Nickel Strike, High Bake
AMS 2416	Nickel-Cadmium Plating, Diffused
AMS 2418	Copper Plating
AMS 2424	Nickel Plating, Low-Stressed Deposit
AMS 2437	Coating, Plasma Spray Deposition
AMS 2470	Anodic Treatment of Aluminum Alloys, Chromic Acid Process
AMS 3065	Compound, Corrosion Preventive, Thin Film, Fingerprint Removing
AMS 4037	Aluminum Alloy Sheet and Plate, 4.4Cu-1.5Mg-0.60Mn (2024; -T3 Flat Sheet, -T351 Plate)

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2.1 (Continued):

AMS 4375	Magnesium Alloy Sheet and Plate, 3.0Al-1.0Zn (AZ31B-O)
AMS 4442	Magnesium Alloy Castings, 3.3Ce-2.5Zn-0.70Zr (EZ33A-T5)
AMS 4507	Brass Sheet, Strip, and Plate, 70Cu-30Zn (CDA26000), Half Hard
AMS 4544	Alloy Sheet, Strip, and Plate, Corrosion Resistant, 67Ni-30Cu, Annealed
AMS 4640	Aluminum Bronze Bars, Rods, Forgings, and Tubing, 81.5Cu-10.3Al-5.0Ni-2.8Fe
AMS 4911	Titanium Alloy Sheet, Strip, and Plate, 6Al-4V, Annealed
AMS 4928	Titanium Alloy Bars, Forgings, and Rings, 6Al-4V, Annealed 120,000 psi (825 MPa) Yield Strength
AMS 5040	Steel Sheet and Strip, 0.15 max Carbon, Deep Forming Grade
AMS 5382	Alloy Castings, Investment, Corrosion and Heat Resistant, 54Co-25.5Cr-10.5Ni-7.5W
AMS 5504	Steel Sheet, Strip, and Plate, Corrosion and Moderate Heat Resistant, 12.5Cr (SAE 51410)
AMS 5508	Steel Sheet, Strip, and Plate, Corrosion and Moderate Heat Resistant, 13Cr-2.0Ni-3.0W
AMS 5524	Steel Sheet, Strip, and Plate, Corrosion and Heat Resistant, 18Cr-13Ni-2.5Mo (SAE 30316)
AMS 5525	Steel Sheet, Strip, and Plate, Corrosion and Heat Resistant, 15Cr-25.5Ni-1.2Mo-2.1Ti-0.006B-0.30V
AMS 5536	Alloy Sheet, Strip, and Plate, Corrosion and Heat Resistant, 47.5Ni-22Cr-1.5Co-9.0Mo-0.60W-18.5Fe
AMS 5537	Alloy Sheet, Corrosion and Heat Resistant, 52Co-20Cr-10Ni-15W
AMS 5544	Alloy Sheet, Strip, and Plate, Corrosion and Heat Resistant, 57Ni-19.5Cr-13.5Co-4.2Mo-3.0Ti-1.4Al-0.05Zr-0.006B, Consumable Electrode or Vacuum Induction Melted, Annealed
AMS 5596	Alloy Sheet, Strip, and Plate, Corrosion and Heat Resistant, 52.5Ni-19Cr-3.0Mo-5.1(Cb+Ta)-0.9Ti-0.5Al-18Fe, Consumable Electrode or Vacuum Induction Melted, 1750°F (955°C) Solution Heat Treated
AMS 5613	Steel Bars, Forgings, Tubing, and Rings, Corrosion and Moderate Heat Resistant, 12.5Cr (SAE 51410), Annealed
AMS 5661	Alloy Bars, Forgings, and Rings, Corrosion and Heat Resistant, 42.5Ni-12.5Cr-5.8Mo-2.9Ti-0.015B-35Fe, Consumable Electrode or Vacuum Induction Melted, Solution, Stabilization, and Precipitation Heat Treated
AMS 6431	Steel Bars, Forgings, and Tubing, 1.05Cr-0.55Ni-1.0Mo-0.11V (0.45-0.50C), Premium Quality, Consumable Electrode Vacuum Melted

3. MATERIALS:

Test materials shall conform to specification requirements or to composition requirements in Figure 1, as applicable. Test materials shall be obtained from commercial sources as available. When a test material is not commercially available, it may be obtained from the applicable engine manufacturer as indicated under Test Materials Sources, Figure 1.

4. SPECIMEN PREPARATION:

4.1 Materials:

Shall be as listed in Tables 2, 3, and 4.

4.2 Preparation of Test Panels, Disks, and Electroplated Panels:

Complete lists of test materials are given in Tables 2 and 3. Test material requirements for specific cleaning compound categories are given in Figure 1. Use Figure 1 to determine test material requirements for a specific cleaning compound category.

4.2.1 Prepare 2 x 5 in (51 x 127 mm) panels from sheet or strip or transverse cross-section disks with parallel ground faces cut from conveniently sized bars, and drill or punch a 1/8 in (3.2 mm) diameter hole near one end if needed for suspension.

