



AEROSPACE MATERIAL SPECIFICATION

AMS2371™**REV. M**

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Superseding AMS2371L

(R) Quality Assurance Sampling and Testing,
Corrosion- and Heat-Resistant Steels and Alloys,
Wrought Products and Forging Stock

RATIONALE

AMS2371M is the result of a Five-Year Review and update of the specification. The revision restructures heat and lot definitions consistent with other specs (see 3.3.1 and 3.3.2), updates fractions to decimal equivalents and adds metric conversions consistent with referenced ASTM when applicable (throughout), adds embrittlement and revises test requirements (see 3.3.3.2), adds strain rate control (see 3.3.3.2.1), adds impact testing (see 3.3.3.3), adds fracture toughness specimen and testing requirements (see 3.3.3.4), adds single melt materials (see 3.3.3.5.1), revises retesting requirements and adds fracture toughness (see 3.3.5.3 and 3.3.5.3.1), updates reporting of invalid tests (see 3.3.5.5), and updates Table 2 to cover macrostructure but removes frequency and severity as it is covered elsewhere.

1. SCOPE

This specification covers quality assurance sampling and testing procedures used to determine conformance to applicable material specification requirements of wrought corrosion- and heat-resistant steel and alloy products and of forging stock.

1.1 Attributes included in detail herein are composition, tensile properties, macrostructure, microstructure, hardness, and micro-inclusion rating. Other requirements are included in Table 2.

1.2 Quality assurance sampling and testing procedures for forgings are covered in AMS2374.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (U.S. and Canada only) or +1 724-776-4970 (outside U.S. and Canada), www.sae.org.

AMS2374 Quality Assurance Sampling and Testing, Corrosion- and Heat-Resistant Steel and Alloy Forgings

AS7766 Terms Used in Aerospace Metals Specifications

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2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A370	Mechanical Testing of Steel Products
ASTM E8/E8M	Tension Testing of Metallic Materials
ASTM E10	Brinell Hardness of Metallic Materials
ASTM E23	Notched Bar Impact Testing of Metallic Materials
ASTM E292	Conducting Time-for-Rupture Notch Tension Tests of Materials
ASTM E399	Metallic Material Fracture Toughness Testing

2.3 Definitions

Terms used in AMS are defined in AS7766.

3. TECHNICAL REQUIREMENTS

3.1 General

- 3.1.1 Omission from this specification of confirmatory tests of certain material properties or attributes controlled by the applicable material specification does not relieve the producer of responsibility for furnishing products that conform in all respects to the applicable material specification.
- 3.1.2 In event of conflict between requirements specified herein and requirements of a particular material specification, requirements of the material specification shall take precedence.

3.2 Responsibility for Tests

The producer of the product shall supply all samples for the producer's tests and shall be responsible for the performance of all required tests. Results of such tests shall be reported to the purchaser as required by the applicable material specification.

3.3 Detail Requirements

3.3.1 Heat

A heat shall be all steel melted in a single furnace charge. For consumable electrode remelted steel, a heat shall be all consumable electrode remelted ingots processed from steel or alloy originally melted as a single furnace charge.

3.3.2 Lot

A lot shall be a mill form of one shape, condition, and nominal cross-sectional dimensions from a single heat, processed in accordance with 3.3.2.1 or 3.3.2.2.

- 3.3.2.1 Sequentially heat treated during a 24-hour period in a continuous furnace with no interruption in operations and no change in furnace temperature, charge rate, or racking pattern.

- 3.3.2.1.1 Time may be extended to 120 hours for austenitic, non-hardenable grades.

- 3.3.2.1.2 The nominal cross-sectional dimension restriction may be disregarded when multiple sizes are heat treated in a single batch or during an 8-hour period in a continuous furnace operating at a constant speed. In such cases, tensile and macrostructure testing shall be performed on the size having the greatest equivalent round cross section. The equivalent round cross section shall be determined by multiplying wall thickness of tubing and thickness or diameter of solids by the shape factors shown in Table 1.

Table 1 - Shape factors

Product	Shape Factor
Tubing	2.0
Rounds	1.0
Hexagons	1.1
Squares	1.25
Flats	1.50

- 3.3.2.2 Sequentially heat treated during a 48-hour period in one or a series of batch-type furnace loads provided the loads are processed in the same furnace or same series of furnaces and at the same power setting, set temperature, soak time, quench parameters, and racking pattern.

- 3.3.2.2.1 Time may be extended to 120 hours for austenitic, non-hardenable grades.

3.3.3 Sampling and Testing

Sampling and testing shall be in accordance with Table 2 and as follows:

3.3.3.1 Composition

- 3.3.3.1.1 The reported composition of the steel or alloy subjected to a single melting operation shall be that of a sample taken immediately before or during the pouring of a heat. Analysis results of the sample shall be within the composition limits established by the material specification, excluding any consideration of product check analysis.

