AEROSPACE INFORMATION REPORT

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User's Guide to AMS Specifications

RATIONALE

AIR4779C results from a Five Year Review and update of this information report.

FOREWORD

SAE has been the source of Aerospace Material Specifications since 1939 when the SAE Aircraft Materials Division issued the original 101 specifications. Aeronautical Material Specifications, as AMS were originally known, were created in response to a recognized need for industry-generated, industry-oriented specifications that would eliminate, or markedly reduce the number of individual company specifications covering the same materials or processes.

AMS specifications continue to be developed by the Aerospace Materials Division (AMD) under the direction of the SAE Aerospace Council. Commodity committees, with members from aerospace companies, material producers, processors, independents, and government organizations, meet at least twice each year to review and issue new or revised documents. There are now more than 2400 AMD documents used throughout the world to define, procure, and produce aerospace materials.

An AMS specification is designed to be an enforceable procurement document defining a product or a service, part of the contract between a purchaser and a vendor of products or services. It is necessary that it be complete, precise, unambiguous, and reasonable.

Although AMS specifications are said to be "user's specifications", they are the result of considerable discussion and negotiation between users and producers. An AMS specification has to be a compromise between the needs of the user and the capability of the producer to economically and reliably provide the product.

The Editorial Style Manual for Preparation of Aerospace Material Specifications (AMS) - Metals and Processes is to be used when drafting AMS documents for metals and related processes. Special guidelines for nonmetals are included in the Nonmetallic Materials Appendix.

1. SCOPE

The reader of specifications sometimes needs some help understanding the format of an AMS and reasoning behind certain usage of terms. The scope of this AIR is to explain the functions of the various sections of the specifications, why some of the terms in AMS specifications are used, and how the specification system works. After the introduction (Section 3 of this document), the topics are presented in the order they usually appear in specifications.

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2. APPLICABLE DOCUMENTS

The following publications form a part of this document 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. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications

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

ARP1917 Clarification of Terms Used in Aerospace Metals Specifications

3. INTRODUCTORY MATERIAL

3.1 Metal Product Specifications

The underlying philosophy behind most of the metal product specifications is:

If (1) we define the material composition limits, the basic methods of melting and alloying, the methods of working and shaping, and the heat treatment of the product, and if (2) we measure and meet selected requirements for certain properties of the product such as: tensile strength and ductility, hardness, grain size, microstructure, surface characteristics, or other properties pertinent to the specific product, then (3) we can be confident that the product is controlled and can be relied upon to have the other important engineering properties within statistically established limits.

Not included are other properties which will be inherent in the product if the specified requirements are met, or which may be of interest to some users, but are not needed to define and control the product.

The details of the requirements differ considerably among the various alloy systems and product forms. The tests designated to measure the selected characteristics are those judged most likely to verify the overall performance of each alloy and product.

3.2 Nonmetallic Product Specifications

Most nonmetallic product specifications depend on definition and measurement of end item performance characteristics, rather than control of the ingredients and methods used to make the product. Otherwise, nonmetallic product specifications are similar to metal specifications. Nonmetallic product specifications define uncured and cured raw materials, as well as finished parts. Included are plastics and rubber, sealants, coatings, fluids, fabrics, ceramics, reference materials, and a variety of other materials not otherwise categorized.

3.3 Process Specifications

These specifications generally define the basic materials, facilities, preparation methods, critical processing steps, control requirements, and end item performance requirements of a process. The specification normally does not provide all of the step by step "how to" details of a process because there are often numerous acceptable ways to meet the requirements of a process. The specification format for process specifications is somewhat different from the AMS material specification format to address the unique needs of each process.

3.4 Converted Government Specifications

Another category indicates AMS Specifications that have been adopted from government specifications. These AMS carry a document identification number that relates to the original government specification (e.g., "AMS-QQ-A-200" is based on Federal Standard "QQ-A-200", AMS-H-6875 is based on MIL-H-6875, etc.). The initial publication of such a "converted government specification" contained technical requirements and text that was virtually identical to the original government specification. Subsequent revision, cancellation, supersession or stabilization of converted government specifications is under the cognizance of the designated AMS Committee. For these reasons, the format and styling of a converted government spec can differ radically from other AMS specifications.

4. DOCUMENT IDENTIFIERS

4.1 AMS Number, Revision Letter, Date

The four digit specification number for a new AMS is established by SAE when the specification is ready for initial publication. The number is selected to place the new specification near similar materials and products or processes in the various indexes. The classification system is best illustrated by examining the "SAE AMS INDEX".

Specification revisions are identified by the original number with the letter "A" added to indicate the first revision since first release, "B" for the second revision, etc. The date of the initial issue and of the most recent revision are shown below the specification number on the first page.