4.2.2 Deburr edges after cutting and drilling or punching.

4.2.3 Wet abrasive blast test specimens all over, using approved alumina or silica abrasive or nonsilicone treated glass beads nominally 0.001 to 0.003 in (0.02 to 0.08 mm) in diameter. Machine air pressure to be 60 to 100 psi (414 to 689 kPa). Specimens may be prepared using dry blasting methods with 500 mesh alumina. Air pressure requirements are 25 to 30 psi (172 to 207 kPa) on a direct pressure machine or 50 to 60 psi (345 to 414 kPa) using a suction type dry blasting machine.

4.2.3.1 Examples of approved abrasive media are: Novaculite No. 200 available from Wheelabrator-Frye, Inc., Mishawaka, IN 46544, or from Vapor Blast Manufacturing Co., Milwaukee, WI 53209, or UNI-SS (280 to 500 mesh) from Abrasive Developments, Henley-in-Arden, Solihull, Warwickshire, UK or equivalent materials.

4.2.4 Number each individual panel or disk for permanent identification.

4.2.5 For electroplated panels, electroplating shall be in accordance with requirements of Table 3.

4.3 Preparation of Plasma Coated Test Panels and Bars:

A complete list of plasma spray materials is given in Table 4. Test material requirements for specific cleaning compound categories are given in Figure 1. Use Figure 1 to determine test material requirements for a specific cleaning compound category.

4.3.1 Preparation of Test Panels:

4.3.1.1 Cut 1 x 3 in (25 x 76 mm) panels and drill or punch a 1/8 in (3.2 mm) diameter hole in each panel for suspension purposes.

4.3.1.2 Deburr all edges.



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- 4.3.1.3 Grind one side of panel flat to approximately 30 μin (0.08 μm) finish.
- 4.3.1.4 Plasma spray coat the ground side of the panel to a thickness of 0.010 to 0.012 in (0.25 to 0.30 mm).
- 4.3.1.5 Grind coated side to leave 0.003 to 0.005 in (0.08 to 0.13 mm) of coating thickness.
- 4.3.1.6 Remove overspray from edges of panel.
- 4.3.1.7 Number panel and identify plasma coating type on the uncoated side of each individual panel for permanent identification.
- 4.3.2 Preparation of Test Bars:
 - 4.3.2.1 Cut corrosion-resistant steel bar specimens 4.0 x 0.32 in (102 x 8.1 mm).
 - 4.3.2.2 Deburr all edges.
 - 4.3.2.3 Grind the bar to approximately 30 μin (0.08 μm) finish.
 - 4.3.2.4 Degrease using any degreasing method approved by engine manufacturer or overhaul facility.
 - 4.3.2.5 Dry abrasive blast, excluding end faces, using 24/36 grade aluminum oxide grit. Air pressure requirements are 25 to 30 psi (172 to 207 kPa) on a direct pressure machine or 50 to 60 psi (345 to 414 kPa) using a suction type dry blasting machine. Clean with a dry air blast to remove residual grit.
 - 4.3.2.6 Apply plasma spray coating to a thickness of 0.010 to 0.012 in (0.25 to 0.30 mm).
 - 4.3.2.7 Grind the coating to leave 0.003 to 0.005 in (0.08 to 0.13 mm) of coating thickness.
 - 4.3.2.8 Remove overspray from edges of panel.
 - 4.3.2.9 Number bar on end face and identify plasma coating type on each bar for permanent identification.

5. TEST PROCEDURES:

5.1 General Instructions:

Evaluation testing of aircraft turbine engine cleaning chemicals shall be accomplished as follows:

- 5.1.1 Determine the category into which the cleaning chemical falls as shown in Table 1.
- 5.1.2 Test the required panels, disks, or bars listed in Tables 2, 3, and 4 and Figure 1, using the prescribed number of serialized specimens for each test.



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- 5.1.3 Enter stock loss and related information on a stock loss data chart as in Figure 2 and forward with letter of transmittal to applicable engine manufacturer(s).
- 5.1.4 If the results are within prescribed limits, the chemical cleaner shall receive preliminary approval of its applicability and the engine manufacturer shall permit performance testing of the cleaner in an appropriate engine overhaul facility. After the cleaner has been in use with a recognized overhaul shop on turbojet and turbofan engines for not less than 6 months and has been used for cleaning at least 10 engines or equivalent, with favorable experience, the cleaner shall be approved by the engine manufacturer for service use.
- 5.1.5 Panels, disks, or bars representing stock loss data submitted to engine manufacturers on the stock loss data chart shall be serialized and retained by the cleaning compound manufacturer for not less than one year after completion of the cleaning compound approval procedure. The serial number of each specimen shall be recorded in the appropriate place on the form. A serialized specimen shall be used for one test only. Specimens retained by the vendor shall be preserved as described in 5.4 to prevent any change in physical condition.
- 5.1.6 Cleaning compound with revised formulation or operating parameters shall be retested to the requirements of the testing procedure and be reapproved by the engine manufacturer before the reformulated cleaning compound may be submitted to engine overhaul facilities for service testing.
- 5.1.7 Do not submit samples of turbine cleaning materials to engine manufacturers or engine overhaul facilities unless specifically requested. Do not submit proprietary information relative to engine cleaning materials.
- 5.2 Test Requirements:
- Testing of any cleaning material for turbine engine use shall be conducted in accordance with the following:
- 5.2.1 Requirements are given in Tables 2, 3, and 4 and Figure 1. If the vendor feels that the test specimen material or coating is incompatible with the cleaning solution, N.R. (Not Recommended) may be entered on the stock loss data chart of Figure 2.
- 5.2.2 The strength of the chemical being tested shall be at the top limit of the vendor's recommended operating limits; e.g., if 12 to 16 fluid ounces per gallon (95 to 125 ml/L) are recommended, use 16 fluid ounces per gallon (125 ml/L) for testing.
- 5.2.3 The temperature of the chemical being tested, if other than room temperature, shall be at the top limit of the vendor's recommended operating limits; e.g., if a range of 190 to 210 °F (88 to 99 °C) is recommended, use 210 °F (99 °C) for test purposes.
- 5.2.4 Exposure time for the test specimens shall be double the vendor's recommended engine part processing time. If vendor's instructions include a recommendation that the cleaning solution be agitated, the test shall be performed in vigorously agitated cleaning solution using the vendor's recommended method of agitation.

