SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

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Superseding AMS 2756

Gas Nitriding of Steel Parts

NONCURRENT NOTICE

This specification has been declared “NONCURRENT” by the Aerospace Materials Division, as of 10-8-84. It is recommended that this specification not be specified for new designs.

This cover sheet should be attached to the initial issue of the subject specification.

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1. SCOPE:

1.1 Purpose:

This specification covers a process for surface-hardening parts, made from appropriate low-alloy steels (See 8.4), by the introduction of nitrogen from ammonia.

1.2 Application:

Primarily for parts requiring hard, wear-resistant surfaces.

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., Two Pennsylvania Plaza, New York, New York 10001.

2.1.1 Aerospace Material Specifications:

AMS 2350 Standards and Test Methods
AMS 2408 Tin Plating

2.2 ASTM Publications:

Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

ASTM E18 Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E92 Vickers Hardness of Metallic Materials

2.3 Government Publications:

Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

2.3.1 Military Standards:

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes

3. TECHNICAL REQUIREMENTS:

3.1 Equipment:

Shall consist of suitable furnaces equipped with a source of dissociated anhydrous ammonia to supply the nitriding atmosphere. The design and capacity of the furnaces shall be such that the temperature at any point in the working zone shall not vary more than ±15°F (±8.3°C) from the desired nitriding temperature after the charge has been brought up to temperature and shall provide means for adequate circulation of the furnace atmosphere over the parts at all times.

3.2 Preparation:

3.2.1 Heat Treatment: Parts, before being nitrided, shall be hardened and tempered to meet mechanical properties specified for the core. The tempering temperature should be at least 100°F (56°C) higher than the nitriding temperature to be used.

3.2.2 Masking: If parts are not to be nitrided all over, the surfaces not to be nitrided shall be masked to prevent absorption of nitrogen from the furnace atmosphere. Masking may be accomplished by tin plating in accordance with AMS 2408, by bronze plating, by coating with a suitable paint, or by other methods acceptable to the purchaser. Alternatively, parts may be nitrided all over and the case ground off the surfaces not to be nitrided.

3.2.3 Surface Condition: Parts, before nitriding, shall be clean and free from dirt, grease, oxide, scale, and other injurious foreign matter. Surfaces to be nitrided shall be free from decarburization.

3.3 Procedure:

3.3.1 Loading Parts: Parts shall be suitably placed and supported in the nitriding furnace to prevent distortion at the nitriding temperature and to ensure free circulation of the nitriding gas to all surfaces. Test specimens of comparable material and hardness shall be included with each load of parts as required for process control.

3.3.2 Nitriding: Parts shall be heated in a furnace containing dissociated anhydrous ammonia at a temperature and for a time sufficient to produce the specified depth of case. Before removing parts from the furnace, they shall be cooled to a temperature below 400°F (204°C) in either the nitriding atmosphere or a nonreactive atmosphere.

3.3.2.1 Two-Stage Process: A two-stage nitriding process may be employed to keep the depth of the white layer to a minimum. The first stage produces the brittle white layer and the second stage the remainder of the nitrided case. This process produces the thickest cases and is advantageous for applications where it is impractical to remove the white layer after nitriding.

3.4 Post Treatment:

3.4.1 Stress Relief: When specified, parts ground after nitriding shall be stress relieved by heating in a circulating air furnace or suitable oil bath to a temperature within the range 325° - 650°F (162.8° - 343.3°C), holding at the selected temperature within ±15°F (±8.3°C) for not less than 2 hr, and cooling in air.

3.5 Properties:

Shall be as follows, determined on parts or on the test specimens of 4.3.2.2:

3.5.1 Case Distribution: When parts are selectively nitrided, case shall appear on all surfaces required to be nitrided. Unless otherwise specified, a tolerance of -0, +1/8 in. (+3.2 mm) will be allowed on the boundaries of cased areas.

3.5.2 Nitride Distribution: The finished case shall show a uniform distribution of nitrides diminishing gradually from the surface to the core. When remaining white layer is permitted, the depth of the white layer shall be not greater than 0.0005 in. (0.013 mm). Examination shall be made on specimens polished, etched, and examined at 500X magnification.

3.5.3 Case Depth: Shall be as specified. Except when effective case depth is specified, requirements apply to total case depth, determined metallographically as the depth to a point of contrast between the case and core as revealed by a suitable etchant. Effective case depth, when specified, shall be the depth below the surface at which the hardness is 60 HRC or equivalent.

3.5.4 Case and Core Hardness: Shall be as specified, determined in accordance with ASTM E18 and ASTM E92, as applicable.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of nitrided 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 parts conform 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 or routine control tests.

4.2.1 Lot: A lot shall consist of all parts of one design, heat treated to the same core property requirements, nitrided in the same furnace at the same time, and submitted for inspection at the same time.

4.3 Sampling:

4.3.1 Preproduction: When requested, the vendor of nitrided parts shall furnish three preproduction samples of nitrided parts manufactured by the methods and procedures proposed for production. Until preproduction samples have been approved, production shall be at the risk of the vendor.

4.3.2 Production:

4.3.2.1 Sampling for visual and dimensional examination shall be in accordance with MIL-STD-105.

4.3.2.2 Three test specimens 1 in. (25 mm) diameter x 1/4 in. (6.4 mm) thick, or portions of forgings, of the same nominal chemical composition but not necessarily of the same heat of steel used for each production lot of nitrided parts.

4.4 Approval:

4.4.1 A nitrided part representative of the first lot processed for each new part and the processing cycle shall be approved by purchaser before nitrided parts for production use are supplied, unless such approval be waived. Results of tests on production parts shall be essentially equivalent to those on the approved samples.

4.4.2 Nitriding processor shall use equipment, atmosphere, thermal cycles, and methods of inspection on production parts which are essentially the same as those used on the approved sample parts. If necessary to make any changes in type of equipment, atmosphere, or thermal cycles, processor shall submit for reapproval of the process a detailed statement of the revised operations and, when requested, sample nitrided parts. No parts made by the revised procedure shall be shipped prior to receipt of reapproval.

4.5 Reports:

The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number, this specification number, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance. The vendor shall also report the nitriding cycle employed.

4.6 Resampling and Retesting:

If any specimen used in the above tests fails to meet the specified requirements, disposition of the parts may be based on the results of testing two additional specimens for each original nonconforming specimen. Except as permitted by 4.6.1, 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.

4.6.1 Parts which do not meet specified strength or hardness limits after processing as specified herein may be reprocessed as necessary and desired to meet specified requirements.

5. PREPARATION FOR DELIVERY:

5.1 Identification:

Nitrided parts shall be identified as agreed upon by purchaser and vendor. The markings shall have no deleterious effect on the parts or their performance and shall be sufficiently stable to withstand normal handling.

5.2 Protective Treatment:

Nitrided parts shall be coated with a suitable corrosion-preventive compound prior to shipment, unless otherwise permitted.

5.3 Packaging:

5.3.1 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.

5.3.2 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 in all quotations and when acknowledging purchase orders.

7. REJECTIONS:

Parts not nitrided in accordance with this specification or with authorized modifications will be subject to rejection.