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) and Aerospace Recommended Practices (ARP) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2241 - Tolerances, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Bars and Wire
AMS 2243 - Tolerances, Corrosion and Heat Resistant Steel Tubing
AMS 2248 - Chemical Check Analysis Limits, Wrought Corrosion and Heat Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys
AMS 2300 - Premium Aircraft-Quality Steel Cleanliness, Magnetic Particle Inspection Procedure
AMS 2315 - Determination of Free Ferrite Content
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 2374 - Quality Assurance Sampling of Corrosion and Heat Resistant Steels and Alloys, Forgings and Forging Stock
AMS 2375 - Control of Forgings Requiring First Article Approval
AMS 2806 - Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Heat and Corrosion Resistant Steels and Alloys
AMS 2808 - Identification, Forgings
AMS 7490 - Rings, Flash Welded, Corrosion and Heat Resistant Austenitic Steels and Austenitic-Type Alloys

2.1.2 Aerospace Recommended Practices:

ARP 1110 - Minimizing Stress Corrosion Cracking in Heat Treatable Wrought Low Alloy and Martensitic Corrosion Resistant Steels

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
ASTM A604 - Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets
ASTM E340 - Macroetching Metals and Alloys
ASTM E353 - Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

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

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.3.2 Military Standards:

MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, Ø determined by wet chemical methods in accordance with ASTM E353, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser:

	min	max
Carbon	--	0.07
Manganese	--	1.00
Silicon	--	1.00
Phosphorus	--	0.025
Sulfur	--	0.025
Chromium	15.00	17.50
Nickel	3.00	5.00
Columbium + Tantalum	5 x C	0.45
Copper	3.00	5.00
Molybdenum	--	0.50

3.1.1 Check Analysis: Composition variations shall meet the requirements of AMS 2248.

3.2 Condition: The product shall be supplied in the following condition:

3.2.1 Bars and Wire:

3.2.1.1 Rounds: Solution heat treated and centerless ground or, when so Ø ordered, centerless ground and polished or cold drawn, solution heat treated, and descaled.

3.2.1.2 Hexagons: Cold drawn, solution heat treated, and descaled. Ø

3.2.1.3 Squares and Flats: Hot finished, solution heat treated, and descaled.

3.2.2 Forgings and Flash Welded Rings: Solution heat treated and descaled.

3.2.2.1 Flash welded rings shall not be supplied unless specified or permitted on purchaser's part drawing. When supplied, they shall be manufactured in accordance with AMS 7490.

3.2.3 Mechanical Tubing: Hot finished, solution heat treated, and descaled.

Ø

3.2.4 Stock for Forging, Flash Welded Rings, or Heading: As ordered by the Ø forging, flash welded ring, or heading manufacturer.

3.3 Heat Treatment: Bars, wire, forgings, mechanical tubing, and flash welded rings shall be solution heat treated by heating to 1900°F ± 25 (1040°C ± 15), holding at heat for a time commensurate with section thickness and with heating equipment and procedure used, and cooling as required to below 90°F (30°C).

3.3.1 Flash welded rings may, when permitted by purchaser, be given a homogeniza- Ø tion heat treatment prior to solution heat treatment. When such treatment is permitted, the rings shall be heated to 2100°F ± 25 (1150°C ± 15), held at heat for not less than 90 min., and cooled in air.

3.4 Properties: The product shall conform to the following requirements; Ø tensile and hardness testing shall be performed in accordance with ASTM A370:

3.4.1 All Products: Shall be as follows for product 8.0 in. (200 mm) and under Ø in nominal diameter or distance between parallel sides; properties of product over 8.0 in. (200 mm) in nominal diameter or distance between parallel sides shall be as agreed upon by purchaser and vendor:

3.4.1.1 Macrostructure: Visual examination of transverse sections as in 4.3.3 from bars, billets, tube rounds or tubes, and stock for forging, flash welded rings, or heading, etched in accordance with ASTM A604 in hot hydrochloric acid (1:1) at 160° - 180°F (70° - 80°C) for sufficient time to develop a well-defined macrostructure, shall show no pipe or cracks.

