



AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AMS 2465A

Superseding AMS 2465

Issued 7-15-63

Revised 12-15-74

DISILICIDE DIFFUSION COATING OF MOLYBDENUM AND MOLYBDENUM ALLOYS Pack Cementation Method

1. SCOPE:

- 1.1 Purpose: This specification covers the procedure for applying a disilicide diffusion coating to molybdenum and molybdenum alloy parts by the pack cementation method and the properties of the coating so deposited.
- 1.2 Application: Primarily to provide protection against oxidation at temperatures over 1100° F (593° C) and for operation in oxidizing atmospheres to approximately 3000° F (1649° C) for limited duration.

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 Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, Pennsylvania 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods

- 2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

ASTM C664 - Thickness of Diffusion Coating

3. TECHNICAL REQUIREMENTS:

3.1 Equipment:

- 3.1.1 Retort: A specially constructed retort designed to withstand operating temperatures up to 2100° F (1149° C).

- 3.1.2 Coating Material: Shall be a siliconizing compound composed of inert filler, silicon, and a suitable halide salt.

3.2 Preparation:

- 3.2.1 Machining, welding, brazing, forming, and heat treating shall be completed before parts are coated.

- 3.2.2 Corners and edges shall be smoothly and uniformly rounded; corner radii shall be not less than 0.125 in. (3.18 mm) and radii on edges (including holes and cut outs) shall be not less than $t/2$ where "t" is the thickness of the material, but in no case shall be less than 0.005 in. (0.13 mm).

- 3.2.3 Parts to be coated shall be cleaned free of grit, dirt, oil, grease, and other foreign materials by a method which will produce results equivalent to the following: wet abrasive blast, wash in a detergent solution, rinse in distilled water, and dry with warm air blast.

- 3.2.4 Immediately before coating, parts shall be degreased with a volatile solvent.

3.3 Procedure:

- 3.3.1 The time and temperature used for application of the coating shall be adequate for the coating to comply with the requirements specified on the drawing, but without causing recrystallization of the basis metal.

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- 3.3.2 Components of riveted assemblies shall be coated prior to assembly and shall be recoated by the same procedure after assembly.
- 3.3.3 The parts to be coated shall be packed in a retort with the coating compound of 3.1.2. An atmosphere control compound may also be used. Alloying materials may be added, where desired to improve the characteristics of the coating. The retort shall be sealed and heated to a temperature between 1750° F (954.4° C) and 2100° F (1148.9° C), held at heat for not less than 3 hr, and cooled. Breaking of the seal and removal of the parts from the pack shall not be performed until the pack has cooled to a temperature of 500° F (260° C) or lower.
- 3.3.4 Parts of extremely thin section or having other features which may require special handling shall be treated as agreed upon by purchaser and vendor.

3.4 Properties:

- 3.4.1 Thickness: The total coating thickness shall be 0.0015 - 0.0025 in. (0.038 - 0.064 mm), determined in accordance with ASTM C664, Method B.
- 3.4.2 Oxidation Resistance: Coated parts and assemblies shall be capable of meeting the following requirements: The coated parts or assemblies shall be placed in a static air atmosphere furnace previously heated to 2200° F \pm 25 (1204.4° C \pm 14). After the parts have reached 2200° F \pm 25 (1204.4° C \pm 14), visual observation shall be made at least 5 times at intervals of 2 minutes. The parts shall be removed after a total time at 2200° F \pm 25 (1204.4° C \pm 14) of 10 minutes. If molybdenum oxide smoke is observed at any time during the test, the part or assembly shall be removed from the furnace. Observation of smoke during the test or after removal from the furnace upon completion of the full 10 min. cycle shall be cause for rejection of the offending part.
- 3.5 Quality: The coating shall be uniform, adherent, and free from defects and shall cover all surfaces of the part.

4. QUALITY ASSURANCE PROVISIONS:

- 4.1 Responsibility for Inspection: The vendor of coated parts shall supply all samples 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 perform such confirmatory testing as he deems necessary to assure that the coating conforms to the requirements of this specification.
- 4.2 Classification of Tests:
- 4.2.1 Acceptance Tests: Tests to determine conformance to edge and corner radii (3.2.2) and coating thickness (3.4.1) requirements are classified as acceptance or routine control tests.
- 4.2.2 Qualification Tests: Tests to determine conformance to freedom from recrystallization (3.3.1) and oxidation resistance (3.4.2) requirements are classified as qualification or periodic control tests.
- 4.3 Sampling: Shall be not less than the following; a lot shall be all parts of the same part number coated in the same retort at the same time.
- Ø 4.3.1 Edge and Corner Radii: At least one production part per lot.
- Ø 4.3.2 Thickness: At least two test samples per lot, not less than 1 X 1.5 in. or 25 X 40 mm, from the same material as the base metal and preferably of the same thickness and the same minimum radii and coated with the parts. One of the test samples shall be furnished to the purchaser for measurement of coating thickness.
- Ø 4.3.3 Oxidation Resistance and Recrystallization: As agreed upon by purchaser and vendor.

4.4 Approval:

- 4.4.1 Parts coated in accordance with this specification shall be approved by purchaser before parts for production use are supplied, unless such approval be waived.
- 4.4.2 Vendor shall use materials, manufacturing procedures, processes, and methods of inspection on production parts which are essentially the same as those used on the approved sample parts. If any change is necessary in processing parameters, the vendor shall submit for reapproval of the process a statement of the revised operations and, when requested, sample coated parts. No production parts coated by the revised procedure shall be shipped prior to receipt of reapproval.
- 4.5 Reports: The vendor of coated parts shall furnish with each shipment three copies of a report showing the purchase order number, part and coating material specification numbers and their revision letters, if any, contractor or other direct supplier of part and coating materials, part number, and quantity.
- Ø When the coating material is produced or purchased by the coated parts vendor, that vendor shall inspect each lot of material to determine conformance to the applicable material specification, and shall include in the report a statement that the materials conform, or shall include copies of laboratory reports showing the results of tests to determine conformance. This report shall also include the results of tests to determine that the coating conforms to the requirements of this specification.
- 4.6 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the coated parts may be based on the results of testing three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the parts represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

- 5.1 Identification: Coated parts shall be identified as agreed upon by purchaser and vendor. The markings shall have no deleterious effect on the coated parts or their performance and shall be sufficiently stable to withstand normal handling.
- 5.2 Packaging:
- 5.2.1 Coated parts shall be packaged in such a manner as will ensure that the parts, during shipment and storage, will be protected against damage from exposure to weather or any normal hazard.
- 5.2.2 Coated parts shall be prepared for shipment in accordance with commercial practice to assure carrier acceptance and safe transportation to the point of delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Parts on which the coating does not conform to this specification or to authorized modifications will be subject to rejection.

8. NOTES:

8.1 Marginal Indicia: The phi (ϕ) symbol is used to indicate technical changes from the previous issue of this specification.

8.2 Precautions:

8.2.1 After preparation and before coating, parts should not be handled with bare hands or otherwise be contaminated by unclean gloves, handling devices, or transfer tools.