When parallel specifications, AMS _____ (for the inch-pound system) and MAM _____ (metric system), are issued for the same product, both will have the same specification number but need not have the same revision letter. For metal product specifications, most if not all MAM (metric system) documents have been cancelled and superseded by the AMS specification to which metric equivalent values have been added.

4.2 Title Block

The first line in the title block is the title of the specification. It provides a brief identification of the principal product or process covered. If a specification covers too many product forms for all to be in the title, the most important forms (as identified by the committee responsible for the specification) are shown in the title and the "less important" forms are mentioned in the scope paragraph.

The second and third lines are subtitles which provide enough information to distinguish the specification from others which have similar titles. Usually, the second line identifies the alloy and the third line indicates the condition of the product.

A fourth line in specifications for metal products shows the UNS (Unified Numbering System) number most similar to the composition of the alloy. However this number should be considered a reference and not a part of the contractual requirements of the specification. (See 12.3.)

4.3 Scope (Section 1 of an AMS)

This section (1) includes paragraphs identifying forms of product covered, typical applications, classes, grades, or types covered and, if necessary, may include precautions to be observed in handling, processing, or usage of the product.

4.3.1 Form

This paragraph identifies all of the product forms covered by the specification, including those not in the title, and repeating those that are in the title. Examples of product forms include: bar, plate, castings, forging stock, forgings, brazing filler, etc.

4.3.2 Application

This paragraph informs the user of typical applications for the product or process and may include important properties intended to help determine if the product or process might be considered for the proposed application.

Although the paragraph offers examples of applications of the product or process, it does not require that users should avoid other applications which may not be similar to the examples.

4.3.3 Classification

If the specification covers more than one product form or process type, surface condition, processing method, etc., a classification paragraph may be used to define such variations and their designation by type, grade, or class of the product or process.

4.3.4 Precautions

A standard general paragraph is included, when appropriate, to notify that some materials, applications, and/or processes covered or referenced in a specification are considered hazardous and that the user must assume responsibility for identifying and implementing suitable precautions.

A more specific warning may be expressed for some materials or processes when deemed appropriate by the committee.

5. APPLICABLE DOCUMENTS (Section 2 of an AMS)

This section (2) lists other specifications, standards, recommended practices, and publications that are included by reference in Sections 1, 3, 4, and 5. Documents referenced in other than these sections are not requirements and, therefore, are not listed in Section 2.

5.1 Each document applies only to the extent referenced in the AMS. This paragraph also provides the general policy for determining which revision or issue to be used for any referenced document. If a certain revision is to be used, this is stated. Any contrary instructions (i.e., specified by customer, drawing, purchase order, etc.) take precedence.

6. TECHNICAL REQUIREMENTS (Section 3 of an AMS)

This section (3) defines the required manufacturing methods and the properties which must be measured and met to assure that the product or process will be satisfactory for the intended usage. Other properties which are inherent in the product if the specified requirements are met, or which may be of interest to some users but are not needed to define and control the product or process, are not included. In most specifications, this section (3) also defines the test procedures to be used to verify compliance with the requirements.

6.1 Special Terminology

Certain terms or phrases that need explanations can appear anywhere in the technical section. These will be covered in the following paragraphs. Those peculiar to certain paragraphs in the section will be covered later in the discussion of that paragraph. Other terms used in AMS may be clarified in ARP1917.

6.1.1 "Unless Otherwise Specified"

These words advise the purchaser, the producer, and others (such as auditors, customers of the user, and accreditors or surveyors) that the purchaser is specifically authorized to, and may routinely, specify an alternative to this requirement.

Some users may not require this language, based on the position that the purchaser is always at liberty to change any requirement in the specification if the supplier will comply. However, other users find that auditors and prime contractors may question compliance with the specification if such changes are made. Producers may also be at some liability risk if their product labeled AMS1234 has not met or been tested for all specified requirements in the specification. Documentation between purchasers and suppliers is commonly used to clarify such requirements.

6.1.2 "When Approved By Purchaser"

This phrase allows a variation to be made in the specification requirements. For example, a rough, oxygen-rich, or decarburized surface may be allowed if the purchaser knows that the discrepant layer will be removed by machining during fabrication of the part. However, written approval is required.

6.1.3 "Acceptable to Purchaser"

The phrase "acceptable to purchaser" is used to avoid a presumed requirement that the producer must have formal written approval by the user of any alternative (i.e., procedure, method, technique, etc.).

This phrase does not require that the purchaser issue a specific approval of an alternative method used by the producer, but permits the purchaser to disapprove the alternative if the method has been determined to be unsatisfactory to purchaser's requirements.

