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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 7312E
Superseding AMS 7312D

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PISTON RINGS, CENTRIFUGALLY-CAST IRON

1. SCOPE:

1.1 Type: This specification covers a centrifugally-cast, alloyed iron in the form of piston rings.

1.2 Application: Primarily for use as top compression rings, oil scraper rings, and dual oil control rings in aircraft piston engines.

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 SAE, 400 Commonwealth Drive, Warrendale, PA 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, PA 19103.

ASTM A247 - Evaluating the Microstructure of Graphite in Iron Castings
ASTM E8 - Tension Testing of Metallic Materials
ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E351 - Chemical Analysis of Cast Iron - All Types

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.3.2 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined on specimens as in 4.3.1 by wet chemical methods in accordance with ASTM E351, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser:

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	min	max
Total Carbon	2.85 -	3.50
Manganese	0.50 -	1.00
Silicon	0.95 -	1.45
Phosphorus	--	0.50
Sulfur	--	0.10

3.2 Condition: Rings shall be supplied in the following condition:

3.2.1 Fabrication: Rings shall be machined from centrifugally-cast sleeves which have been annealed and normalized.

3.2.2 Finish: Sides of rings shall be ground or lapped. Periphery shall be turned smooth.

3.3 Properties: Shall be as follows, determined on specimens prepared as in 4.3.2:

3.3.1 Test Specimens:

3.3.1.1 Tensile Strength: Shall be not lower than 70,000 psi (485 MPa), determined in accordance with ASTM E8.

3.3.1.2 Modulus of Elasticity: Shall be not lower than 17,000,000 psi (117 GPa), determined in flexure by applying a steadily increasing load to the 0.260 in. (6.50 mm) face of the specimen.

3.3.1.3 Hardness: Shall be 95 - 105 HRB, or equivalent, determined in accordance with ASTM E18.

3.3.2 Finished Rings: Shall conform to the following requirements:

3.3.2.1 Hardness: Shall be 95 - 105 HRB, or equivalent, determined in accordance with ASTM E18.

3.3.2.2 Microstructure: Shall consist of temper carbon nodules in a uniform pearlitic matrix, evaluated in accordance with ASTM A247. Small amounts of free ferrite associated with the graphite are permissible. Any particles of cementite shall be small and isolated.

3.3.2.3 Circularity: The diameter through the gap shall exceed the diameter 90 deg from the gap by not less than 0.0025 in. per in. (0.0025 mm/mm) of nominal ring diameter when finished ring is held around its periphery by a flexible steel band 0.0045 - 0.0055 in. (0.115 - 0.140 mm) thick and of width approximately equal to that of the ring and whose inside circumference is equal to the nominal outside circumference of ring ±0.003 in. (±0.08 mm).

3.3.2.4 Light-Tightness of Periphery: When finished ring is placed in a Ø circular gage whose ID is equal to the nominal OD of ring ±0.0005 in. (±0.012 mm), the portion of periphery on each side of the gap equal to 20% of the nominal OD of the ring shall be light-tight. The space between the balance of ring periphery and ID of gage shall be not greater than 0.0005 in. (0.012 mm) at any point and not less than 85% of the periphery of the ring shall be light-tight. Intermittent or fuzzy light shall be considered the same as light-tight. Light source shall be 40 W lamp.

3.3.2.5 Flatness: When weight of not more than 0.50 lb per inch (8.9 g/mm) of nominal OD of ring is applied to a ring supported in a gage having the same nominal diameter +0.001 in (+0.02 mm), -0.000, and having the same interior angle as the nominal angle between side face and periphery of ring, the ring shall show, by light gage, bluing, or other acceptable method, at least line contact around not less than 85% of the side face of the ring. This contact may be anywhere between the inside and outside circumference and may vary between these limits on any one ring. This contact shall indicate that ring side faces are not wavy.

3.3.2.6 Heat Stability: Finished rings, heated at 600°F ± 10 (315°C ± 5) for 60 min. ± 5 and cooled to room temperature while confined in a retaining ring having ID equal to the nominal OD of ring ±0.001 in. (±0.02 mm), shall retain not less than 90% of the original free gap opening.

3.4 Quality: Rings, as received by purchaser, shall be uniform in quality and Ø condition, sound, and free from foreign materials and from internal and external imperfections detrimental to usage of the rings.

3.5 Tolerances: Rings shall conform to the following tolerances, unless Ø otherwise specified:

3.5.1 Squareness of Periphery: The ring periphery shall be square with the Ø sides within 0.0005 in. (0.012 mm).

3.5.2 Wall Thickness: Shall be within the limits specified on the drawing but Ø shall not vary more than 0.004 in. (0.10 mm) throughout the circumference of any one ring.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of rings shall supply all samples for vendor's tests 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 sample and to perform any confirmatory testing deemed necessary to ensure that the rings conform to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and shall be performed on each melt or lot as applicable.

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed on the first-article shipment of a ring to a purchaser, when a change in material or processing, or both, requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be in accordance with the following; a lot shall be all sleeves cast in a period of eight consecutive hours and heat treated in a single furnace charge:

4.3.1 Composition: At least one sample from each melt. If composition is determined on the melt, a chilled pencil-type specimen is preferred for carbon determinations but other types of samples of proven accuracy may be used. If composition is determined on sleeves, a solid sample cut from the sleeve shall be used.

4.3.2 Mechanical Properties: At least one specimen from each lot of sleeves. Blanks for specimens shall be cut longitudinally from representative sleeves after final heat treatment. Tensile specimens shall be machined to have a cross section not smaller than the cross section of the finished ring. Modulus of elasticity specimens shall be machined to rectangular cross section 0.260 in. ± 0.005 (6.50 mm ± 0.12) wide and 0.140 in. ± 0.005 (3.56 mm ± 0.12) thick.

4.3.3 Hardness: Specimens shall be those on which tensile strength or modulus of elasticity is determined and shall be not less than one ring of each part number in each shipment.

4.3.4 Microstructure, Circularity, and Light-Tightness: As agreed upon by purchaser and vendor.