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5.2.5 If chemical strength and/or processing time differs for application to titanium parts, all details regarding this difference shall be indicated in the remarks space on the stock loss data chart of Figure 2 and stock loss figures based thereon entered on the chart for titanium.

5.2.5.1 The requirements of 5.2 shall apply for any modified procedure.

5.3 Stock Loss Test:

5.3.1 Sheet Alloy Panels or Disks and Electroplated Panels (3 Each):

5.3.1.1 Prepare specimens as in 4.2.

5.3.1.2 Degrease using any degreasing method approved by engine manufacturer or overhaul facility.

5.3.1.3 Rinse in alcohol or acetone.

5.3.1.4 Air dry for 15 to 20 min or oven dry at a temperature below 200 °F (93 °C) and air cool, and immediately weigh panel or disk to nearest milligram and record weight (W_i).

5.3.1.5 Suspend test panel or disk not less than 2 in (51 mm) below the surface of the cleaning solution being tested for the time specified.

5.3.1.5.1 In order to avoid possible error by galvanic action between the specimen and the tank or other grounding source, the specimen should be suspended without contact in the cleaning solution using a corrosion-resistant steel wire insulated from the tank or any grounding source.

5.3.1.6 Rinse in clean, cold tap water.

5.3.1.7 Brush with soft brush, apply pressure spray, or ultrasonically rinse.

5.3.1.8 Rinse in clean, cold tap water.

5.3.1.9 Rinse in clean, hot tap water.

5.3.1.10 Discard wire hanger and rinse or ultrasonically rinse specimen in alcohol or acetone.

5.3.1.11 Air dry for 15 to 20 min or oven dry at a temperature below 200 °F (93 °C) and air cool, and immediately weigh panel or disk to nearest milligram and record weight (W_f).

5.3.1.12 Determine the weight lost in the cleaning solution by subtracting weight (W_f) in 5.3.1.11 from weight (W_i) in 5.3.1.4.



5.3.1.13 From weight loss of 5.3.1.12, total surface area of test specimen, and density of metal alloy or electrodeposit shown in Table 5, determine stock loss in the cleaning solution using Equation 1.

$$\text{Stock Loss} = \frac{W_i - W_f}{D \times A} \quad (\text{Eq. 1})$$

where:

W_i = initial weight of specimen

W_f = final weight of specimen

D = density of specimen

A = area of specimen

Example: (Inch/Pound Units) Weight of material lost from a standard 0.040 x 2 x 5 in AMS 5504 panel was determined to be 0.060 g.

$$\begin{aligned} W_i - W_f &= 0.060 \text{ g} \\ &= 0.060 \text{ g} \times \frac{1}{454 \text{ g/lb}} = 0.000132 \text{ lb} \end{aligned}$$

$$\text{Density} = 0.279 \text{ lb/in}^3$$

$$\text{Area} = 20.5 \text{ in}^2$$

(Includes 2 sides and all edges of standard panel; if disk specimens are used, appropriate calculation of disk area is required.)

$$\frac{W_i - W_f}{D \times A} = \frac{0.000132 \text{ lb}}{0.279 \text{ lb/in}^3 \times 20.5 \text{ in}^2}$$

$$\text{Stock Loss} = 0.000023 \text{ in}$$

Example: (SI Units) Weight of material lost from a standard 1.02 x 51 x 127 mm AMS 5504 panel was determined to be 0.060 g.

$$W_i - W_f = 0.060 \text{ g}$$

$$\begin{aligned} \text{Density} &= 7.8 \text{ g/cm}^3 \\ &= 7.8 \text{ g/cm}^3 \times \frac{1}{1000 \text{ mm}^3/\text{cm}^3} \end{aligned}$$

$$\text{Area} = 12\,850 \text{ mm}^2$$

(Includes 2 sides and all edges)

$$\frac{W_i - W_f}{D \times A} = \frac{0.060 \text{ g}}{0.0078 \text{ g/mm}^3 \times 12\,850 \text{ mm}^2}$$

$$\text{Stock Loss} = 0.00059 \text{ mm} = 0.59 \text{ } \mu\text{m}$$

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5.3.1.14 The maximum allowable stock loss is 0.000025 in (0.635 μm) for any alloy panel or disk or electroplated panel.