6.2 Composition

Metal specifications have a composition paragraph with a table showing the alloying elements and the required limits. The order of listing of the elements varies with the base alloy system, as does the label for "other impurities", "residual elements", "other elements", or other designation for unlisted elements. Subparagraphs provide additional description of the composition and related testing requirements.

It should be recognized that producers will often analyze for and report elements which are not included in the composition table. Limits for acceptability for such elements may be specified by the purchaser.

6.3 Melting Practice

The melting practice is specified, when necessary, to prevent use of methods not deemed satisfactory for the product quality required.

6.4 Condition

The condition paragraph defines the as-supplied state of the product, usually by general terms describing typical methods of fabrication, finishing and/or heat treatment, such as "cold rolled, hot rolled, cold drawn, as extruded, bright finished, descaled, annealed, strain hardened, solution heat treated, etc. It is not necessary to precisely specify the details of these methods but to identify them sufficiently for the supplier to know the condition of products and representative specimens to be tested and delivered, and the user to know what to expect when the product is received.

6.5 Properties

The property requirement paragraphs state the key characteristics that must be met in the product. Methods of testing (including the orientation and types of test specimens and any special considerations) are stated, as well as the required test results.

6.6 Quality

This paragraph includes a "general workmanship" or "general quality" statement that, in undefined parameters, expresses that the product must be of an overall quality consistent with good industry practices for high reliability applications.

It provides a basis for rejection of product that has defects not specifically described in the specification but exceeding the level typically associated with the product. Examples are corrosion, surface damage, deformation, discoloration, staining, dirt, excessive variations within a lot in hardness, ductility, flarability, machinability, weldability, or other fabrication properties, etc.

In addition, the quality section may also contain specific requirements for appearance (visual), soundness (nondestructive testing), or other characteristics.

6.7 Special Requirements

The following contain examples of special requirements applicable to certain of products:

6.7.1 Cast and Helix (Weld Wire)

Simple tests are used to determine if the weld wire is properly wound on spools, so it will feed satisfactorily in mechanical-feed welding equipment.

6.7.2 Weldability

On occasion, wire can meet all of the regular requirements for wire products but may not make a good weld when used as a weld wire. Since the property of wire that makes it weld satisfactorily is not understood sufficiently to allow precise definition of every parameter, a requirement is included in weld wire specifications to require that the wire produce acceptable welds and to offer a referee test method to resolve disputes.

6.7.3 Microstructure

The microstructure of many metal alloy products is controlled by reference to standard metallographic procedures because some fabrication and service performance requirements are dependent on proper microstructure.

6.7.4 Hardness

Hardness test requirements appear in many specifications, but an out of range hardness value is not always grounds for rejection. For certain materials, the specification accepts product with out of range hardness if tensile testing is performed and demonstrates that the material meets the required tensile strength properties.

6.7.5 Dimension Tolerances

Dimensional tolerances for products such as forgings, rings, castings, powder compacts, and stock for secondary metal working are not mentioned in specifications; when required, these are specified on drawings or purchase orders when required. Tolerances for other standard product forms may be included, either in the specification or by reference to other specifications.

7. QUALITY ASSURANCE PROVISIONS (Section 4 of an AMS)

This section (4) describes the type and intent of sampling and testing, sampling procedures, approval requirements, reporting requirements, and resampling and retesting options. Test procedures are not included, having been specified in the technical requirement section.

7.1 Inspection

This standard paragraph makes it clear that the supplier is responsible for the specified sampling and testing to certify that the product meets the specification. They may conduct the testing themselves or have others perform the testing. The purchaser may also conduct the same tests for verification.

7.2 Classification of Tests

Paragraphs under this heading identify the required frequency of testing by grouping tests under classes. The classes usually are:

a. Acceptance test: Testing is required of each heat, lot, or batch of product, as applicable.

b. Periodic tests: Testing is not required for each individual heat, lot, or batch. Unless the purchaser specifies frequency of periodic testing, the producer is obligated to test only as often as deemed necessary to ensure the conformance of untested lots. The objective is to reduce testing costs for characteristics that are capable within routine control of the process.

c. Preproduction test: Demonstration of producer's ability to meet the requirements of the specification prior to or on first article shipment, and after changes are made that may affect the product characteristics.

d. Qualification tests: Demonstration of the producer's ability to meet the requirements of the specification for the purpose of being added to a Qualified Products List (QPL).

7.3 Sampling and Testing

These paragraphs present numbers and details regarding selection, location, and/or configuration of samples to be taken and tested.

7.4 Reporting

The requirements for data to be presented in the product certification report are given with variations in detail depending on the products covered and the testing required.