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SUPERSEDING
(see 6.3)

MILITARY STANDARD

COATING, ALUMINUM AND SILICON DIFFUSION, PROCESS FOR

AMSC N/A FSC 8030

DEPARTMENT OF DEFENSE
Washington, DC 20301

Coating, Aluminum and Silicon Diffusion, Process for

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FOREWORD

This military standard describes the diffusion process for aluminum and silicon coating for high temperature parts used in gas turbine engines for ground vehicles.

CONTENTS

1. SCOPE

1.1 Purpose. This is one of the coating processes used to provide a coating on certain metallic parts to protect them against oxidation, sulfidation or erosion at high temperature operation, and resistance to thermal shock during cycling.

1.2 Scope. This standard covers the procedure for applying aluminum and silicon by the diffusion coating process.

2. REFERENCED DOCUMENTS

(This section is not applicable to this standard.)

3. DEFINITIONS

3.1 Diffusion coating. Any process whereby a basis metal or alloy is either: (1) coated with another metal or alloy and heated to a sufficient temperature in a suitable environment or (2) exposed to gaseous or liquid medium containing the other metal or alloy. The result is diffusion of the coating or of the other metal or alloy into the base metal with resultant change in the composition and properties of its surface.

3.2 Aluminide. Aluminide is the protective surface alloy formed as a result of aluminum diffusion into the base metal.

4. GENERAL REQUIREMENTS

4.1 Equipment.

4.1.1 Drying oven. The drying oven shall be a recirculating type of oven with suitable controls to operate at 625 ± 10 degrees Fahrenheit (°F) [330 ± 5 degrees Celsius (°C)].

4.1.2 Diffusion furnace. The diffusion furnace shall be a controlled atmosphere furnace capable of maintaining temperatures up to 1950 ± 25°F (1065 ± 15°C).

4.2 Materials.

4.2.1 Vapor degreasing solvent. The vapor degreasing solvent shall be stabilized 1-1-1 trichloroethane or equivalent type solvent.

4.2.2 Dry abrasive blast. The dry abrasive blast material shall be 220 mesh aluminum oxide (Al_2O_3), zirconite 200 or equivalent.

4.2.3 Inert gases. The diffusion shall be done in one of the following atmospheres:

a. Commercially pure argon with a dew point of at least -40°F (-40°C).

b. Commercially pure hydrogen with a dew point of at least -40°F (-40°C).

4.2.4 Coating material mixing. As the coating mixture solids will settle into a very compact mass on standing, it is very important that the coating mixture is thoroughly mixed in its original container to ensure the liquid to solids ratio is maintained. To ensure thorough mixing of the coating mixture, the original container can be placed on the rollers of a ball mill and mechanically rolled until the coating mixture is in even suspension.

4.3 Test specimens. Test specimens shall be prepared, coated and diffusion treated with each lot of parts, and submitted to the procuring activity's material laboratory for examination. There shall not be less than one test specimen, processed through the coating and thermal processing, for microscopic examination. Test specimens shall be made of the same alloy as the parts being processed.

4.4 Process approvals. As a condition of procurement and manufacturing, specific work instructions (process procedures) and changes or revisions of such work instructions shall be submitted to the procuring activity's material laboratory for approval.

5. DETAILED REQUIREMENTS

5.1 Diffusion coating material. The diffusion coating material shall be Sermaloy "J" of Sermetel, a subsidiary of Teleflex Incorporated, International Headquarters, Limerick Road, Limerick, Pennsylvania 19468, or equivalent.

5.2 Procedures and operations.

5.2.1 Coating material preparation. The diffusion coating material shall be thoroughly mixed prior to use as follows:

a. Agitate or shake the coating material in its original container for at least 15 minutes.

b. Strain coating material successively through 50, 100 and 150 mesh screens to remove all agglomerated material.

5.2.2 Surface preparation. The surface preparation of the parts or assemblies to be coated shall include the following:

a. Parts or assemblies shall be vapor degreased.

b. Areas of parts or assemblies not requiring coating shall be suitably masked.

c. Areas of parts or assemblies to be coated shall be thoroughly dry abrasive blasted (see 4.2.2) using an air pressure of 60 pounds per square inch (psi). When damaged coatings are being reworked by this coating process, the edges of the damaged coated shall be suitable feathered.

CAUTION: After abrasive blasting, parts or assemblies shall only be handled in a manner which will preclude recontamination. In as much as possible, touching the area to be coated shall be avoided.

5.2.3 Diffusion coating material application. The diffusion coating material (see 5.2.1) shall be sprayed, dipped, or brushed on the areas to be coated. The coating shall be applied by alternately applying a coating of 2 or 3 mils [0.051 to 0.076 millimeter (mm)] and then curing until a total coat material thickness is reached which will provide the proper finished coating thickness after the diffusion treatment.

5.2.4 Curing. Curing shall be as follows:

a. Bake coated parts at a temperature of 175 $\pm$ 10°F (80 $\pm$ 5°C) for 15 minutes.

b. Remove masking.

c. Cure coated parts at a temperature of 625 ± 25°F (330 ± 15°C) for not less than 1 hour.

CAUTION: Coating is very friable and shall not be handled.

5.2.5 Inspection (prediffusion treatment). Visually inspect coating for crazing, cracking, and any other visible surface defects. Defective coatings shall be stripped and recoated in accordance with 5.2.1 through 5.2.3.

5.2.6 Diffusion treatment. Unless otherwise specified on the engineering drawing, diffusion treatment shall be done in an argon or hydrogen atmosphere. The part temperature shall be raised to the temperature approved by the procuring activity's material laboratory and held at heat for at least one hour. The parts shall be cooled to at least 400°F (205°C) in a controlled atmosphere then the part may be removed and cooled in air.

5.2.6.1 Racking. Coated parts shall be racked in such a manner to preclude the coating area from touching either the racks or retort.

5.2.7 Post cleaning. The powder residue on the parts after diffusion heat treatment may be removed by any method which will not affect the diffusion coating's thickness or properties.

5.3 Test methods.

5.3.1 Visual. All parts and assemblies and test specimens shall be visually inspected to verify the diffusion coating is adherent to the base material and has a uniform continuous surface free from spalling, chipping, flaking, cracking and other objectionable imperfections.

5.3.2 Metallographic. When examined at 100X magnification, a microscopic examination of the test specimen cut normal to the coated surface shall not reveal any cracks, porosity, pitting or other imperfections which would expose the base metal.

5.3.2.1 Coating thickness. The coating thickness of the diffused coating shall be measured to verify a coating thickness of 2.0 to 3.0 mils (0.051 to 0.076 mm) or to the thickness specified on the engineering drawing.

5.4 Rework. Damaged or imperfect coatings may be reworked once without further approvals provided the coating is completely removed by mechanical methods.

dard conditions for 6 hours. The test panel shall be immersed in jet reference fluid

6. NOTES

6.1 Intended use. The process covered by this standard is intended primarily for use as a diffusion coating which provides an oxidation, sulfidation, erosion and thermal shock resistant surface.

6.2 Subject term (key word) listing.

Aluminum coating process
Diffusion coating process
Process for diffusion coating
Silicon coating process

6.3 Supersession data. This military standard supersedes AVCO Lycoming specification number P6413, revision C, dated 26 April 1982.

Custodian:
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(Project 8030-A120)

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