5.3.2 Plasma Coated Panels or Bars (3 Each):

5.3.2.1 Panels:

5.3.2.1.1 Prepare specimens as in 4.3.1.

5.3.2.1.2 Determine weight loss from uncoated AMS 4911 or AMS 5504 panels processed through 5.3.1.2 through 5.3.1.11, inclusive.

5.3.2.1.3 Determine weight loss of AMS 5504 or AMS 4911 panels plasma coated on only one side and processed through 5.3.1.2 through 5.3.1.11, inclusive.

5.3.2.1.4 Calculate weight loss caused by cleaning process from plasma coated side of panel only as follows:

5.3.2.1.4.1 Weight loss from coated face equals weight loss in 5.3.2.1.3 minus one-half the weight loss in 5.3.2.1.2.

5.3.2.1.5 From weight loss in 5.3.2.1.4.1, determine material thickness from coated surface using Equation 2.

$$\text{Stock Loss} = \frac{W_i - W_f - 1/2 (W_{si} - W_{sf})}{D \times 1/2 A} \quad (\text{Eq. 2})$$

where:

W_i = initial weight of coated panel

W_f = final weight of coated panel

W_{si} = initial weight of uncoated AMS 5504 standard panel

W_{sf} = final weight of uncoated AMS 5504 standard panel

D = density of coating

A = total area of specimen

Example: (Inch/Pound Units) To determine the thickness loss for a plasma deposit on a standard 0.040 x 1 x 3 in AMS 5504 panel, take one-half of the weight loss determined for the uncoated panel and subtract from weight loss determined for the coated panel so that only the weight change for the coated surface will be used for determining the dimensional decrease for the coated side. Use only the area of the coated side of the panel in calculating dimensional loss as follows:

$$\begin{aligned} W_i - W_f - 1/2 (W_{si} - W_{sf}) &= 0.060 \text{ g} \\ &= 0.060 \text{ g} \times \frac{1}{454 \text{ g/lb}} = 0.000132 \text{ lb} \end{aligned}$$

5.3.2.1.5 (Continued):

$$\begin{aligned}
 \text{Density} &= 0.471 \text{ lb/in}^3 \\
 \text{Area} &= 6.3 \text{ in}^2 \\
 \text{(Including 2 sides and all edges)} & \\
 \frac{W_i - W_f - 1/2 (W_{si} - W_{sf})}{D \times 1/2 A} &= \frac{0.000132 \text{ lb}}{0.471 \text{ lb/in}^3 \times 1/2 (6.3 \text{ in}^2)} \\
 \text{Stock Loss} &= 0.000089 \text{ in}
 \end{aligned}$$

Example: (SI Units) To determine the thickness loss for a plasma deposit on a standard 1.02 x 25 x 76 mm AMS 5504 panel, take one-half of the weight loss determined for the uncoated panel and subtract from weight loss determined for the coated panel so that only the weight change for the coated surface will be used for determining the dimensional decrease for the coated side. Use only the area of the coated side of the panel in calculating dimensional loss as follows:

$$\begin{aligned}
 W_i - W_f - 1/2 (W_{si} - W_{sf}) &= 0.060 \text{ g} \\
 \text{Density} &= 13.2 \text{ g/cm}^3 \\
 &= 13.2 \text{ g/cm}^3 \times \frac{1}{1000 \text{ mm}^3/\text{cm}^3} \\
 &= 0.0132 \text{ g/mm}^3 \\
 \text{Area} &= 3950 \text{ mm}^2 \\
 \text{(Including 2 sides and all edges)} & \\
 \frac{W_i - W_f - 1/2 (W_{si} - W_{sf})}{D \times 1/2 A} &= \frac{0.060 \text{ g}}{0.0132 \text{ g/mm}^3 \times 1/2 (3950 \text{ mm}^2)} \\
 \text{Stock Loss} &= 0.0023 \text{ mm} = 2.3 \mu\text{m}
 \end{aligned}$$

5.3.2.1.6 The maximum allowable stock loss for plasma spray deposits is 0.0001 in (2.5 μm).

5.3.2.2 Bars:

5.3.2.2.1 Prepare specimens as in 4.3.2.

5.3.2.2.2 Determine weight loss of plasma coated AMS 5613 or AMS 4928 bar processed through 5.3.1.2 through 5.3.1.11, inclusive.

5.3.2.2.3 Calculate weight loss from cleaning process by subtracting weight (W_f) in 5.3.1.11 from weight (W_i) in 5.3.1.4.

