

BLACKENING SOLUTION FOR STEEL
Touch-Up Method

1. SCOPE: This specification covers a blackening solution, applied at room temperature, for touchup of black oxide coated (AMS 2485 or MIL-C-13924, Class 1) steel to provide a uniform, ebony-black surface. Such black coatings are used on gears and in optical applications.
2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.
 - 2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.
 - 2.1.1 Aerospace Material Specifications:
 - AMS 2350 - Standards and Test Methods
 - AMS 2485 - Black Oxide Coating
 - AMS 6350 - Steel Sheet, Strip, and Plate, 0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130)
 - 2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.
 - ASTM D2247 - Testing Coated Metal Specimens at 100 Percent Relative Humidity
 - ASTM F519 - Mechanical Hydrogen Embrittlement Testing of Plating Processes and Aircraft Maintenance Materials
 - 2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.
 - 2.3.1 Military Specifications:
 - MIL-C-13924 - Coating, Oxide, Black, For Ferrous Metals

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2.3.2 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

- 3.1 Composition: Shall be optional with the manufacturer but shall yield a product conforming to the requirements of 3.2.
- 3.2 Properties: Parts or representative test panels shall conform to the following requirements; tests shall be conducted in accordance with specified test methods on parts or representative test panels prepared as in 4.3.1:
- 3.2.1 Hydrogen Embrittlement: Solution shall be non-embrittling, determined in accordance with ASTM F519, Type 1a, 1c, or 2a.
- 3.2.2 Humidity Resistance: Parts or test panels shall withstand exposure for not less than 120 hr to humidity test conducted in accordance with ASTM D2247 except that temperature in humidity cabinet shall be $40^{\circ}\text{C} \pm 3$ ($100^{\circ}\text{F} \pm 5$).
- 3.2.3 Intergranular Attack: Parts or test panels shall evince no intergranular attack greater than 0.0001 in. (2.5 μm), determined on a cross-section at 500X magnification.
- 3.2.4 Blackening Ability: Solution shall form a coating that completely covers the existing steel surface providing a uniform, ebony-black surface that is free from smut when wiped with a clean, dry, white cloth.
- 3.2.5 Dimensional Change: Solution shall cause no measurable change in dimensions of parts or test panels, measured by micrometer.
- 3.3 Quality: Applied coating on steel parts shall be continuous, smooth, dense, and adherent to basis metal. It shall not chip, peel, crack, or rub off under any conditions incidental to normal handling or storage.
- 3.3.1 Applied coating on polished surfaces shall have a uniform, lustrous black color. Coating on non-polished surfaces shall be black or dark gray in color and uniform on areas of equivalent surface finish.
- 3.3.2 Coating on all types of surfaces shall be free from spots of red oxide or an overall reddish-brown color but an overall reddish-brown cast on a basically black color is acceptable.
- 3.3.3 Coating shall not cause damage or degradation of existent coatings on steel parts.

4. QUALITY ASSURANCE PROVISIONS:

- 4.1 Responsibility for Inspection: The vendor of the blackening solution shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the blackening solution conforms to the requirements of this specification.
- 4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and as preproduction tests and shall be performed prior to or on the initial shipment of blackening solution to a purchaser, on each lot, when a change in ingredients or processing, or both, requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.
- 4.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.
- 4.3 Sampling: Sufficient blackening solution shall be taken at random from each lot to perform all required tests. The number of determinations for each requirement shall be as specified in the applicable test procedure or, if not specified therein, not less than three. A lot shall be all blackening solution manufactured at one time from one group of raw materials and presented for vendor's inspection at one time.
- 4.3.1 Samples for determining conformance to the requirements of 3.2 properties shall be representative parts or six AMS 6350 or similar steel panels, 0.040 x 1 x 6 in. (1 x 25 x 150 mm), cleaned by abrasive if required to remove rust or oxidation, cleaned by wiping with a cloth dampened with methyl ethyl ketone (MEK) or other suitable solvent, coated with the blackening solution at room temperature using either swab or dip method, and dried in accordance with manufacturer's recommendations. Blackening solution shall be applied to the parts or panels at the lowest use dilution recommended by the manufacturer.
- 4.3.1.1 Similar control parts and representative steel panels shall be black oxide coated in accordance with AMS 2485 or MIL-C-13924, Class 1, prior to coating as in 4.3.1.
- 4.4 Approval:
- 4.4.1 Sample blackening solution shall be approved by purchaser before blackening solution for production use is supplied, unless such approval be waived by purchaser. Results of tests on production blackening solution shall be essentially equivalent to those on the approved sample.

- 4.4.2 Vendor shall use ingredients, manufacturing procedures, and methods of inspection on production blackening solution which are essentially the same as those used on the approved sample blackening solution. If necessary to make any change in ingredients or in manufacturing procedures, vendor shall submit for reapproval a statement of the proposed changes in material or processing, or both, and, when requested, sample blackening solution. Production blackening solution made by the revised procedure shall not be shipped prior to receipt of reapproval.
- 4.5 Reports: Unless waived by purchaser, the vendor of the blackening solution shall furnish with each shipment three copies of a report showing the results of tests to determine conformance to the technical requirements of this specification. This report shall include the purchase order number, AMS 2484, manufacturer's identification, lot number, and quantity.
- 4.6 Resampling and Retesting: If any sample used in the above tests fails to meet the specified requirements, disposition of the blackening solution may be based on the results of testing three additional samples for each original nonconforming sample. Failure of any retest sample to meet the specified requirements shall be cause for rejection of the blackening solution represented and no additional testing shall be permitted. Results of all tests shall be reported.
5. PREPARATION FOR DELIVERY:
- 5.1 Packaging and Identification:
- 5.1.1 Blackening solution shall be packaged in containers of a type and size agreed upon by purchaser and vendor.
- 5.1.2 Each container shall be legibly marked to show not less than AMS 2484, purchase order number, manufacturer's identification, lot number, and quantity.
- 5.1.3 Containers of blackening solution shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the solution to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.
- 5.1.4 For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-794, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.1.1 and 5.1.3 will be acceptable if it meets the requirements of Level C.
6. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.