



AEROSPACE MATERIAL

Society of Automotive Engineers, Inc.

400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AMS7496F

Superseding AMS 7496E

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RINGS, FLASH WELDED Carbon and Low-Alloy Steels

1. SCOPE:

1.1 Form: This specification covers flash welded rings made of carbon and low-alloy steels (See 8.1).

1.2 Application: Primarily for parts such as flanges and rings.

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. Documents not listed herein, such as AMS not specifically mentioned and private specifications, shall be applicable in the issue specified on the purchase order.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, Pennsylvania 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods

AMS 2370 - Quality Assurance Sampling of Carbon and Low-Alloy Steels, Wrought Products
Except Forgings and Forging Stock

AMS 6302 - Steel Bars, Forgings, and Tubing, Low-Alloy Heat Resistant
0.65Si - 1.25Cr - 0.50Mo - 0.25V (0.28 - 0.33C)

AMS 6303 - Steel Bars and Forgings, Low-Alloy, Heat Resistant,
0.65Si - 1.25Cr - 0.50Mo - 0.85V (0.25 - 0.30C)

AMS 6412 - Steel Bars and Forgings, 0.80Cr - 1.8Ni - 0.25Mo
(0.35 - 0.40C) (4337)

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

ASTM A370 - Mechanical Testing of Steel Products

3. TECHNICAL REQUIREMENTS:

3.1 Material: Material from which rings are made shall be as specified on the drawing.

3.2 Fabrication:

3.2.1 Forming: Rings shall be formed from suitably rolled, extruded, or forged shapes. Grain flow in the formed rings shall be substantially circumferential.

3.2.2 Preparation for Welding: Formed rings shall be clean and free from foreign materials in the area of electrode contact and at the surfaces to be welded.

- 3.2.3 Welding: The ends of the formed rings shall be flash butt-welded together; there shall be only one weld per ring, unless otherwise permitted by purchaser. Welding shall be performed on a machine provided with accurate control of feed of joint during flashing, rate and distance of travel of sections to be welded, secondary voltage and current magnitude, and timing and current cut-off. The flash shall be maintained during the flashing interval of the welding operation. The amount of manual flashing, for purposes of preheating, shall be limited to 10% of total flashing distance. The machine shall be capable of repeating the sequence of operations independently of the skill of the operator. A record of all machine settings and sequence of operations for welding each different ring shall be kept by the vendor and be made available to the purchaser upon written request.
- 3.2.4 Heat Treatment: Unless otherwise specified, the welded rings shall be normalized by heating to the appropriate temperature, holding at heat for not less than 1 hr, and cooling as desired and tempered as necessary to produce the specified hardness. Materials such as AMS 6302, AMS 6303, and AMS 6412 may be cycle annealed to produce the specified hardness. For material less than 0.188 in. (4.78 mm) in thickness, time at normalizing heat may be reduced to 15 - 30 minutes.
- 3.2.5 Proof Testing Of Welds (Sizing): Unless otherwise specified, each ring, after cooling to room temperature following heat treatment, shall be tested to determine the quality of the weld. Each ring shall have flash and excess metal at the weld removed to within $+1/32$ in. ($+0.8$ mm) of parent metal surface either before or after heat treatment as in 3.2.4 but before sizing. Preliminary sizing may be done before cooling but final sizing shall be done at room temperature. The stress supplied for final sizing shall be sufficient to provide a permanent expansion of not less than 1% across a 2 in. (50.8 mm) gage length centered on the weld. Sizing shall be performed in such a way as to provide uniform stress distribution throughout the ring.
- 3.2.5.1 For rings made of material less than 0.188 in. (4.78 mm) in thickness, flash removal may reduce thickness below that of parent metal provided that the finished weld blends smoothly into adjacent metal and provided that thickness is not reduced below the minimum specified on the drawing for the parent metal; proof testing of such rings will be waived if welding precedes a final forming operation which involves an expansion of the weld equivalent to or exceeding that required by 3.2.5.
- 3.2.6 When the drawing or applicable material specification requires additional heat treatment, rings shall be so heat treated after sizing.
- 3.2.7 Restoration to Shape: If it is necessary to restore shape of rings following sizing, or following final heat treatment when specified, such operation shall be done on suitable presses and not by localized blows as from a hammer. Rings may be reheated for such operation but shall not be heated to a temperature higher than any prior tempering temperature.
- 3.2.8 Any descaling requirement shall be as agreed upon by purchaser and vendor.
- 3.3 Properties: Rings shall conform to the following requirements; hardness and tensile testing shall be performed in accordance with ASTM A370:
- 3.3.1 Tensile Properties Through Welded Area: Shall be as follows; test specimens shall be cut, after final heat treatment of the lot, from welded rings processed to this specification. When permitted by purchaser, rings to be supplied with additional heat treatment after the heat treatment of 3.2.4 may be tested in the normalized and tempered or the cycle annealed condition by the vendor but the final basis for acceptance shall be tests made on fully heat treated rings. Unless otherwise specified, tensile testing will not be required on rings made of material less than 0.188 in. (4.78 mm) in thickness for which proof testing is waived in 3.2.5.1.

3.3.1.1 Rings Having Specified Maximum Hardness Up to 241 HB, Incl, or Equivalent:

Tensile Strength, min	90% of parent metal in same ring
Elongation in 4D, min	60% of parent metal in same ring but not less than 15%

3.3.1.2 Rings Having Specified Maximum Hardness Higher than 241 HB or Equivalent:

Tensile Strength, min	90% of parent metal in same ring
Elongation, in 4D, min	50% of parent metal in same ring

3.3.1.2.1 When permitted by purchaser, rings not conforming to 3.3.1.2 will be considered acceptable if the tensile strength, determined after final heat treatment, is not lower than the minimum requirements of the material specification or of the drawing.

3.3.2 Hardness: Shall be not higher than 241 HB or equivalent, unless otherwise specified.

3.4 Quality:

3.4.1 Parts shall be uniform in quality and condition, clean, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance. Any controlled grain size requirement shall be as agreed upon by purchaser and vendor.

3.4.2 Parts shall be subject to nondestructive testing as agreed upon by purchaser and vendor.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the rings 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 rings 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.

Ø 4.3 Sampling: Shall be in accordance with AMS 2370.

4.4 Approval:

4.4.1 Sample parts shall be approved by purchaser as in 4.4.2, unless such approval be waived.

4.4.2 When a new vendor is being considered, new welding equipment is being placed in operation, settings on an old machine are changed, or changes in joint size or shape are made, the welding procedure shall be approved in the following manner: One or more rings from the first shipment of each size ring shall be selected at random. The ring or rings shall be subjected to tensile tests, hardness determinations, and examination of structure. If the requirements of 3.3.1 and 3.3.2 are met and the structure of the weld is satisfactory, the equipment and procedure will be considered satisfactory for making the weld.