Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

# AEROSPACE MATERIAL SPECIFICATION

AMS 7496G
Superseding AMS 7496F

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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.

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, PA 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, PA 19103.

ASTM A370 - Mechanical Testing of Steel Products

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

2.3.1 Military Standards:

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

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.





Printed in U.S.A.

3.2.2 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.

3.2.3 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 nominal thickness, time at normalizing heat may be reduced to 15 - 30 minutes.

3.2.3.1 For rings less than 0.188 in. (4.78 mm) in thickness, austenitizing and cooling are not normally required but, when required by purchaser, may be performed locally, unless otherwise specified.

3.2.3.2 Other Heat Treatment: When the drawing or applicable material specification requires additional heat treatment after the heat treatment of 3.2.3, rings shall be so heat treated.

3.2.4 Proof Testing of Welds (Sizing): Each ring, except as specified in 3.2.4.1, after cooling to room temperature following heat treatment, shall be tested to determine the quality of the weld, unless otherwise specified. 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 3.2.3 but before sizing. Preliminary sizing may be done before cooling but final sizing shall be done at room temperature. The stress applied for final sizing shall be sufficient to provide a permanent expansion of not less than 1% across a 2 in. (50 mm) gage length centered on the weld. Sizing shall be performed in such a way as to provide uniform stress distribution throughout the ring.

3.2.4.1 For rings made of material less than 0.188 in. (4.78 mm) in nominal 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 we waived if welding precedes a final forming operation which involves an expansion of the weld equivalent to or exceeding that required by 3.2.4.

3.2.5 When the drawing or applicable material specification requires additional heat treatment, rings shall be so heat treated after sizing.

3.2.6 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 localizing blows as from a hammer. Except as specified in 3.2.6.1, rings may be reheated for such operation but shall not be heated to a temperature higher than any prior tempering temperature.

3.2.6.1 When permitted by purchaser, restoration to shape may be performed in conjunction with cooling Ø from a heat treatment operation by placing the ring on a press which will produce slight (approximately 1/4%) expansion or compression of the ring diameter and flattening of the ring.

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: Shall be as follows determined on specimens 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 3.2.3 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. Tensile testing will not be required on rings made of material less than 0.188 in. (4.78 mm) in nominal thickness for which proof testing is waived in 3.2.4.1, unless otherwise specified.

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<br>60% of parent metal in same ring but not less than 15% |

3.2.1.2 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 |

3.3.1.3 Ø When permitted by purchaser, rings not conforming to 3.3.1 will be considered acceptable if the tensile properties through the welded area, determined after final heat treatment, are 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 Ø Rings as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to usage of the rings.

3.4.1.1 Any controlled grain size requirement shall be as agreed upon by purchaser and vendor.

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

4. QUALITY ASSURANCE PROVISIONS:

4.1 Ø Responsibility for Inspection: The vendor of 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 ensure that the rings conform to the requirements of this specification.

4.2 Ø Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and as preproduction tests.

4.2.1 Ø For direct U.S. Military procurement, substantiating test data and, when requested, preproduction rings 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 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.

4.4.3 Vendor shall use the same size, type, and shape of stock, type of forming equipment, heating cycles for forming and preheating welding schedule (except that current settings may be changed by ± 10%), heating and cooling procedures and atmospheres for heat treatment, cleaning operations, and methods of routine inspection for production rings as for approved sample rings. If necessary to make any changes in any of these factors, vendor shall submit for reapproval a statement of the proposed changes in processing and, when requested, sample rings produced by the revised procedure. Production rings incorporating the revised operations shall not be shipped prior to receipt of reapproval.

4.5 Reports:

4.5.1 The vendor of welded rings shall furnish with each shipment three copies of a report showing the results of tests for tensile properties and hardness of each lot. This report shall include the purchase order number, AMS 7496G, material specification number and its revision letter if any, contractor or other direct supplier of material, size or part number, heat number, and quantity from each lot. When material for making rings is produced or purchased by the ring vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of the applicable material 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.

4.5.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, AMS 7496G, material specification number and its revision letter if any, contractor or other direct supplier of welded rings, part number, and quantity. When welded rings for making parts are produced or purchased by the parts vendor, that vendor shall inspect each lot of rings to determine conformance to the requirements of this specification and the applicable material specification, and shall include in the report a statement that the rings conform to both applicable specifications, or shall include copies of laboratory reports showing the results of tests to determine conformance.

4.6 Resampling and Retesting: Shall be in accordance with AMS 2370.

5. PREPARATION FOR DELIVERY:

5.1 Identification: Rings shall be identified as agreed upon by purchaser and vendor.

5.2 Packaging:

5.2.1 Rings shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of these rings to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

5.2.2 For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-794, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.2.1 will be acceptable if it meets the requirements of Level C.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Rings not conforming to this specification or to authorized modifications will be subject to rejection.

8. NOTES: