ASTM INTERNATIONAL
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Form and Style for ASTM Standards

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Contents

Preface

ASTM International (hereafter referred to as ASTM International or ASTM), founded in 1898, is a scientific and technical organization formed for "the development of standards on characteristics and performance of materials, products, systems, and services; and the promotion of related knowledge." It is the world's largest source of voluntary consensus standards.

The purpose of this manual is to promote uniformity of form and style in ASTM standards. Such uniformity is desirable because it helps the user to find what is needed more easily and to understand what is read more quickly. Such uniformity in a manuscript is necessary if it is to be published by ASTM International. Deviations from ASTM style may mean wasted time on the part of authors, reviewers, editors, and eventually the reader of the standard. This means costly time and resources are lost by everyone involved.

Section 10.8 of the *Regulations Governing ASTM Technical Committees* requires that the current edition of this manual be followed in the writing of standards. When conditions preclude compliance with this manual, a committee may request an exemption from the Committee on Standards (COS).

Responsibility for the *Form and Style for ASTM Standards* is vested in the Board of Directors. Revisions to this manual may be recommended by the Board of Directors, by the Committee on Standards, or by a technical committee or its Executive Subcommittee. The Committee on Standards acts upon recommendations for changes and reviews all requests from technical committees for exceptions to the *Form and Style for ASTM Standards*. Recommended changes to this manual in *technical* substance and format shall be referred to the Committee on Standards, which, at a regular meeting, shall rule on the merits of the recommendation. A circular letter ballot will be issued to the technical committees and the responses will be addressed by COS. The COS recommendation shall be sent to the Board of Directors. Changes adopted by the Board of Directors shall be announced to the members and shall become effective on the date determined by the Board of Directors.

Suggestions for *editorial* revision of this manual should be addressed to the Staff Coordinator—Form and Style Manual, ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959.

Introduction

This manual is the basic textbook for anyone writing an ASTM standard. A study of Parts A, B, C, or E will show the proper form for the principal types of standards including a detailed explanation of how to write each section, from the title to the appendixes. Within Parts A, B, C, and E, the first section lists the preferred sequence of headings and indicates whether these sections are mandatory. The headings identified as “mandatory” are required. Other headings shall be included when the subject matter is pertinent to the document under development, in which case, all instructions and guidance for that particular section shall be followed. For example, if the standard does not contain reference to any standard documents within the text, it is not required to include a section on Referenced Documents. If, however, specific hazards are cited throughout the text, then the section on Hazards shall be followed. Included at appropriate places are examples and standard wording. Also included are examples of correctly written complete manuscripts of various types of standards. Where standards are referenced throughout the text of this manual, visit the ASTM website, www.astm.org, and refer to the standard’s Document Summary page.

For easy reference purposes, each paragraph in an ASTM standard shall be numbered. The modified decimal numbering system adopted is explained in Part D. Part E gives instructions for preparing standard definitions and a format for specialized terminology standards. Special instruction concerning patents, use of trademarks, open-end agreements, fire standards, and other legal issues are given in Part F.

Part G is a detailed Style Manual that includes among other things information on abbreviations, spellings, literature references, and preparation of illustrations.

ASTM policy is that SI units be included in all standards. Part H is included to aid the standards writer to incorporate these units correctly. It is the technical committee’s decision whether SI or other units are the preferred unit of measurement used in the committee’s document. When SI and non-SI units of measurement are contained in a document, the order in which they appear is determined by that committee.

For additional information about ASTM procedures, or available publications such as the *Regulations Governing ASTM Technical Committees* and *Officer Handbook*, contact ASTM Technical Committee Operations, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959 (Telephone: 610-832-9673).

Definitions

The following definitions apply to the use of the content of this manual and clarify which sections or formats, or both, are mandatory when presenting ASTM documents:

1. "Shall" is used to indicate that a provision is mandatory.
2. "Should" is used to indicate that a provision is not mandatory but is recommended as good practice.
3. "May" is used to indicate that a provision is optional.
4. "Will" is used to express futurity, but never to indicate any degree of requirement.

