The Engineering Society For Advancing Mobility Land Sea Air and Space ®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 2755D

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Submitted for recognition as an American National Standard

Superseding AMS 2755C

NITRIDING, MOLTEN SALT BATH

1. SCOPE

1.1 Purpose

This specification covers the engineering requirements for producing a thin carbide-bearing nitride case on parts by means of a low-temperature, aerated, molten salt bath process, and the properties of the case.

1.2 Application:

This process has been used typically for increasing the resistance to wear on ferrous alloys including oil- and air-hardening tool steels, corrosion-resistant steels, and cast irons, but usage is not limited to such applications.

1.3 Safety - Hazardous Materials

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

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

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

ARP 1820 Chord Method of Evaluating Surface Microstructural Characteristics

SAE J423 Methods of Measuring Case Depth

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 384 Microhardness of Materials

3. TECHNICAL REQUIREMENTS:

3.1 Material:

3.1.1 Nitriding Salts: Shall consist of a mixture of sodium and potassium cyanide and other salts.

3.1.2 Salt Bath: The cyanate, cyanide, and iron contents of the bath shall be controlled within the percentages by weight shown in Table 1.

TABLE 1 - Bath Composition

Ingredients	Percent by Weight min	Percent by Weight max
Cyanate, determined as KCNO	42	50
Cyanide, determined as KCN	45	50
Iron, determined as $Na_4Fe(CN)_6$	--	0.20

3.2 Preparation:

3.2.1 Hardening: Parts, where core hardening is specified, shall be heat treated to the required core hardness before processing as in 3.3.2. Tempering to attain core hardness shall be at a temperature not lower than 1075 °F (579 °C).

3.2.2 (R) Stress Relief: When specified, stress relief shall be performed at a temperature not lower than 1075 °F (579 °C) (See 8.2).

3.2.3 Cleaning: Parts shall be clean at the time of nitriding, shall be free of scale, entrapped sand, core material, metal particles, oil, and grease. Parts shall be completely dry.

3.3 Procedure:

3.3.1 Preheating: Parts, prior to immersion in the cyanide-cyanate bath, shall be preheated in air at 750 to 900 °F (399 to 482 °C) to maintain bath temperature and avoid thermal shock.

3.3.2 Nitriding: Parts shall be immersed in an aerated cyanide-cyanate bath at temperatures and times shown in Table 2 (See 8.3).

TABLE 2 - Process Parameters

Material	Recommended Time min	Recommended Time max	Temperature °F	Temperature °C
Carbon and Low-Alloy Steels	1 hour	2 hours	1060 ± 10	571 ± 6
Tool and Die Steels (Structural)	30 minutes	3 hours	1000 to 1060	538 to 571
Tool Steels (Cutting)	5 minutes	1 hour	1000 to 1060	538 to 571
Corrosion and Heat Resistant Steels	1 hour	2 hours	1060 ± 10	571± 6
Ductile, Malleable, and Gray Cast Iron	1 hour	4 hours	1060 ± 10	571 ± 6
Powder Metal Products (Ferrous)	30 minutes	2 hours	1060 ± 10	571 ± 6

3.4 Properties:

Nitrided case shall conform to the following requirements:

3.4.1 (R) Depth of Compound Layer: Shall be as shown in Table 3, determined at not less than 500X magnification in accordance with the taper or step grind procedures of SAE J423 or ARP1820, microscopic method.

TABLE 3 - Compound Case Depth

Material	Case Depth Inch min	Case Depth Inch rnax	Case Depth Millimeter min	Case Depth Millimeter max
Plain carbon and low-alloy steels	0.00015	0.001	0.0038	0.025
Tool and die steels (structural)	0.0001	0.0005	0.0025	0.127
Tool and die steels (cutting)	--	0.0001	--	0.0025
Corrosion and heat resistant steels	0.00015	0.001	0.0038	0.025
Ductile, malleable, and gray cast iron	0.00015	0.001	0.0038	0.025
Powder metal products (ferrous)	0.00015	0.001	0.0038	0.025

3.4.2 Case Quality: Any surface porosity present shall not extend deeper than one-half the observed depth of the compound layer, determined by examining specimens metallographically at 500X magnification (See 8.4 and 8.5).