- 3.3.3.1.1.1 If the sample of 3.3.3.1.1 is lost, a new sample shall be taken from the semifinished or finished product.

- 3.3.3.1.2 For remelted steels and alloys, analyses shall be obtained from the remelted ingot or product thereof in accordance with a sampling plan that will allow the reported composition of the steel to conform to one of the following options:

- The average of all ingots in the remelted heat.
- The average of the ingots directly involved with the order.
- The average of samples representing the first and last usable metal poured from the heat.
- The analysis of each ingot involved with the order.

- 3.3.3.1.2.1 If an average for an element is reported, each analysis of the element shall fall within the composition limits established by the material specification; each individual analysis may include the applicable product check analysis allowance, but no average shall include analyses that are both above and below the compositional limits.

- 3.3.3.1.2.2 When the remelting method is vacuum arc remelting and the applicable material specification establishes minimum values for carbon and/or manganese, these elements shall be determined and reported for each remelted ingot.

- 3.3.3.1.3 The heat analysis may be used for reporting the analyses of those elements governed only by a maximum in the material specification if the analysis is within the composition limits and the element routinely decreases or remains constant during remelting.

3.3.3.1.4 Analyses of samples made prior to discard need not be reported.

3.3.3.2 Tensile, Stress-Rupture, Creep, Embrittlement, and Hardness Specimen Orientation, Location, and Size

Specimens conforming to either ASTM E8/E8M, ASTM A370, or ASTM E292, as applicable, shall be cut from the semifinished or finished product in the direction indicated in the following paragraphs and shall be cut from the locations and to the sizes specified. The sample shall consist of one or more sections of the product selected to represent a specific location or locations with respect to the order of pouring of the selected ingot or ingots and with respect to the location within the ingot. Specimens conforming to ASTM E10 shall be cut from the same location as that for the tensile specimen.

3.3.3.2.1 When minimum tensile and/or yield strength are specified, the strain rate shall be set at 0.005 in/in/min (0.005 mm/mm/min) and maintained within a tolerance of ± 0.002 in/in/min (± 0.002 mm/mm/min) through 0.2% offset yield strain. The requirement for compliance becomes effective for material produced 1 year after the publication date of this specification.

3.3.3.2.2 Sheet, Strip, and Plate

3.3.3.2.2.1 Orientation

Specimens shall be taken with the axis of the specimen perpendicular to the direction of rolling from widths 9 inches (229 mm) and over and parallel to the direction of rolling from widths under 9 inches (229 mm). When short-transverse tensile properties are specified in the applicable material specification, specimens shall be taken with axis of the specimen parallel to the thickness direction of the product.

3.3.3.2.2.1.1 Longitudinal and Long-Transverse Specimens

The standard 0.500 inch (12.5 mm) wide rectangular specimen or pin-loaded tensile specimen with 2.000-inch (50.0-mm) gauge length shall be used for sheet, strip, and plate 0.625 inch (15.88 mm) and under in nominal thickness. For plate 0.625 to 0.750 inch (15.88 to 19.05 mm), inclusive, in nominal thickness, either the standard 0.500 inch (12.5 mm) wide rectangular specimen with 2.000-inch (50.0-mm) gauge length or the standard 0.500 inch (12.5 mm) round tensile specimen with 2.000-inch (50.0-mm) gauge length or a smaller, round specimen proportional to the standard shall be used. For plate over 0.750 inch (19.05 mm) in nominal thickness, the standard 0.500 inch (12.5 mm) round tensile specimen with 2.000-inch (50.0-mm) gauge length or a smaller, round specimen proportional to the standard shall be used. The tensile specimen shall be located midway between the faces of product 1.50 inches (38.1 mm) and under in nominal thickness and midway from center to surface for product over 1.50 inches (38.1 mm) in nominal thickness.

3.3.3.2.3.1.2 Short-Transverse Specimens

For plate 2.500 inches (63.5 mm) and over in nominal thickness, subsize round tensile specimens, proportional to the standard, shall be used when thickness is insufficient to accommodate standard 0.500 inch (12.5 mm) round tensile specimens with 2.000-inch (50.0-mm) gauge length. Short-transverse testing is not applicable for plate under 2.50 inches (63.5 mm) in nominal thickness.

3.3.3.2.3 Bar, Rod, and Wire

3.3.3.2.3.1 Orientation

Specimens shall be taken with the axis of the specimen in the longitudinal direction except that, when long-transverse tensile properties are specified in the applicable material specification, specimens shall be taken with the axis of the specimen perpendicular to the rolling or extruding direction. When short-transverse tensile properties are specified for rectangular bar in the applicable material specification, specimens shall be taken with the axis of the specimen parallel to the thickness direction of the bar.