MIL-STD-340(AT)
29 March 1988
SUPERSEDING
(see 6.3)

MILITARY STANDARD

COATING, PACK CEMENTATION, CHROME ALUMINIDE, PROCESS FOR

AMSC N/A FSC 8030

DEPARTMENT OF DEFENSE
Washington, DC 20301

Coating, Pack Cementation, Chrome Aluminide, Process for

1. This Military Standard is approved for use by U.S. Army Tank-Automotive Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: US Army Tank-Automotive Command, ATTN: AMSTA-GDS, Warren, MI 48397-5000, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FOREWORD

This military standard covers the pack cementation coating processes, chrome aluminide for high temperature parts used in gas turbine engines for ground vehicles.

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FIGURES

1. SCOPE

1.1 Purpose. This process is one of many used by industry to provide a coating(s) on thoria dispersed (TD) nickel alloys to protect them against environmental oxidation, corrosion or erosion at high temperature operation.

1.2 Scope. This military standard covers the procedure for the application and inspection of a chrome aluminide pack cementation coating on TD nickel alloys.

2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Specifications. Unless otherwise specified, the following specifications of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this standard to the extent specified herein.

SPECIFICATIONS
MILITARY

MIL-H-6875 - Heat Treatment of Steel, Process for.

(Copies of specifications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following document(s) form a part of this standard to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. The issues of documents which have not been adopted shall be those in effect on the date of the cited DoDISS.

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

AMS 5865 - Nickel Sheet and Strip, Corrosion and Heat Resistant Thoria Dispersion Strengthened, 2.2THO_2.

(Application for copies should be addressed to the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.)

(Nongovernment standards are generally available for reference from libraries. They are also distributed among nongovernment standards bodies and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this standard and the references cited herein, the text of this standard shall take precedence.

3. DEFINITIONS

3.1 Cementation. The introduction of one or more elements into the outer portion of a metal object by means of diffusion at high temperature.

3.2 Diffusion coating. An alloy coating produced at high temperature by the inward diffusion of the coating material into the base material.

3.3 Aluminizing. A surface treatment at elevated temperature, generally carried out in pack, hot dipping or hot spraying, in which a protective surface alloy is formed by the inward diffusion of aluminum or aluminum alloy into the base metal.

3.4 Aluminide. Aluminide is the protective surface alloy formed as a result of aluminizing treatment.

3.5 Chromizing. A surface treatment at elevated temperature, generally carried out in pack, vapor or salt bath, in which a protective surface alloy is formed by the inward diffusion of chromium into the base metal.

4. GENERAL REQUIREMENTS

4.1 Equipment.

4.1.1 Furnaces. Furnaces shall be of sufficient size and equipped with temperature and atmosphere controllers to perform its intended function. In addition, furnaces shall meet the uniform temperature control requirements specified in MIL-H-6875.

4.1.1.1 Temperatures. Temperatures of the diffusion furnace shall be maintained during the diffusion coating processes at up to 2350 ± 25 degrees Fahrenheit (°F) [1288 ± 14 degrees Celsius (°C)] for chromizing process and up to 1850 ± 25°F (1010 ± 14°C) for aluminizing process.

4.1.2 Retorts. Retorts shall be of sufficient size and shape to the parts to be coated, required number of test panels, and sufficient pack material to produce the desired coating.

4.2 Materials.

4.2.1 Pack materials. Pack materials shall be chromalloy R-17 material for the chromizing process and chromalloy R-1700 material for the aluminizing process in accordance with Chromalloy Research and Technology Division, Orangeburg, New York 10962, or equivalent.

4.2.2 Test panels. Test panels shall be 0.75 x 4.0 inches (in) [19.0 x 101.6 millimeter (mm)] TD nickel metal panels in accordance with AMS 5865. Each panel shall be weighed to the nearest 0.1 milligram (mg) and shall be permanently marked with a serial number. Marking shall be made in a manner that will be legible through the coating. Test panels shall be identified by their thickness as follows:

Identification	Thickness	
	in	mm
MIL-STD-XXXX-01	0.025	0.635
MIL-STD-XXXX-02	0.031	0.787
MIL-STD-XXXX-03	0.037	0.940
MIL-STD-XXXX-04	0.039	0.991
MIL-STD-XXXX-05	0.040	1.016
MIL-STD-XXXX-06	0.050	1.270

4.2.2.1 Uncoated weights. The weight of each uncoated test panel shall be recorded with the corresponding serial number. The weight of any test panel given special treatment prior to coating shall be verified and reported by the coating vendor.

