AEROSPACE MATERIAL SPECIFICATION

AMS7311	REV. G

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Superseding AMS7311F

Piston Rings, Centrifugally-Case Alloyed Iron 0.50Mo - 0.50Cu

RATIONALE

AMS7311G has been reaffirmed to comply with the SAE five-year review policy.

NONCURRENCY NOTICE

This specification has been declared “NONCURRENT” by the Aerospace Materials Division, SAE, as of January, 2004. It is recommended, therefore, that this specification not be specified for new designs.

“NONCURRENT” refers to those specifications which have previously been widely used and which may be required on some existing designs in the future. The Aerospace Materials Division, however, does not recommend these specifications for future use in new designs. “NONCURRENT” specifications are available from SAE upon request.

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1. SCOPE:

1.1 Type:

This specification covers a centrifugally-cast, alloyed iron in the form of sleeves for the fabrication of piston rings.

1.2 Application:

Primarily for use as top compression rings in aircraft piston engines. Rings usually require chromium plating for compatibility with the cylinder barrel material.

2. APPLICABLE DOCUMENTS:

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

2.1 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM A 247	Evaluating the Microstructure of Graphite in Iron Castings
ASTM E 8	Tension Testing of Metallic Materials
ASTM E 8M	Tension Testing of Metallic Materials (Metric)
ASTM E 18	Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E 351	Chemical Analysis of Cast Iron - All Types

2.2 U.S. Government Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, Pa 19111-5094.

2.2.1 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 E 351, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

	min		max
Total Carbon	2.85	-	3.50
Manganese	0.50	-	1.00
Silicon	1.00	-	1.65
Phosphorus	- -		0.30
Sulfur	- -		0.12
Molybdenum	0.35	-	0.65
Copper	0.35	-	0.65

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, hardened, and tempered.

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

3.3 Properties:

Shall conform to the following requirements:

3.3.1 Test Specimens: Shall be as follows, determined on specimens prepared as in 4.3.2:

3.3.1.1 Tensile Strength: Shall be not lower than 88,000 psi (607 MPa), determined in accordance with ASTM E 8 or ASTM E 8M.

3.3.1.2 Modulus of Elasticity: Shall be not lower than 20,000,000 psi (138 GPa), determined in flexure by applying a steadily increasing load to the 0.260 inch (6.60 mm) face of the specimen.

3.3.1.3 Hardness: Shall be 24 - 30 HRC, or equivalent, determined in accordance with ASTM E 18.

3.3.2 Finished Rings: Shall meet the following requirements:

3.3.2.1 Hardness: Shall be 24 - 30 HRC, or equivalent, determined in accordance with ASTM E 18.

3.3.2.2 Microstructure: Shall consist of tempered, partly-spheriodized martensitic matrix with evenlydistributed, isolated particles of cementite, evaluated in accordance with ASTM A 247. Graphite shall be present for most part as temper carbon nodules; primary graphite shall exist only as small, isolated areas. Free ferrite shall be absent.

3.3.2.3 Circularity: The diameter through the gap shall exceed the diameter 90 degrees from the gap by not less than 0.0025 inch/inch (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 (0.114 - 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 inch (± 0.076 mm).

3.3.2.4 Light-Tightness of Periphery: When finished ring is placed in a circular gage whose ID is equal to the nominal OD of ring ± 0.0005 inch (± 0.013 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 inch (0.013 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 a 40-watt lamp.

3.3.2.5 Flatness: When weight of not more than 0.50 pounds/inch (8.9 kg/m) of nominal OD of ring is applied to a ring supported in a gage having the same nominal diameter ±0.001 inch (±0.025 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 faces are not wavy.

3.3.2.6 Heat Stability: Finished rings, heated at 600°F ± 10 (316°C ± 6) for 60 minutes ±5 and cooled to room temperature while confined in a retaining ring having ID equal to the nominal OD of ring ± 0.001 inch (± 0.025 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 condition, sound, and free from foreign materials and from imperfections detrimental to usage of the rings.

3.5 Tolerances:

Rings shall conform to the following:

3.5.1 Squareness of Periphery: The ring periphery shall be square with the sides within 0.0005 inch (0.013 mm).

3.5.2 Wall Thickness: Shall be within the limits specified on the drawing but shall not vary more than 0.004 inch (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. 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:

Tests for all technical requirements of this specification are acceptance tests and preproduction tests and shall be performed prior to or on the first-article shipment of a ring to a purchaser, on each melt or lot as applicable, when a change in material and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.1 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, contracting officer, or request for procurement.

4.3 Sampling and Testing:

Shall be in accordance with the following; a lot shall be all sleeves cast in 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 sleeve after final heat treatment. Tensile specimens shall be machined to have a cross section not less than the cross section of the finished ring. Modulus of elasticity specimens shall be machined to rectangular cross section 0.260 inch ± 0.005 (6.60 mm ± 0.13) wide and 0.140 inch ± 0.005 (3.56 mm ± 0.13) 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, Light-Tightness, and Flatness: As agreed upon by purchaser and vendor.

4.3.5 Heat Stability: One ring from each shipment.