Ø Except as specified in 3.4.1.1.1, porosity, segregation, inclusions, and other imperfections for product 36 sq in. (230 cm^2) and under in nominal cross-section shall be no worse than the following macrographs of ASTM A604; macrostructure standards for product over 36 sq in. (230 cm^2) in nominal cross-sectional area shall be as agreed upon by purchaser and vendor:

Class	Condition	Severity
1	Freckles	A
2	White Spots	A
3	Radial segregation	A
4	Ring pattern	B

3.4.1.1.1 If tubes are produced directly from ingots or large blooms, transverse Ø sections may be taken from tubes rather than tube rounds. Macrostructure standards for such tubes shall be as agreed upon by purchaser and vendor.

3.4.1.2 Microstructure: The product shall contain not more than 5% free
Ø ferrite, determined in accordance with AMS 2315.

3.4.2 Bars, Wire, Forgings, Mechanical Tubing, and Flash Welded Rings:

3.4.2.1 As Solution Heat Treated:

3.4.2.1.1 Hardness:

3.4.2.1.1.1 Bars: Not higher than 363 HB or equivalent, determined at approximately mid-radius or quarter-thickness.

3.4.2.1.1.2 Forgings, Mechanical Tubing, and Flash Welded Rings: Not higher than 363 HB or equivalent.

3.4.2.1.2 Tensile Properties: Wire shall have tensile strength not higher than 175,000 psi (1205 MPa) or equivalent hardness.

3.4.2.2 After Precipitation Heat Treatment: The solution heat treated product, precipitation heat treated to a particular condition in accordance with the corresponding temperatures and times shown in Table I and cooled in
Ø air, shall have the properties shown in 3.4.2.2.1 and 3.4.2.2.2 for that particular condition. Tensile and hardness tests shall be made in only one precipitation heat treated condition. Unless otherwise specified by purchaser, the precipitation heat treated testing condition shall be H900.

TABLE I

Condition	Temperature	Time
H900	900°F ± 10 (480°C ± 5)	1 hr ± 0.1
H925	925°F ± 10 (495°C ± 5)	4 hr ± 0.3
H1025	1025°F ± 10 (550°C ± 5)	4 hr ± 0.3
H1075	1075°F ± 10 (580°C ± 5)	4 hr ± 0.3
H1100	1100°F ± 10 (595°C ± 5)	4 hr ± 0.3
H1150	1150°F ± 10 (620°C ± 5)	4 hr ± 0.3

3.4.2.2.1 Tensile Properties: Shall be as specified in Table II.

3.4.2.2.1.1 Longitudinal tensile property requirements apply to specimens taken in the longitudinal direction from bars, wire, and extrusions, to
Ø specimens taken from forgings with axis of specimen in the area of gage length varying not more than 15 deg from parallel to the forging flow lines, and to specimens taken in the circumferential direction from flash welded rings.

3.4.2.2.1.2 Transverse tensile property requirements apply to specimens taken approximately perpendicular to the longitudinal direction of bars and extrusions, to specimens taken from forgings with axis of specimen in the area of gage length varying not more than 15 deg from perpendicular to the forging flow lines, and to specimens taken in the radial direction from flash welded rings.

3.4.2.2.1.3 Transverse tensile property requirements apply only to products from which a test specimen not less than 2-1/2 in. (62.5 mm) long or 1/2 in. (12.5 mm) x 1/2 in. (12.5 mm) cross-section can be taken.

3.4.2.2.1.4 Products tested in the transverse direction need not be tested in the longitudinal direction.

3.4.2.2.2 Hardness: Should be within the range shown in Table III, or equivalent, for the corresponding precipitation heat treated condition but the product shall not be rejected on the basis of hardness if the tensile property requirements of Table II are met.

TABLE III

Condition	Hardness, HB
H900	388 - 444
H925	375 - 429
H1025	331 - 401
H1075	311 - 375
H1100	302 - 363
H1150	277 - 352

3.4.3 Forging Stock: When a sample of stock is forged to a test coupon and heat treated as in 3.3 and 3.4.2.2, specimens taken from the heat treated coupon shall conform to the requirements of 3.4.2.2.1 and 3.4.2.2.2. If specimens taken from the stock after heat treatment as in 3.3 and 3.4.2.2 conform to the requirements of 3.4.2.2.1 and 3.4.2.2.2, the tests shall be accepted as equivalent to tests of a forged coupon.

