

STEEL BARS, HIGH EXPANSION  
9.5Ni - 5.5Mn (0.55 - 0.65C)  
Cold Finished

1. SCOPE:

- 1.1 Form: This specification covers a high-expansion steel in the form of bars 1.063 in. (27 mm) and under in nominal diameter or distance between parallel sides.
- 1.2 Application: Primarily for bolts and screws 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 Aerospace Material Specifications (AMS) and Aerospace Standards (AS) 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 and 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, Maraging and Other Highly-Alloyed Steels, and Iron Alloys
- 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 2806 - Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Heat and Corrosion Resistant Steels and Alloys

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## 2.1.2 Aerospace Standards:

AS 1182 - Standard Machining Allowance, Aircraft Quality and Premium Quality Steel Products

## 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 B95 - Linear Expansion of Metals

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, 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     | 0.55 | 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: Cold finished.

3.3 Properties: Bars shall conform to the following requirements; tensile and hardness testing shall be performed in accordance with ASTM A370:

### 3.3.1 Tensile Properties:

3.3.1.1 Shall be as follows for bars 1 in. (25 mm) and under in nominal diameter or distance between parallel sides:

|                                    |                       |
|------------------------------------|-----------------------|
| Tensile Strength, min              | 125,000 psi (860 MPa) |
| Yield Strength at 0.2% Offset, min | 100,000 psi (690 MPa) |
| Elongation in 4D, min              | 16%                   |
| Reduction of Area, min             | 30%                   |

3.3.1.2 Shall be as follows for product over 1 in. (25 mm) to 1.063 in. (27 mm), incl, in nominal diameter or distance between parallel sides:

|                                    |                       |
|------------------------------------|-----------------------|
| Tensile Strength, min              | 120,000 psi (825 MPa) |
| Yield Strength at 0.2% Offset, min | 90,000 psi (620 MPa)  |
| Elongation in 4D, min              | 16%                   |
| Reduction of Area, min             | 30%                   |

3.3.2 Hardness: Shall be as follows or equivalent:

| Nominal Diameter or Distance<br>Between Parallel Sides |                     | Hardness, Brinell |
|--|---------------------|-------------------|
| Inches   | Millimetres         |                   |
| Up to 1.000, incl                                      | Up to 25, incl      | 255 - 331         |
| Over 1.000 to 1.063, incl                              | Over 25 to 27, incl | 248 - 331         |

3.3.3 Coefficient of Thermal Expansion: Shall be not lower than  
 $\emptyset$   $11.5 \times 10^{-6}$  in./in. per F deg ( $20.7 \times 10^{-6}$  mm/mm per C deg) over the temperature range 72° - 600°F (22° - 316°C), determined in accordance with ASTM B95.

3.4 Quality: Bars, 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 bars.

3.4.1 Bars, after removal of the standard machining allowance, shall be free  
 $\emptyset$  from seams, laps, tears, cracks, and other defects exposed to the machined surfaces. Standard machining allowance shall be in accordance with AS 1182.

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 ft (2 - 6 m) but not more than 10% of any shipment shall be supplied in lengths shorter than 10 ft (3 m).

3.6 Tolerances: Unless otherwise specified, tolerances shall conform to all applicable requirements of AMS 2241 or MAM 2241.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of bars 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 bars conform to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to requirements for composition (3.1), tensile properties (3.3.1), hardness (3.3.1), and tolerances (3.6) are classified as acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for coefficient of thermal expansion (3.3.3) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling: Shall be in accordance with AMS 2371.

4.4 Reports:

4.4.1 The vendor of bars shall furnish with each shipment three copies of a report showing the results of tests for chemical composition of each heat and for tensile properties and hardness of each lot and stating that the bars conform to the other technical requirements of this specification. This report shall include the purchase order number, heat number, AMS 5625B, size, and quantity from each heat.

4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, AMS 5625B, contractor or other direct supplier of bars, part number, and quantity. When bars for making parts are produced or purchased by the parts vendor, that vendor shall inspect each lot of bars to determine conformance to the requirements of this specification and shall include in the report either a statement that the bars conform or copies of laboratory reports showing the results of tests to determine conformance.

4.5 Resampling and Retesting: Shall be in accordance with AMS 2371.

5. PREPARATION FOR DELIVERY:

5.1 Identification: Bars shall be identified in accordance with AMS 2806.