4.2.2.2 Coated weights. The chromized and the aluminized weights of each test panel shall be kept along with each other on records with their corresponding serial number and coating run number.

5. DETAILED REQUIREMENTS

5.1 Procedure. All part preparation, coating processes, and post cleaning shall be in accordance with Chromalloy Research and Technology Division.

5.1.1 Chromizing process. The detail parts and test panels shall be prepared and chromized in such a manner to provide a chromized coating weight of 35 to 60 mg per 100 square millimeters.

5.1.2 Fabrication. After chromizing, the parts shall be fabricated into assemblies by machining, brazing, or welding prior to aluminizing.

5.1.3 Aluminizing. The chromized assemblies and test panels shall be prepared and aluminized in such a manner to provide an aluminized coating weight of 1.5 to 6.0 mg per 100 square millimeters.

5.2 Test methods.

5.2.1 Visual. All parts or assemblies and test panels shall be visually inspected after chromizing and aluminizing. The surface shall be smooth in its entirety and without evidence of cracking and spalling. There shall be no evidence of untreated areas of pack material adhering to the surface. In addition, there shall be no significant difference in color indicative of uneven coating.

5.2.2 Test samples.

5.2.2.1 Chromizing. There shall be not less than two test panels placed in each retort of parts to be chromized. The test panels shall be placed in the retort in a manner which will accurately represent detail coating quality. In some cases, it may be required to place several test panels in the retort to provide a sufficient number of chromized test panels.

5.2.2.2 Aluminizing. There shall be not less than one acceptable chromized test panel (see 5.2.2.1) placed in each retort of parts or assemblies to be aluminized. The test panels shall be placed in the retort in a manner which will accurately represent part coating quality.

5.2.2.3 Reduced sampling. Once the chromizing and aluminizing cycles are fixed for a specific part, the use of test panels may be reduced or discontinued. When any changes are made in either the chromizing or aluminizing cycles, test panels shall again be processed with the parts.

5.2.2.4 Resistance welding samples. When requested by manufacturing, test specimens for resistance welding shall be processed through the chromizing cycle. The test specimens for resistance welding shall be of the same thickness and material and chromized in the same manner as the parts represented by the test specimens.

5.2.3 Testing.

5.2.3.1 Chromized test panel. The chromized test panels shall be evaluated as follows:

a. Coating weight: Each chromized test panel shall have the amount of diffused chromium determined by weighing.

b. Microstructure: A sufficient number of the chromized test panels shall be examined through a transverse section at a magnification of 500X to verify the following:

(1) There shall be no alpha chrome on the surface.

(2) Inert pack particles shall not be evident for more than 5 percent (%) of the total micro area.

(3) The diffusion zone on the test panel shall be essentially even across the entire transverse section of the test panel examined.

(4) Typical examples of acceptable microstructure are identified in figure 1.

5.2.3.2 Aluminized test panel. The aluminized test panels shall be evaluated as follows:

a. Coating weight: Each chromized test panel shall have the amount of aluminum deposited determined by weighing.

b. Microstructure: A sufficient number of the chrome aluminide test panels shall be examined through a transverse section at a magnification of 500X to verify the following:

(1) The coating cross section shall consist of three distinct layers.

(2) The outer beta aluminide zone shall be 0.2 to 1.0 mil thick.

(3) The inner alpha chromium or gamma nickel zone shall be 0.2 to 0.8 mil thick.

(4) The balance of the coating cross section shall be gamma nickel.

(5) There shall be no evidence of entrapped pack material on or below the coated surface in excess of 5%.

(6) Typical examples of acceptable microstructure are illustrated in figure 2.

6. NOTES

6.1 Intended use. The process covered by this standard is primarily for the purpose of imparting improved corrosion resistance to parts.