5.3.2.2.4 From weight loss in 5.3.2.2.3, determine material thickness loss from coated bar using Equation 3.

$$\text{Stock Loss} = \frac{W_i - W_f}{D \times A} \quad (\text{Eq. 3})$$

where:

W_i = initial weight of coated bar
 W_f = final weight of coated bar
 D = density of coating
 A = area of coated bar

Example: (Inch/Pound Units) Weight of material lost from a 4 x 0.3345 in diameter plasma coated bar was determined to be 0.060 g.

$$\begin{aligned}
 W_i - W_f &= 0.060 \text{ g} \\
 &= 0.060 \text{ g} \times \frac{1}{454 \text{ g/lb}} = 0.000132 \text{ lb} \\
 \text{Density} &= 0.471 \text{ lb/in}^3 \\
 \text{Area} &= 4.203 \text{ in}^2 \\
 \frac{W_i - W_f}{D \times A} &= \frac{0.000132 \text{ lb}}{0.471 \text{ lb/in}^3 \times 4.203 \text{ in}^2} \\
 \text{Stock Loss} &= 0.000067 \text{ in}
 \end{aligned}$$

Example: (SI Units) Weight of material lost from a 102 x 8.496 mm diameter plasma coated bar was determined to be 0.060 g.

$$\begin{aligned}
 W_i - W_f &= 0.060 \text{ g} \\
 \text{Density} &= 13.2 \text{ g/cm}^3 \\
 &= 13.2 \text{ g/cm}^3 \times \frac{1}{1000 \text{ mm}^3/\text{cm}^3} \\
 &= 0.0132 \text{ g/mm}^3 \\
 \text{Area} &= 2740 \text{ mm}^2 \\
 \frac{W_i - W_f}{D \times A} &= \frac{0.060 \text{ g}}{0.0132 \text{ g/mm}^3 \times 2740 \text{ mm}^2} \\
 \text{Stock Loss} &= 0.00166 \text{ mm} = 1.66 \text{ } \mu\text{m}
 \end{aligned}$$

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5.3.2.2.5 The maximum allowable stock loss from plasma spray deposits is 0.0001 in (2.5 µm).

5.4 Preservation of Test Specimens:

5.4.1 Record material or coating identification and serial number of specimen on a small tag.

5.4.2 Clean the specimen by vapor degreasing in trichloroethylene or by an acetone dip.

5.4.3 If preservation is required, apply AMS 3065 thin-film corrosion-preventive compound at room temperature by dipping, brushing, or spraying the specimen.

5.4.4 Drain excess compound.

5.4.5 Make visual check for uniform coating.

5.4.6 Place each specimen in a separate polyethylene bag, and attach the identifying tag of 5.4.1.

5.4.7 Retain specimens for not less than one year after completion of cleaning compound approval procedure.

6. REPORTS:

The report shall consist of a fully executed copy of the stock loss data chart illustrated in Figure 2. One copy shall be forwarded to the appropriate department of the applicable aircraft engine manufacturer(s).

PREPARED BY SAE AMS COMMITTEE "J" (AMCM)



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TABLE 1 - Cleaning Compound Categories and Operating Temperatures

Cleaning Solution Categories	Operation Temperature (Unless Otherwise Specified by Manufacturer)
1. Cold carbon and paint remover	Room temperature
2. Alkaline rust remover	190 to 210 °F (88 to 99 °C)
3. Alkaline oxide conditioner	As specified
4. Acidic oxide conditioner	120 to 130 °F (49 to 54 °C)
5. Alkaline permanganate oxide conditioner	180 to 200 °F (82 to 93 °C)
6. Inhibited phosphoric acid	Room temperature
7. Hot carbon and paint remover	130 to 150 °F (54 to 66 °C)
8. Silicone rubber remover	Room temperature or in accordance with manufacturers' recommendation
9. Antigalling compound remover	As specified
10. Aqueous cleaner	As specified
11. Alkaline degreaser	As specified
12. Organic solvent cleaner	Room temperature

TABLE 2 - Alloy Panel and Disk Requirements /1/ /2/

Material
AMS 4037 Aluminum Sheet
AMS 4375 Magnesium Sheet
AMS 4442 Magnesium Alloy Castings
AMS 4507 Copper Alloy Sheet
AMS 4544 Nickel-Copper Alloy Sheet
AMS 4640 Aluminum Bronze Castings
AMS 4911 Titanium Sheet
AMS 5040 Carbon Steel Sheet
AMS 5382 Cobalt Alloy Castings
AMS 5504 Corrosion Resistant Steel Sheet
AMS 5508 Corrosion Resistant Steel Sheet
AMS 5524 Corrosion Resistant Steel Sheet
AMS 5525 Corrosion Resistant Steel Sheet
AMS 5536 Nickel Alloy Sheet
AMS 5537 Cobalt Alloy Sheet
AMS 5544 Nickel Alloy Sheet
AMS 5596 Nickel Alloy Sheet
AMS 5661 Nickel Alloy Bars
AMS 6431 Steel Bars
Bar Ni-9Cr-10Co-1.5Ti-5.5Al-10W-2.5Ta-1.5Hf (Mar-M 002)
Bar Ti-6Al-5Zr-0.5Mo-0.25Si (IMI 685)

/1/ Uncoated panels or disks (three of each material)

/2/ Dimensions: Sheet 0.040 to 0.060 in (1.02 to 1.52 mm) thick by 2 x 5 in ± 1/16 (51 x 127 mm ± 1.6) or
disks cut from bar stock of convenient size with faces ground flat and parallel

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TABLE 3 - Electroplated Panel Requirements /1/ /2/

Specification	Description	Deposit Thickness in	Deposit Thickness mm
AMS 2400	Cadmium Plating	0.0005 to 0.0007	0.013 to 0.018
AMS 2406	Chromium Plating	0.0005 to 0.0010	0.013 to 0.025
AMS 2410	Silver Plating	0.0004 to 0.0006	0.010 to 0.015
AMS 2416	Nickel-Cadmium Plating	As Specified	As Specified
AMS 2418	Copper Plating	0.0020 to 0.0030	0.051 to 0.076
AMS 2424	Nickel Plating	0.0018 to 0.0022	0.046 to 0.056
AMS 2470	Anodic Treatment	0.00015 to 0.0002	0.0038 to 0.005

/1/ Coated AMS 5504 corrosion-resistant steel and anodized AMS 4037 panels (three of each). See table for specific coating/basis metal combinations.

