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INTERNATIONAL
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 7493J

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Submitted for recognition as an American National Standard

Superseding AMS 7493H

RINGS, FLASH WELDED
Ferritic and Martensitic Corrosion Resistant Steels

UNS S41000

1. SCOPE:

1.1 Form:

This specification covers flash welded rings made of ferritic and martensitic corrosion resistant steels.

1.2 Application:

These rings have been used typically for parts, such as flanges and rings, requiring both corrosion and moderate heat resistance, but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS:

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

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2371 Quality Assurance Sampling and Testing, Corrosion and Heat Resistant Steels and Alloys, Wrought Products and Forging Stock
AMS 5613 Steel Bars, Wire, Forgings, Tubing, and Rings, Corrosion and Moderate Heat Resistant, 12.5Cr (SAE 51410), Annealed
AMS 5616 Steel Bars, Forgings, Tubing, and Rings, Corrosion and Moderate Heat Resistant, 13Cr - 2.0Ni - 3.0W, Annealed

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2.2 ASTM Publications:

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

ASTM A 370 Mechanical Testing of Steel Products

2.3 U.S. Government Publications:

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

MIL-STD-2073-1 DOD Materiel, Procedures for Development and Application of Packaging Requirements

3. TECHNICAL REQUIREMENTS:

3.1 Material:

(R)

Shall be a ferritic or martensitic corrosion-resistant steel 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 surface to be welded.

3.2.3 Welding: The ends of the formed rings shall be flash butt-welded together with only one weld per ring. Welding shall be performed on a machine provided with accurate control of feed of joint during flashing, rate and distance of travel of section 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 purpose 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 significant machine settings and sequence of operations for welding each difference type (part number) ring shall be maintained by the vendor and made available for examination by purchaser upon written request.

3.2.4 Annealing: The welded rings shall be annealed by heating to a temperature within the range 1200 to 1500 °F (649 to 816 °C), holding at the selected temperature within ±25 °F (±14 °C) for not less than 1 hour, and cooling in air or faster. When specified by purchaser, rings made of AMS 5613 or AMS 5616 shall be austenitized by heating to a temperature not lower than 1750 °F (954 °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 under 0.188 inch (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 to 30 minutes, and cooling in air.

3.2.5 Proof Testing of Welds (Sizing): Each ring, after cooling to room temperature, 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 inch (+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-inch (50.8-mm) gage length centered on the weld. The 1% minimum permanent expansion shall be verified by measurement on at least one ring from each welding lot. 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 steel under 0.188 inch (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 may 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 operations shall be done on suitable presses and not be 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 A 370:

3.3.1 (R) 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 from product under 0.188 inch (4.78 mm) in nominal 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, Inclusive, or Equivalent:

Tensile Strength, minimum	90% of parent metal in same ring
Elongation in 4D, minimum	60% of parent metal in same ring

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

Tensile Strength, minimum	90% of parent metal in same ring
Elongation in 4D, minimum	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 a higher hardness is specified on the part drawing.

3.4 Quality:

3.4.1 Rings, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign material and from imperfections detrimental to usage of the rings.

3.4.2 Rings shall be subjected to nondestructive testing. Method of testing and standards for acceptance shall be as agreed upon by purchaser and vendor.

4. QUALITY ASSURANCE PROVISIONS:

4.1 (R) 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:
(R)

Tests for all technical requirements are acceptance tests and preproduction tests and shall be performed prior to or on the initial shipment of rings to a purchaser, on each heat or lot as applicable, when a change in material and/or processing requires reapproval as in 4.4.3, 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:
(R)

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 by purchaser.

4.4.2 When a new vendor is being considered, new welding equipment is being placed in operation, settings on an existing 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 shall 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 inspection for production rings as for approved sample rings. If necessary to make any changes 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.

4.4.3.1 Reapproval may be waived by purchaser or parts may be reapproved by following the approval procedure of 4.4.2.