3.4.3 Case Hardness: Shall be as shown in Table 4, determined by microhardness measurements in accordance with ASTM E 384 on the nitrided surface or on metallographically prepared cross-sections of the nitrided case using Vickers, Knoop, or other appropriate hardness tester acceptable to purchaser (See 8.6.

TABLE 4 - Minimum Case Hardness

Material	Hardness HK200, or equivalent
Plain carbon steels	300
Low-alloy steels	450
Tool and die steels	700
Corrosion and heat resistant steels	900
Ductile, malleable, and gray cast iron	600
Powder metal products (ferrous)	600

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

(R) Processor of treated parts shall supply all samples for processor's tests and shall be responsible for the performance of all required tests. Parts, if required for test, shall be supplied by purchaser. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the parts conform to specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Depth of compound layer (3.4.1), case quality (3.4.2), and case hardness (3.4.3) are acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Bath composition (3.1.2) is a periodic test and shall be performed at a frequency selected by the processor unless frequency of testing is specified by purchaser.

4.2.3 Preproduction Tests: All technical requirements are preproduction tests and shall be performed prior to or on the first-article shipment of a processed part to a purchaser, when a change in ingredients and/or processing requires approval by the cognizant engineering organization (See 4.4.2), and when purchaser deems confirmatory testing to be required.

4.3 Sampling and Testing:

(R) Shall be not less than the following: a lot shall be all parts of the same part number processed in the same furnace load and presented for processor's inspection at one time.

4.3.1 (R) For Acceptance Tests: Parts shall be randomly selected from all parts in the load or from samples distributed throughout the load and shall be tested in accordance with Table 5.

4.3.1.1 (R) Samples, if used, shall be of the same generic class of alloy and heat treat condition as the parts represented.

TABLE 5 - Sampling for Acceptance Testing

Number of Parts in Lot	Number of Specimens
up to 7	3
8 to 40	4
41 to 110	5
111 to 300	6
301 to 500	7
Over 500	8

4.3.2 (R) For Preproduction and Periodic Tests: Sample quantity and frequency shall be at the discretion of the processor unless otherwise specified.

4.4 Approval:

4.4.1 (R) The process and control procedures, a preproduction sample, or both, whichever is specified, shall be approved by the cognizant engineering organization before production parts are supplied.

4.4.2 (R) The processor of nitrided parts shall make no significant change in bath type, heat treat conditions, or control factors from those on which approval was based, unless the change is approved by the cognizant engineering organization. A significant change is one which, in the judgment of the cognizant engineering organization, could affect properties or performance of nitrided parts.

4.4.2.1 Control factors include, but are not limited to, the following:

Molten salt bath composition
Tempeature/time controls
Quench Media

4.4.2.1.1 (R) Any of the process control factors for which parameters are considered proprietary by the processor may be assigned a code designation. Each variation in such parameters shall be assigned a modified code designation.

4.5 Reports:

The processor of nitrided parts shall furnish with each shipment a report showing the results of tests to determine conformance to the acceptance test requirements and, when performed, to the periodic test requirements. This report shall include the purchase order number, lot number, AMS 2755D, part number, and quantity.

4.6 Resampling and Retesting:

4.6.1 (R) If any acceptance test fails to meet specified requirements, disposition of the parts may be based on the results of testing three additional samples for each nonconforming specimen. Failure of any retest specimen to meet specified requirements shall be cause for rejection of the parts represented. Results of all tests shall be recorded and, when requested, reported.

4.6.2 (R) If results of any periodic test fail to meet specified requirements, the process is nonconforming; no additional parts shall be processed until the process is corrected and new parts or specimens are processed and tested. Purchaser shall be notified of all parts processed since the last acceptable test.

5. PREPARATION FOR DELIVERY:

5.1 Identification:

Each container of nitrided parts shall be legibly marked with not less than AMS 2755D, purchase order number, processor's identification, part number, and quantity.