/2/ Dimensions: 0.040 in (1.02 mm) thick by 2 x 5 in $\pm$ 1/16 (51 x 127 mm $\pm$ 1.6)

TABLE 4 - Plasma Sprayed Panel or Bar Requirements /1/ /2/

Specification	Description	Deposit Thickness in	Deposit Thickness mm
AMS 2437-3	88 tungsten carbide + 12 cobalt	0.003 to 0.005	0.08 to 0.13
AMS 2437-2	75 chromium carbide + 25 (80Ni-20Cr) alloy	0.003 to 0.005	0.08 to 0.13
AMS 2437-5	Cobalt 25.5Cr-10.5Ni-7.5W	0.003 to 0.005	0.08 to 0.13
AMS 2437-6	50 (88 tungsten carbide - 12 cobalt) + 35 (70Ni-16.5Cr-4Fe-4Si-3.8B) + 15 (80Ni-20Al)	0.003 to 0.005	0.08 to 0.13
AMS 2437-7	95Ni-5Al (unalloyed composite powder)	0.003 to 0.005	0.08 to 0.13

/1/ Coated AMS 5504 corrosion-resistant steel and AMS 4911 titanium panels (three of each) or AMS 5613 corrosion-resistant steel and AMS 4928 titanium, if barstock is used.

/2/ Dimensions: Approximately 0.125 in (3.18 mm) thick by 1 x 3 in $\pm$ 1/16 (25 x 76 mm $\pm$ 1.6) for panels approximately 4 in (102 mm) x 0.32 in $\pm$ 0.020 (8.1 mm $\pm$ 0.51) diameter for barstock

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TABLE 5 - Test Material Densities

Designation	Nominal Composition	Density lb/in ³	Density g/cm ³
AMS 2400	Cadmium Plate	0.307	8.50
AMS 2406	Chromium Plate	0.253	7.00
AMS 2410	Silver Plate	0.375	10.38
AMS 2416	Nickel-Cadmium Plate	0.307	8.50
AMS 2418	Copper Plate	0.318	8.80
AMS 2424	Nickel Plate	0.318	8.80
AMS 2437-3	88 Tungsten Carbide - 12 Cobalt	0.471	13.00
AMS 2437-2	75 Chromium Carbide - 25 (80Ni-20Cr) Alloy	0.232	6.47
AMS 2437-5	56.5Co-25.5Cr-10.5Ni-7.5W	0.311	8.61
AMS 2437-6	50 (88 Tungsten Carbide - 12 Cobalt + 35 (70Ni-16.5Cr-4Fe-4Si-3.8B) + 15 (80Ni-20Al)	0.364	10.08
AMS 2437-7	95Ni-5Al	0.239	6.62
AMS 2470	Anodic Treatment	---	---
AMS 4037	Aluminum	0.100	2.77
AMS 4375	Magnesium	0.064	1.77
AMS 4442	Magnesium	0.064	1.77
AMS 4507	Copper Alloy	0.303	8.39
AMS 4544	Nickel-Copper Alloy	0.318	8.80
AMS 4640	Aluminum Bronze	0.268	7.42
AMS 4911	Titanium	0.161	4.46
AMS 4928	Titanium	0.161	4.46
AMS 5040	Carbon Steel	0.282	7.80
AMS 5382	Cobalt Alloy	0.307	8.50
AMS 5504	Corrosion Resistant Steel	0.279	7.77
AMS 5508	Corrosion Resistant Steel	0.285	7.89
AMS 5524	Corrosion Resistant Steel	0.286	7.92
AMS 5525	Corrosion Resistant Steel	0.286	7.92
AMS 5536	Nickel Alloy	0.297	8.22
AMS 5537	Cobalt Alloy	0.330	9.13
AMS 5544	Nickel Alloy	0.293	8.11
AMS 5596	Nickel Alloy	0.297	8.22
AMS 5613	Nickel Alloy	0.297	8.22
AMS 5661	Nickel Alloy	0.293	8.11
AMS 6431	Steel	0.278	7.70
MAR-M™-002	60Ni-9Cr-10Co-1.5Ti-5.5Al-10W-2.5Ta-1.5Hf	0.307	8.50
IMI™-685	88Ti-6Al-5Zr-0.5Mo-0.2Si	0.161	4.46