3.4.4 Stock for Flash Welded Rings or Heading: Specimens taken from the stock after heat treatment as in 3.3 and 3.4.2.2 shall conform to the requirements of 3.4.2.2.1 and 3.4.2.2.2.

3.5 Quality:

3.5.1 Steel shall be premium aircraft-quality conforming to AMS 2300. It shall be multiple melted using consumable electrode practice in the remelt cycle.

3.5.2 The product, 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 product.

3.5.2.1 Forgings shall have substantially uniform macrostructure and grain flow. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.6 Sizes: Except when exact lengths or multiples of exact lengths are ordered, straight bars, wire, and tubing will be acceptable in mill lengths of 6 - 20 ft (2 - 6 m) but not more than 10% of any shipment shall be supplied in lengths shorter than 10 ft (3 m).

3.7 Tolerances: Unless otherwise specified, tolerances shall conform to all applicable requirements of the following:

3.7.1 Bars and Wire: AMS 2241.

3.7.2 Mechanical Tubing: AMS 2243.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product shall supply all samples for vendor's tests 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 sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to the following requirements are classified as acceptance tests and shall be performed on each heat or lot as applicable:

4.2.1.1 Composition (3.1) and macrostructure (3.4.1.1) of each heat.

4.2.1.2 Hardness (3.4.2.1.1) of each lot of bars, forgings, mechanical tubing, and flash welded rings as solution heat treated.

4.2.1.3 Tensile strength of each lot of wire (3.4.2.1.2) as solution heat treated.

4.2.1.4 Tensile properties (3.4.2.2.1) and hardness (3.4.2.2.2) of each lot of bars, wire, forgings, mechanical tubing, and flash welded rings after precipitation heat treatment at 900°F ± 10 (480°C ± 5) unless purchaser specifies another precipitation heat treatment temperature.

4.2.1.5 Tolerances (3.7) of bars, wire, and mechanical tubing.

4.2.2 Periodic Tests: Tests of forging stock (3.4.3) and stock for flash welded rings or heading (3.4.4) to demonstrate ability to develop required properties, microstructure (3.4.1.2) for products 3 in. (75 mm) and under in cross-section, and AMS 2300 frequency-severity rating (3.5.1) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.2.3 Preproduction Tests: Tests of forgings to determine conformance to all applicable technical requirements of this specification when AMS 2375 is Ø specified are classified as preproduction tests and shall be performed on the first-article shipment of a forging to a purchaser, when a change in material or processing, or both, requires reapproval as in 4.4, and when purchaser deems confirmatory testing to be required.

4.2.3.1 For direct U.S. Military procurement of forgings, substantiating test Ø data and, when requested, preproduction forgings 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 the following; a heat shall be the Ø consumable electrode remelted ingots produced from steel originally melted as a single furnace charge:

4.3.1 Bars, Wire, Mechanical Tubing, Flash Welded Rings, and Stock for Flash Ø Welded Rings or Heading: AMS 2371.

4.3.2 Forgings and Forging Stock: AMS 2374. Ø

4.3.3 Samples for macrostructure (3.4.1.1) testing shall be full cross-sectional Ø specimens obtained from the finished billet or suitable rerolled product representing the top and bottom of at least the first, middle, and last usable ingots of each heat.

4.4 Approval: When specified, approval and control of forgings shall be in Ø accordance with AMS 2375.

4.5 Reports:

4.5.1 The vendor of the product shall furnish with each shipment three copies of a report showing the results of tests for chemical composition and microstructure of each heat and for tensile properties and hardness of each lot and stating that the product conforms to the other technical Ø requirements of this specification. This report shall include the purchase order number, heat number, AMS 5622A, type of melting used, size, and quantity from each heat. If forgings are supplied, the part number and the size and melt source of stock used to make the forgings shall also be included.