SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®

400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 2281

Issued 4-1-89

An American National Standard

TRACE ELEMENT CONTROL
Nickel Alloy, Cobalt Alloy, and Iron Alloy Wrought Products
For High-Temperature, High-Stressed Applications

1. SCOPE:

1.1 Purpose: This specification establishes maximum permissible limits for elements not normally specified but which may occur in trace amounts in wrought nickel, cobalt, and iron alloy products.

1.2 Application: Primarily for highly-stressed rotating parts, such as turbine discs, where control of trace elements is required to maintain elevated-temperature tensile, stress-rupture, creep, and low-cycle fatigue properties.

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 four classes of trace element control, defined by the elements to be controlled as follows:

Class 1 – Lead, Bismuth
Class 2 – Lead, Bismuth, Selenium
Class 3 – Lead, Bismuth, Selenium, Silver, Tin
Class 4 – Lead, Bismuth, Selenium, Silver, Tin, Thallium, Tellurium, Arsenic

1.3.1 When trace element control is required, the elements to be controlled shall be indicated by this specification number and the appropriate class number. For example, AMS 2281, Class 1 will indicate that control of lead and bismuth is required.

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.

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

2.1.1 Aerospace Recommended Practices:

ARP1313 – Determination of Trace Elements in High Temperature Alloys

3. TECHNICAL REQUIREMENTS:

3.1 When this specification is invoked, the elements for which control is required shall not exceed the following percentages by weight as applicable to the class specified. These requirements supplement those of the applicable material specification. No check analysis limits apply to these elements. The elements requiring control and the limit for each shall be as follows for the classes shown:

3.1.1 Class 1

Element	Limit Percent	Limit ppm
Lead	0.0005	5
Bismuth	0.00003	0.3

3.1.2 Class 2

Element	Limit Percent	Limit ppm
Lead	0.0005	5
Bismuth	0.00003	0.3
Selenium	0.0003	3

3.1.3 Class 3

Element	Limit Percent	Limit ppm
Lead	0.0005	5
Bismuth	0.00003	0.3
Selenium	0.0003	3
Silver	0.0005	5
Tin	0.0050	50

3.1.4 Class 4

Element	Limit Percent	ppm
Lead	0.0005	5
Bismuth	0.00003	0.3
Selenium	0.0003	3
Silver	0.0005	5
Tin	0.0050	50
Thallium	0.0001	1
Tellurium	0.00005	0.5
Arsenic	0.0025	25

3.2 Analytical Procedures: The analytical procedures for determining conformance of a product to the requirements of this specification and the methods of obtaining or producing standards on which the analytical results are based shall be established industry techniques acceptable to purchaser (See 8.2). ARP1313 details methods which may be used for determining the trace elements.

3.2.1 The following methods, not detailed in ARP1313, may also be considered acceptable; these procedures are not listed in any order of preference:

Atomic absorption by other techniques
Inductively coupled plasma emission spectroscopy
Direct current plasma emission spectroscopy
Emission spectrography by other techniques
Glow discharge mass spectrometry
Isotope dilution mass spectrometry
TOPO/extraction ultraviolet or visible spectrophotometry

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, the laboratory performing the trace analysis, and the analytical technique(s) used. When it is not appropriate to report an actual amount due to analytical considerations, the following reporting conventions shall be used:

4.1.1 The symbol < or the words "less than" preceding a number shall be used to indicate the apparent presence of the element in an amount above the detection limit but below that value which can be meaningfully quantified.

4.1.2 The symbol < or the words "less than" preceding a number and the letters "ND" for "none detected" following the number shall be used to indicate the apparent absence of the element and the number value indicative of the detection limit.

4.2 Laboratories performing trace element analysis using techniques other than those in ARP1313 shall provide data demonstrating equivalent analytical capability upon request.