Definitions for *standard, classification, guide, practice, specification, terminology,* and *test method* are quoted below from the current *Regulations Governing ASTM Technical Committees*:

standard, *n*— *as used in ASTM International*, a document that has been developed and established within the consensus principles of the Society and that meets the approval requirements of ASTM procedures and regulations.

DISCUSSION—The term "standard" serves in ASTM International as a nominative adjective in the title of documents, such as test methods or specifications, to connote specified consensus and approval. The various types of standard documents are based on the needs and usages as prescribed by the technical committees of the Society.

classification, *n*— a systematic arrangement or division of materials, products, systems, or services into groups based on similar characteristics such as origin, composition, properties, or use.

guide, *n*— a compendium of information or series of options that does not recommend a specific course of action.

DISCUSSION—A guide increases the awareness of information and approaches in a given subject area.

practice, *n*— a set of instructions for performing one or more specific operations that does not produce a test result.

DISCUSSION—Examples of practices include, but are not limited to: application, assessment, cleaning, collection, decontamination, inspection, installation, preparation, sampling, screening, and training.

specification, *n*— an explicit set of requirements to be satisfied by a material, product, system, or service.

DISCUSSION—Examples of specifications include, but are not limited to, requirements for; physical, mechanical, or chemical properties, and safety, quality, or performance criteria. A specification identifies the test methods for determining whether each of the requirements is satisfied.

terminology standard, *n*— a document comprising definitions of terms; explanations of symbols, abbreviations, or acronyms.

test method, *n*— a definitive procedure that produces a test result.

DISCUSSION—Examples of test methods include, but are not limited to: identification, measurement, and evaluation of one or more qualities, characteristics, or properties. A precision and bias statement shall be reported at the end of a test method. (Refer to Section A21 on Precision and Bias.)

approval date, *n*— the date assigned by ASTM International through the Committee on Standards, which indicates that a new standard, revision or reapproval has successfully completed the balloting and appeals process in accordance with the *Regulations Governing ASTM Technical Committees.*

publication date, *n*— the month/year that an approved standard is made publicly available in either electronic or hardcopy form.

Part A
Form of ASTM Test Methods

INTRODUCTION

An ASTM test method, as defined on p. iv, typically includes a concise description of an orderly procedure for determining a property or constituent of a material, an assembly of materials, or a product. The directions for performing the test should include all of the essential details as to apparatus, test specimen, procedure, and calculations needed to achieve satisfactory precision and bias.

An ASTM test method should represent a consensus as to the best currently available test procedure for the use intended. It should be supported by experience and adequate data obtained from cooperative tests.

In order to be the "best currently available," test methods need periodic review to determine whether revisions are desirable as the result of technological advances in manufacturing, testing, and use requirements.

ASTM test methods are frequently intended for use in the buying and selling of materials according to specifications and therefore should provide such precision that when the test is properly performed by a competent operator the results will be found satisfactory for judging the compliance of the material with the specification. These test methods cover the determination of fundamental properties of materials such as density, absolute viscosity, softening point, and flash point. They may include a variety of different laboratory procedures such as chemical and spectrochemical analyses, mechanical and electrical tests, weathering tests, visual examination, fire tests, performance characteristics, sampling, nondestructive tests, and radiation exposure tests. In some standards, optional test methods are included.

Statements addressing precision and bias are required in ASTM test methods. This gives the user of the test method an idea of the nature of the sample to be prepared and analyzed and information regarding the nature of the data obtained by using the method. The requirement of precision and bias statements does not mean that numerical statements are required. It means that the spread of resulting data and its relationship to an accepted reference material or source (if available) shall be addressed. Some test methods have no numerical expression of precision or bias (for example, pass/fail tests, spot tests.) In these cases, precision and bias shall be addressed and the reasons for not including relevant data explained. Test methods are sometimes prepared for use in research rather than in the buying and selling of materials. Other test methods cover process control, screening, and field tests. Although these latter test methods may not always be as precise as referee test methods, they are sufficiently precise for the intended use and usually require less time. Field tests allow testing at the site, thus eliminating transportation of specimens to and from the laboratory.