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
Material	Cold Carbon Solvent (See Note 1)	Alkaline Rust Remover	Alkaline Oxide Conditioner	Acidic Oxide Conditioner	Alkaline Permanganate	Inhibited Phosphoric Acid	Hot Carbon Solvent	Silicone Rubber Remover	Anti-Galling Compound Remover	Aqueous Cleaner	Alkaline Degreaser	Organic Solvent Cleaner
UNCOATED PANELS OR DISKS												
AMS 4037 Aluminum	1, 2, 3, 4	R	NR	NR	NR	NR	R	R	R	R	NR	R
AMS 4375 Magnesium	1, 2, 3, 4	R	NR	NR	NR	NR	R	R	NR	R	NR	R
AMS 4442 Magnesium	4	R	NR	NR	NR	NR	R	R	NR	R	NR	R
AMS 4507 Copper Alloy	2, 3	R	R	NA	R	R	R	NR	NR	R	R	R
AMS 4544 Nickel Alloy	2, 3	R	R	R	R	R	R	NA	R	R	R	R
AMS 4640 Aluminum Bronze	4	R	NA	NA	NA	NA	R	NA	NA	R	R	R
AMS 4911 Titanium	1, 2, 3, 4	R	R	NA	NA	NA	NA	R	R	R	R	R
AMS 5040 Carbon Steel	1, 2, 3, 4	R	R	R	R	R	R	R	R	R	R	R
R - Required (panel is required for qualification) NR - Not Recommended (may be detrimental) NA - Not Applicable (panel not necessary for qualification)												

FIGURE 1 - Test Material Requirements for Cleaning Compound Categories

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
Material	Cold Carbon Solvent	Alkaline Rust Remover	Alkaline Oxide Conditioner	Acidic Oxide Conditioner	Alkaline Permanganate	Inhibited Phosphoric Acid	Hot Carbon Solvent	Silicone Rubber Remover	Anti-Galling Compound Remover	Aqueous Cleaner	Alkaline Degreaser	Organic Solvent Cleaner
Test Material Source(s): (See Note 1)												
AMS 5382 Cobalt Alloy	2, 4	R	R	R	R	R	R	NA	NA	R	R	R
AMS 5504 Corrosion-Resistant Steel	1,2, 3,4	R	R	R	R	R	R	R	R	R	R	R
AMS 5508 Corrosion-Resistant Steel	1,2,3,4	NA	R	R	R	R	NA	NA	NA	R	R	R
AMS 5524 Corrosion-Resistant Steel	1,2,3,4	R	R	R	R	R	R	R	R	R	R	R
AMS 5525 Corrosion-Resistant Steel	1,2,3	R	R	R	R	R	R	R	R	R	R	R
AMS 5536 Nickel Alloy	1,2,3,4	R	R	R	R	R	R	NA	R	R	R	R
AMS 5537 Cobalt Alloy	1,2,3	R	R	R	R	R	R	NA	NA	R	R	R
AMS 5596 Nickel Alloy	2	R	R	R	R	R	R	NA	R	R	R	R

FIGURE 1 (Continued)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12
Material	Cold Carbon Solvent (See Note 1)	Alkaline Rust Remover	Alkaline Oxide Conditioner	Acidic Oxide Conditioner	Alkaline Permanganate	Inhibited Phosphoric Acid	Hot Carbon Solvent	Silicone Rubber Remover	Anti-Galling Compound Remover	Aqueous Cleaner	Alkaline Degreaser	Organic Solvent Cleaner
AMS 5661 Nickel Alloy	4	R	R	R	R	R	R	R	R	R	R	R
AMS 6431 Steel	2, 4	R	R	R	R	R	R	R	R	R	R	R
Ni-9Cr-10Co-1.5Ti- 5.5Al-10W-2.5Ta- 1.5Hf (Mar-M™ 002)	4	R	R	R	R	NA	R	NA	R	R	R	R
Ti-6Al-5Zr-0.5Mo- 0.25Si (IMI™ 685)	4	R	NA	NA	NA	NA	NA	R	R	R	R	R
ELECTROPLATED PANELS												
AMS 5504/AMS 2400 Cadmium	1,2,3,4	R	NA	NR	NA	NR	R	NA	NA	R	R	R
AMS 5504/AMS 2406 Chromium	1,2,3,4	R	R	NR	NR	NA	R	NA	R	R	R	R

FIGURE 1 (Continued)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12	
Material	Test Material Source(s): (See Note 1)	Cold Carbon Solvent	Alkaline Rust Remover	Alkaline Oxide Conditioner	Acidic Oxide Conditioner	Alkaline Permanganate	Inhibited Phosphoric Acid	Hot Carbon Solvent	Silicone Rubber Remover	Anti-Galling Compound Remover	Aqueous Cleaner	Alkaline Degreaser	Organic Solvent Cleaner
AMS 5504/AMS 2410 Silver	1,2,3,4	R	R	NR	NR	NA	NA	R	R	R	R	R	R
AMS 5504/AMS 2416 Nickel-Cadmium	1,2,3	R	R	NR	NA	NA	NA	R	NA	NA	R	R	R
AMS 5504/AMS 2418 Copper	4	R	R	R	R	R	NR	R	NR	R	R	R	R
AMS 5504/AMS 2424 Nickel-Cadmium	1,2,3,4	R	R	R	R	R	R	R	NA	NA	R	R	R
AMS 4037/AMS 2470 Anodic Treatment	1,2,3,4	R	NR	NR	NR	NR	NR	R	R	R	R	R	R
PLASMA COATED PANELS OR BARS													
AMS 4911/AMS 2437-3	1,2,3,4	R	R	NR	NA	NA	NA	NA	R	NA	R	R	R
AMS 5504/AMS 2437-2	1,2,3,4	R	R	R	R	R	R	R	NA	NA	R	R	R

