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

AEROSPACE MATERIAL SPECIFICATION

AMS 7493H
Superseding AMS 7493G

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RINGS, FLASH WELDED
Non-Austenitic Corrosion Resistant Steels

1. SCOPE:

1.1 Form: This specification covers flash welded rings made of non-austenitic corrosion resistant steels.

1.2 Application: Primarily for parts such as flanges and rings requiring corrosion and moderate heat resistance.

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 2371 - Quality Assurance Sampling of Corrosion and Heat Resistant Steels and Alloys, Wrought Products Except Forgings and Forging Stock
AMS 5613 - Steel Bars, Forgings, Tubing, and Rings, Corrosion and Moderate Heat Resistant, 12.5Cr (SAE 51410)
AMS 5614 - Steel, Corrosion and Moderate Heat Resistant, 12Cr - 0.5Mo
AMS 5615 - Steel Bars and Forgings, Corrosion and Moderate Heat Resistant, 12.5Cr - 1.9Ni (SAE 51414)
AMS 5616 - Steel Bars, Forgings, Tubing, and Rings, Corrosion and Moderate Heat Resistant, 13Cr - 2.0Ni - 3.0W

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 U.S. 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: 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 request.

3.2.4 Annealing: The welded rings shall be annealed by heating to a temperature within the range 1200° - 1500°F (650° - 815°C), holding at the selected temperature within ± 25°F (± 15°C) for not less than 1 hr, and cooling in air. When specified by purchaser, rings made of AMS 5613 or AMS 5616 shall be austenitized by heating to not lower than 1750°F (955°C) and not higher than 1850°F (1010°C) and cooled to room temperature before annealing. Annealing shall precede sizing as in 3.2.5 except that non-hardenable steels may be sized before annealing.

3.2.4.1 If the drawing or material specification specifies the annealing cycle, the rings shall be annealed in accordance therewith.

3.2.4.2 For rings less than 0.188 in. (4.78 mm) in nominal thickness, austenitizing and cooling are not required and, when permitted by purchaser, annealing may be performed locally by heating the weld zone to the proper temperature within the range specified in 3.2.4, holding at heat for 15 - 30 min., and cooling in air.

3.2.5 Proof Testing of Weld (Sizing): Each ring, after cooling to room temperature, 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 annealing 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 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.

3.2.5.1 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 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 annealing, or following final heat treatment when specified, such operation shall be done on suitable presses and not by localized blows as from a hammer. Except as specified in 3.2.7.1, rings may be reheated for such operation but shall not be heated to a temperature higher than any prior tempering temperature.

3.2.7.1 When permitted by purchaser, restoration to shape may be performed in conjunction with cooling 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, determined in accordance with ASTM A370:

3.3.1 Tensile Properties Through Welded Area: 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 annealing may be tested in the 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 3.2.5.1, 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
Elongation in 4D, min	60% of parent metal in same ring

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

3.3.1.3 When permitted by purchaser, rings not conforming to 3.3.1.1 or 3.3.1.2 will be 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: Rings shall have hardness not higher than 241 HB or equivalent, unless otherwise specified.

3.4 Quality:

3.4.1 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.

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

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of rings shall supply all samples for vendor's tests and ø 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 such confirmatory testing as he deems 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 ø are classified as acceptance tests and shall be performed on each lot.

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 requires reapproval as in 4.4.3, 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 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 2371 and the following:

4.3.1 Extent of sampling for nondestructive testing shall be as agreed upon by purchaser and vendor.

4.4 Approval:

4.4.1 Sample rings 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 that 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 change in parameters for any of the above factors, vendor shall submit for reapproval a statement of the proposed changes in processing and, when requested, sample rings. 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 7493H, 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 7493H, 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 2371.