6.2 Subject term (key word) listing.

Aluminizing process
Chrome aluminide coating, pack cementation
Chromizing process
Pack cementation, chrome aluminide
Process for chrome aluminide coating

6.3 Supersession data. This military standard supersedes AVCO Lycoming specification number P6457, revision A, dated 26 April 1982.

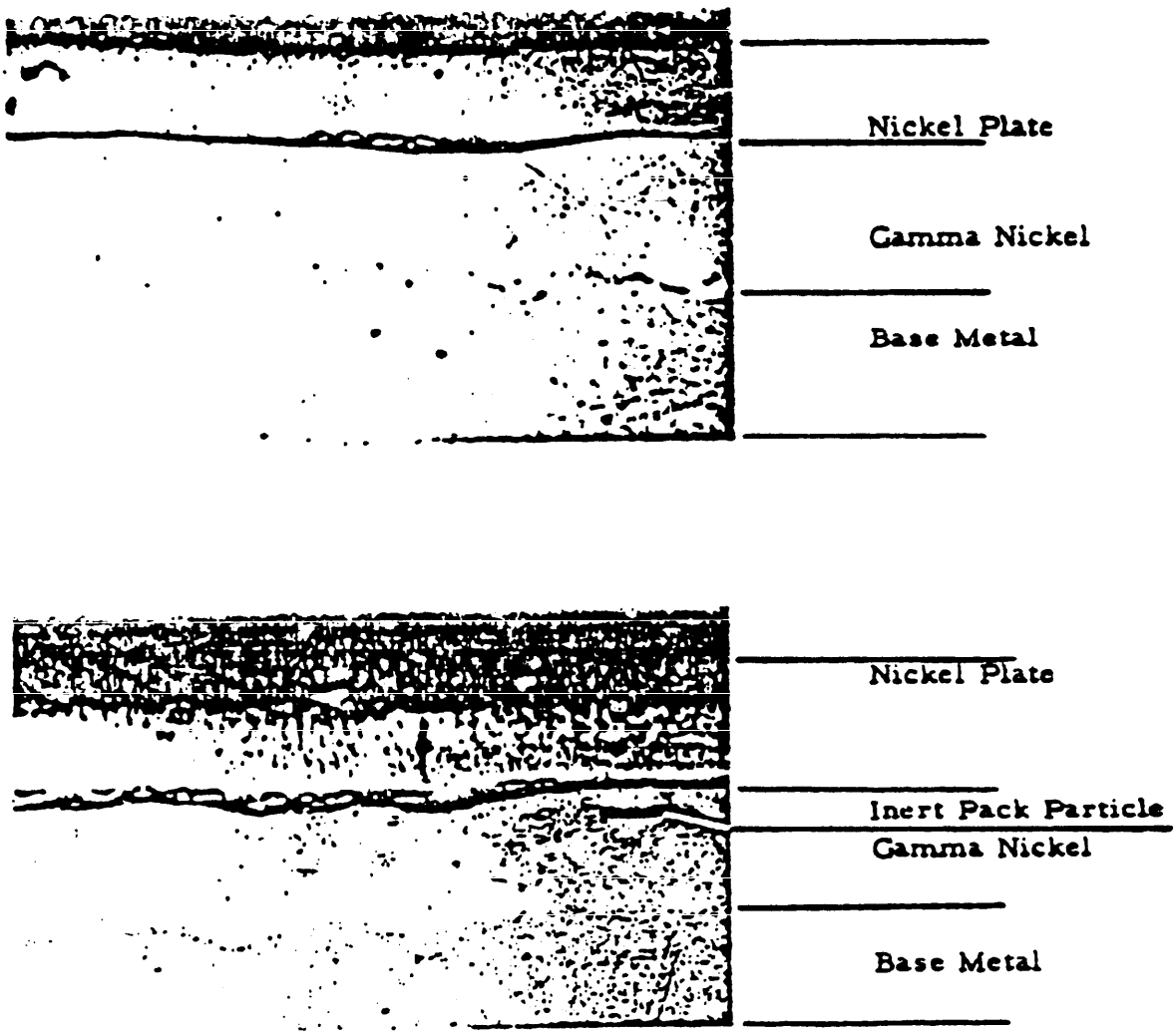

FIGURE 1. Typical Acceptable Chromized Coating.

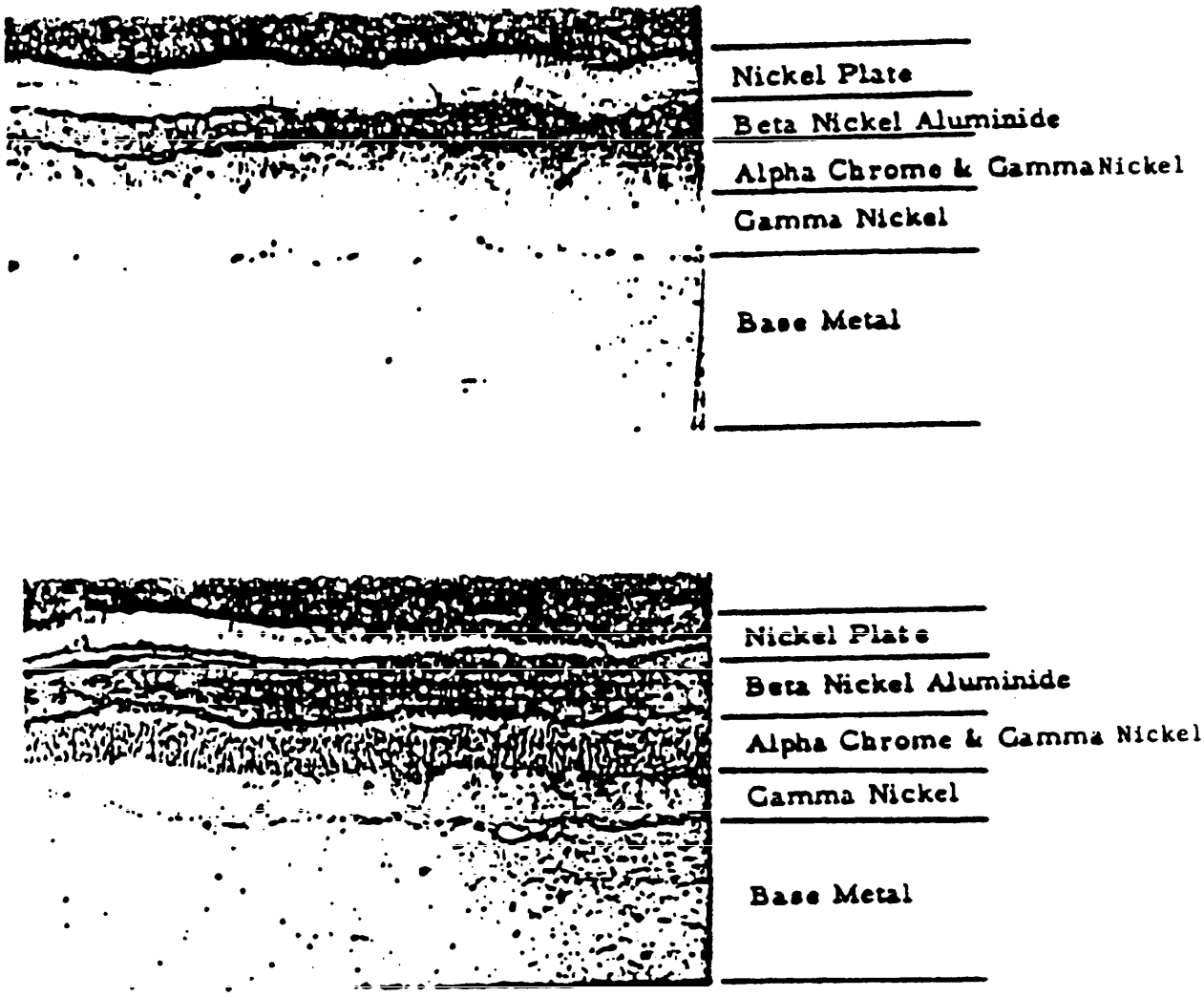

FIGURE 2. Typical Acceptable Aluminized Coating.

Custodian:
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Preparing activity:
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(Project 8030-A119)

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a. Paragraph Number and Wording:

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