FIGURE 1 (Continued)

CATEGORY	1	2	3	4	5	6	7	8	9	10	11	12	Material
φ	Test Material Source(s): (See Note 1)	Cold Carbon Solvent	Alkaline Rust Remover	Alkaline Oxide Conditioner	Acidic Oxide Conditioner	Alkaline Permanganate	Inhibited Phosphoric Acid	Hot Carbon Solvent	Silicone Rubber Remover	Anti-Galling Compound Remover	Aqueous Cleaner	Alkaline Degreaser	Organic Solvent Cleaner
	AMS 5504/AMS 2437-3	1,2,3,4	R	R	NA	R	NA	R	R	R	R	R	R
	AMS 5504/AMS 2437-5	1,2,3,4	NA	R	R	R	R	NA	NR	NR	R	R	R
	AMS 5504/AMS 2437-6	1,2,3,4	NA	NA	NA	NA	NA	NA	NA	NA	R	R	R
φ	AMS 5504/AMS 2437-7	1,2,3,4	R	R	R	R	R	R	R	R	R	R	R

Note 1: Code for source(s) to be contacted for commercially unavailable test materials:

1. Pratt & Whitney Aircraft Group
2. GE Aircraft Engines
3. Allison Gas Turbine Division (GMC)
4. Rolls-Royce Limited

Note 2: If bar stock specimens are used, AMS 4928 and AMS 5613 shall be used in place of AMS 4911 and AMS 5504.

FIGURE 1 (Continued)

This section to be completed by the VENDOR or by the LABORATORY conducting the tests.				
Vendor's Name:		Name of Laboratory:		
Address:		Address:		
Telephone No.:		Telephone No.:		
Product Name or Reference No.:	Category (Table 1)	Dilution Operating Limits	Temperature Operating Limits	Recommended Cycle Time in Minutes
				Date Submitted

THIS SECTION FOR ENGINE MANUFACTURERS USE ONLY.					
Engine Mfr. Prelim. OK for Service Test	Name and Location of Recognized Overhaul Shop & Starting Date	Engine Mfr. Field Rep. Report No. & Date Received	Date Final OK for Service Use	Engine Mfr. Designation for This Product, If Any	ANS Number

FIGURE 2 - Stock Loss Data

Vendor name: Product name, or reference number:	Not Recommended	Panel Serial No.	Loss in Inches	Panel Serial No.	Loss in Inches	Panel Serial No.	Loss in Inches	Average Loss in Inches	Average Weight Loss (over 3 panels)
UNCOATED PANELS OR DISCS:									
AMS 4037 Aluminum									
AMS 4375 Magnesium									
AMS 4442 Magnesium									
AMS 4507 Copper Alloy									
AMS 4544 Nickel Alloy									
AMS 4640 Aluminum Bronze									
AMS 4911 Titanium Alloy									
AMS 5040 Carbon Steel									
AMS 5382 Cobalt Alloy									
AMS 5504 Corrosion Resistant Steel									
AMS 5508 Corrosion Resistant Steel									
AMS 5524 Corrosion Resistant Steel									
AMS 5525 Corrosion Resistant Steel									
AMS 5536 Nickel Base Alloy									
AMS 5537 Cobalt Base Alloy									
AMS 5544 Nickel Base Alloy									
AMS 5596 Nickel Base Alloy									
AMS 5661 Nickel Base Alloy									
AMS 6431 Steel									
MAR-M TM -002 (60Ni/9Cr/10Co/1.5Ti/ 5.5Al/10M/2.5Ta/1.5Hf)									
IMI TM 685 (88Ti/6Al/5Zr/0.5Mo/0.25Si)									
ELECTROPLATED PANELS:									
AMS 4037/AMS 2470									
AMS 5504/AMS 2400									
AMS 5504/AMS 2406									
AMS 5504/AMS 2410									
AMS 5504/AMS 2416									
AMS 5504/AMS 2418									
AMS 5504/AMS 2424									

FIGURE 2 (Continued)

Vendor name: Product name, or reference number:	Not Recommended	Panel Serial No.	Loss in Inches	Panel Serial No.	Loss in Inches	Panel Serial No.	Loss in Inches	Average Loss in Inches	Average Weight Loss (over 3 panels)
PLASMA COATED PANELS OR BARS: (NOTE ¹)									
AMS 4911/AMS 2437-3									
AMS 5504/AMS 2437-3									
AMS 5504/AMS 2437-2									
AMS 5504/AMS 2437-5									
AMS 5504/AMS 2437-6									
AMS 5504/AMS 2437-7									

Note 1: If bar stock specimens are used, AMS 4928 and AMS 5613 shall be used in place of AMS 4911 and AMS 5504.

FIGURE 2 (Continued)