SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS2280 | REV. C

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Superseding AMS2280B

(R) Trace Element Control Nickel Alloy Castings

RATIONALE

AMS2280C is a complete revision which incorporates the recommendations of ARP1313.

1. SCOPE

1.1 Purpose

This specification establishes testing methods and maximum permissible limits for trace elements in nickel alloy castings.

1.2 Application

These products have been used typically for limited use to achieve premium-quality material for highly-stressed rotating parts, such as turbine blades, where control of trace elements is required to maintain elevated-temperature tensile, stress-rupture, creep, and low-cycle fatigue properties, but usage is not limited to such applications.

1.2.1 It is intended that this specification be invoked only for selected applications by stipulation on drawings, purchase orders, or other documentation supplementing the material specification or in material specifications.

1.3 Classification

This specification covers two classes of trace element control, defined by the elements to be controlled as follows:

Class 1 - Lead, Bismuth, Selenium, Tellurium, and Thallium

Class 2 - Lead, Bismuth, Selenium, Tellurium, Thallium, and Others (See 3.1.2)

Class 3 - Cancelled, use Class 1

Class 4 - Cancelled, use Class 2

1.3.1 When trace element control is required, the elements to be controlled shall be indicated by this specification number and a suffix number indicating the class. For example, AMS2280-1 indicates that control of lead, bismuth, selenium, tellurium, and thallium is required. If no class is indicated, Class 1 shall apply.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
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http://www.sae.org/technical/standards/AMS2280C

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 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 E50 Apparatus, Reagents, and Safety Considerations for Chemical Analysis of Metals, Ores, and Related Materials

ASTM E135 Terminology Relating to Analytical Chemistry for Metals, Ores, and Related Materials

ASTM E353 Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

ASTM E354 Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

ASTM E1184 Determination of Elements by Graphite Furnace Atomic Absorption

ASTM E1361 Correction of Interelement Effects in X-Ray Spectrometric Analysis

ASTM E1473 Chemical Analysis of Nickel, Cobalt, and High-Temperature Alloys

ASTM E1621 X-Ray Emission Spectrometric Analysis

ASTM E1770 Optimization of Electrothermal Atomic Absorption Spectrometric Equipment

ASTM E1834 Analysis of Nickel Alloys by Electrothermal Atomic Absorption Spectrometric Method

ASTM E1835 Analysis of Nickel Alloys by Flame Atomic Absorption Spectrometry

3. TECHNICAL REQUIREMENTS

3.1 When this specification is invoked, the elements for which control is required shall not exceed the limits shown in Table 1, as applicable to the class specified. These requirements supplement those of the applicable material specification. No check analysis limits apply to these elements.

3.1.1 Classes 1 and 2

TABLE 1 - TRACE ELEMENT CONTROL

Element	Max Limit Percent	Max Limit ppm
Lead	0.0005	5
Bismuth	0.00005	0.5
Selenium	0.0003	3
Tellurium	0.00005	0.5
Thallium	0.0005	5

3.1.2 Class 2

When this class is specified, the following additional elements shall not exceed 0.0050% (50 ppm) each and the total of all these elements shall not exceed 0.0400% (400 ppm):

Antimony	Gold	Sodium
Arsenic	Indium	Thorium
Cadmium	Mercury	Tin
Gallium	Potassium	Uranium
Germanium	Silver	Zinc

3.2 Analytical Procedures

Determination of conformance to 3.1.1 and 3.1.2 shall be conducted using the analytical methods that are described below, or other analytical methods that are acceptable to the purchaser.

- Atomic Absorption (Graphite Furnace and Flame)
- Inductively Coupled Plasma Optical Emission Spectrometry
- Inductively Coupled Plasma Mass Spectrometry
- Glow Discharge Mass Spectrometry
- Glow Discharge Optical Emission Spectrometry
- Hollow Cathode Optical Emission Spectrometry

3.2.1 Laboratories may use the following ASTM procedures, as applicable. It is recognized that ASTM procedures are not available for all techniques used in the measurement of these elements, and some ASTM procedures are no longer applicable to modern instrumentation.

ASTM E50 Apparatus, Reagents, and Safety Considerations for Chemical Analysis of Metals, Ores, and Related Materials

ASTM E135 Terminology Relating to Analytical Chemistry for Metals, Ores, and Related Materials

ASTM E353 Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

ASTM E354 Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

ASTM E1184 Determination of Elements by Graphite Furnace Atomic Absorption

ASTM E1361 Correction of Interelement Effects in X-Ray Spectrometric Analysis

ASTM E1473 Chemical Analysis of Nickel, Cobalt, and High-Temperature Alloys

ASTM E1621 X-Ray Emission Spectrometric Analysis

ASTM E1770 Optimization of Electrothermal Atomic Absorption Spectrometric Equipment

ASTM E1834 Analysis of Nickel Alloys by Electrothermal Atomic Absorption Spectrometric Method

ASTM E1835 Analysis of Nickel Alloys by Flame Atomic Absorption Spectrometry

3.2.2 Laboratories shall participate in proficiency testing programs for each of the testing methods and elements.

3.2.3 When available, analytical standards that are traceable to recognized standardizing agencies shall be used.

3.2.4 Laboratories shall have a procedure for validating results with standards and controls.

3.2.5 The laboratory shall determine the detection limit, linear range and precision for each analytical method and element. These items shall be appropriate for the expected composition and specification limits.

3.2.6 The laboratory testing methods shall address interelement effects and associated corrections that are applied.

4. QUALITY ASSURANCE PROVISIONS

Shall be as specified in the applicable material specification and as follows:

4.1 Reports

The report of composition required by the material specification shall also include the actual amounts found for each trace element required to be determined by the class specified.

4.2 Approval

When approval to use methods other than those described in 3.2 is required by the purchaser, the approval shall be as agreed upon between purchaser and vendor.

5. PREPARATION FOR DELIVERY

Not applicable.

6. ACKNOWLEDGMENT

A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

7. REJECTIONS

Product not conforming to this specification, or to modifications authorized by purchaser, shall be subject to rejection.

8. NOTES

8.1 A change bar (|) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

8.2 Trace elements, control of which is specified in 3.1.1 and 3.1.2, have been found to drastically reduce mechanical properties such as elevated-temperature tensile, stress-rupture, creep, and low-cycle fatigue.

8.3 The limits on trace elements specified in 3.1.1 approach the limit of detection. The importance of agreement on all details of methods of producing the required comparison standards and of procedures for determining the content of each element cannot be overemphasized.