

**STEEL BARS AND FORGINGS, HIGH EXPANSION
9.5Ni - 5.5Mn (0.55 - 0.65C)
Annealed**

UNS K91456

1. SCOPE:

1.1 Form This specification covers a high-expansion steel in the form of bars, forgings, and forging stock.

1.2 Application: Primarily for parts, such as bushings and spacers, requiring a coefficient of thermal expansion approaching that of aluminum alloys. This steel is hardenable only by cold working.

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.

2.1.1 Aerospace Material Specifications:

AMS 2241 - Tolerances, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium and Titanium Alloy Bars and Wire

MAM 2241 - Tolerances, Metric, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium and Titanium Alloy Bars and Wire

AMS 2248 - Chemical Check Analysis Limits, Wrought Corrosion and Heat Resistant Steels and Alloys, Mraging and Other Highly Alloyed Steels, and Iron Alloys

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

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2.1.1 (Continued):

**AMS 2806 - Identification, Bars, Wire, Mechanical Tubing, and Extrusions,
Carbon and Alloy Steels and Corrosion and Heat Resistant
Steels and Alloys**

AMS 2808 - Identification, Forgings

2.1.2 Aerospace Standards:

**AS1182 - Standard Machining Allowance, Aircraft Quality and Premium
Aircraft Quality Steel Products**

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

ASTM E 10 - Brinell Hardness of Metallic Materials

**ASTM E 228 - Linear Thermal Expansion of Solid Materials with a Vitreous
Silica Dilatometer**

**ASTM E 353 - Chemical Analysis of Stainless, Heat-Resisting, Maraging, and
Other Similar Chromium-Nickel-Iron Alloys**

2.3 U.S. Government Publications: Available from Naval Publications and Forms Center, Attn: NPODS, 5801 Tabor Avenue, Philadelphia, PA 19120-5099.**2.3.1 Military Standards:**

ML-STD-163 - Steel M11 Products, Preparation for Shipment and Storage

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight,
0 determined by wet chemical methods in accordance with ASTM E 353, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

	min	max
Carbon	0.55	0.65
Manganese	5.00	6.00
Silicon	--	1.00
Phosphorus	--	0.040
Sulfur	--	0.030
Nickel	8.50	10.50

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

3.2 Condition:

3.2.1 Bars: Annealed.

**3.2.1.1 Bars 2.75 Inches (69.8 mm) and Under in Nominal Diameter or Distance
0 Between Parallel Sides and Hexagons: Annealed and cold finished.**

- 3.2.1.2 Bars, Other Than Hexagons. Over 2.75 Inches (69.8 mm) in Nominal Diameter or Distance Between Parallel Sides: Hot finished and annealed.**
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- 3.2.2 Forgings: Annealed.**
- 3.2.3 Forging Stock: As ordered by the forging manufacturer.**
- 3.3 Properties: The product shall conform to the following requirements:**
- 3.3.1 Hardness: Shall be 149 - 179 HB, or equivalent, determined in accordance with ASTM E 10.**
- 3.3.2 Coefficient of Thermal Expansion: Shall be not lower than 11.5×10^{-6} inch/inch per F degree (20.7×10^{-6} mm/mm per C degree) over the temperature range 72° - 600° F (22° - 316° C), determined in accordance with ASTM E 228.**
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- 3.4 Quality: The product, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections**
- 3.4.1 Bars ordered hot rolled, cold drawn, ground, turned, or polished shall, after removal of the standard machining allowances in accordance with AS1182, be free from seams, laps, tears, and cracks open to the thereby created ground, turned, or polished surfaces.**
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- 3.4.2 Grain flow of die forgings, except in areas which contain flash-line end grain, shall follow the general contour of the forgings showing no evidence of re-entrant grain flow.**
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- 3.5 Sizes: Except when exact lengths or multiples of exact lengths are ordered, straight bars will be acceptable in mill lengths of 6 - 20 feet (1.8 - 6.1 m) but not more than 10% of any shipment shall be supplied in lengths shorter than 10 feet (3 m).**
- 3.6 Tolerances: Bars shall conform to all applicable requirements of AMS 2241 or MAM 2241.**
- 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 4.4. 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 for composition (3.1), hardness (3.3.1), and tolerances (3.6) are acceptance tests and shall be performed on each heat or lot as applicable.**

4.2.2 Periodic Tests: Tests for coefficient of thermal expansion (3.3.2) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing: Shall be in accordance with the following:

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4.3.1 Bars: AMS 2371.

4.3.2 Forgings and Forging Stock: AMS 2374.

4.4 Reports:

4.4.1 The vendor of bars and forgings shall furnish with each shipment a report showing the results of tests for chemical composition of each heat and for hardness of each lot, and, when performed, the results of tests to determine conformance to the periodic test requirements. This report shall include the purchase order number, lot number, AMS 5623B, size, and quantity. If forgings are supplied, the part number and the size and melt source of stock used to make the forgings shall also be included.

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4.4.2 The vendor of forging stock shall furnish with each shipment a report showing the results of tests for chemical composition of each heat. This report shall include the purchase order number, heat number, AMS 5623B, size, and quantity.

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4.5 Resampling and Retesting: Shall be in accordance with the following:

4.5.1 Bars: AMS 2371.

4.5.2 Forgings and Forging Stock: AMS 2374.

5. PREPARATION FOR DELIVERY:

5.1 Identification: Shall be as follows:

5.1.1 Bars: In accordance with AMS 2806.

5.1.2 Forgings: In accordance with AMS 2808.

5.1.3 Forging Stock: As agreed upon by purchaser and vendor.

5.2 Packaging:

5.2.1 The product 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 the product to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.