Special instructions with respect to the legal aspects are included in Part F and shall be followed in writing any standard. These include such matters as contractual items, caveat statements, patents, and fire standards. Assistance on the development of fire standards is available from Committee E05. The policies contained in Part F are approved by and are under the jurisdiction of the ASTM Board of Directors.

When a standard is being developed, the costs associated with its development and subsequent use generally should be considered. The prime objective should be the optimum use of resources to achieve satisfactory definition of the product or service. However, it should be noted that when the standard relates to the safety of persons, cost considerations are likely to become much less important than when attributes of materials or products are

involved. Some standards, such as definitions, impose no cost on the user; others that include numerous and extensive requirements can entail significant expense to users of the standard. The requirements to be included should, therefore, be those that are technically relevant and yield benefits commensurate with the cost of their determination.

Cost effectiveness statements or rationale may be included within a standard if appropriate, usually in an appendix.

A1. Subject Headings of Text

A1.1 The following is the sequence for the text of ASTM test methods. Headings are those most generally used but may not be all-inclusive. It may be necessary to include other headings for specialized subjects. The headings identified as “mandatory” are required. Other headings shall be included when the subject matter is pertinent to the document under development, in which case, all instructions and guidance for that particular section shall be followed. For example, if the standard does not contain reference to any standard documents within the text, it is not required to include a section on Referenced Documents. If, however, specific hazards are cited throughout the text, then the section on Hazards shall be followed.

Title (mandatory)
† Designation (mandatory)
† Introduction
Scope (mandatory)
† Referenced Documents
† Terminology
Summary of Test Method
Significance and Use (mandatory)
Interferences
Apparatus
Reagents and Materials
Hazards (mandatory when applicable)
Sampling, Test Specimens, and Test Units
Preparation of Apparatus
Calibration and Standardization
Conditioning
Procedure (mandatory)
Calculation or Interpretation of Results
Report
Precision and Bias (mandatory)
Measurement Uncertainty
† Keywords (mandatory)
† Annexes and Appendixes
† References
Summary of Changes

† The headings marked with a dagger (†) should appear only once in test methods that contain two or more test methods.

A1.2 Not all of these headings may be required for a particular standard. Additional headings that are included to cover specialized subjects should appear in the most appropriate place, depending on their relation to the sections listed in A1.1. When a standard includes several test methods, repetition of appropriate headings may be desirable.

A1.3 Subject headings in boldface type shall precede each section to orient the reader. Text divisions shall be subdivided in accordance with the Use of the Modified Decimal Numbering System guide in Part D of this publication.

A1.4 For convenience in application and when economy in printing may result, test methods may include a series of procedures for determining the same or different properties of a given material. In such test methods, include at the beginning of the standard individual sections describing those features that are common to all of the separate test methods. Identify different methods within the standard by capital letters, starting with A; i.e., Test Method A, Test Method B, etc.

A1.5 Examples of test methods for single determination:

B331 Test Method for Compressibility of Metal Powders in Uniaxial Compaction
C693 Test Method for Density of Glass by Buoyancy

A1.6 Examples of test methods covering a series of test methods:

D1179 Test Methods for Fluoride Ion in Water
D2137 Test Methods for Rubber Property—Brittleness Point of Flexible Polymers and Coated Fabrics
F38 Test Methods for Creep Relaxation of a Gasket Material

A1.7 In deciding whether to describe similar test methods as portions of a single standard or as separate test methods, the following criterion may be found useful: When the descriptions of the apparatus and procedure are similar and a significant economy in printing can be accomplished by combining, and if, because of clearly understood distinctions in applicability, no confusion can rise as to which test method should be used, then it is desirable to treat the test methods as parts of a single standard. If confusion could arise, the test methods should be published separately. If one test method is preferred as a referee method, it should be so designated, in which case the other test methods should be designated as optional or nonreferee. When test methods are published separately, a worthwhile saving can be accomplished by making cross-references from one test method to another for the apparatus and detailed description of the procedure.

A2. Title (Mandatory)

A2.1 The title should be concise but complete enough to identify the nature of the test, the material to which it is applicable, and to distinguish it from other similar titles. Titles of analogous standards should be identical, except for the distinctive feature(s) of each standard. Titles are used frequently in lists, tables of contents, indexes, tabulating card systems, etc., and therefore should be brief but inclusive. Select words that easily lend themselves to indexing. The essential features of a title are the particular property or constituent being determined, the material to which the test method is applicable, and when pertinent, the technique or instrumentation. If the test method is designated to determine a number of constituents or properties, use a general title, omitting the names of specific constituents or properties. When a standard includes a number of individual test methods for different constituents or properties, the title need indicate only the general nature of the tests and the material to which it is applicable.

A3. Designation and Year Date

A3.1 *Designation (mandatory)*—The ASTM designation, assigned by Headquarters on submittal for approval, consists of the following sequential parts:

A3.1.1 A letter designation denoting in general the classification according to material, product, system or service.

A—Ferrous metals and products
B—Nonferrous metals and products

C—Cementitious, ceramic, concrete, and masonry materials
D—Miscellaneous materials and products
E—Miscellaneous subjects
F—End-use materials and products
G—Corrosion, deterioration, weathering, durability, and degradation of materials and products

A3.1.2 A sequential number following the letter designation (for example, Specification C150).

A3.2 *Year Date:* (for example, Specification C150-01).

A3.2.1 After the designation, a hyphen is followed by the last two numbers of the year of acceptance or of last revision. If the standard is revised again during the same year, this is indicated by adding an “a” for the second revision, “b” for the third revision, etc.

A3.2.2 The parenthetical phrase “(Reapproved 20___)” to designate the year of last reapproval of a standard, if applicable.

A3.2.3 For editorial changes that do not change the year designation, a note is inserted before the text to indicate the location and date of the change and a superscript epsilon ($^{\varepsilon}$) is added after the year designation. The epsilon designations and corresponding notes are numbered chronologically and are deleted upon occasion of the next revision or reapproval.

A3.3 The designation numbers of standards that have been discontinued are not reassigned.

A3.4 *SI Standards* (see Part H and Section G24.)

A4. Introduction

A4.1 A separate section covering general introductory or informational material is not generally used in ASTM test methods. Occasionally, a test method is of such a nature that it requires an explanatory statement for proper understanding by the user. In such instances an introduction should be included immediately after the title of the test method but without a section number.

A4.2 Examples of test methods that include introductions are as follows:

D143 Test Methods for Small Clear Specimens of Timber
D905 Test Method for Strength Properties of Adhesive Bonds in Shear by Compression Loading

A5. Scope (Mandatory)

A5.1 Include in this section information relating to the purpose of the test method. State if the method is quantitative or qualitative, and any known limitations. Concisely state the property or constituent that is being determined and the materials that can be analyzed. State the range of concentrations/values determined.

A5.2 Include, where applicable, the analytical technique, for example, gas chromatography, and whether the test is performed in the laboratory, field, or on-line.

A5.3 Include in this section the system of units to be used in referee decisions.

A5.4 Include in this section any caveats required by ASTM policy such as the caveats on *safety hazards* (see F2.1) and *fire hazards* (see F2.2).

A5.5 For standards developed for reference in model (building) codes, include the following statement:

The text of this standard refers to notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

A6. Referenced Documents

A6.1 List in alphanumeric sequence the designation and complete title of the following documents referenced within the standard; ASTM standards and adjuncts; and standards and codes of other organizations. For references to all other documents, including ASTM STPs, use the format indicated in Section G21.

A6.2 Provide footnotes to this section to indicate the sources of these documents. When ASTM standards are referenced later in the text, use only the type of standard (that is, specification, test method, practice, classification, guide, terminology, etc.) and the designation letter and number (for example, Test Method D1310).

A6.3 Do not include the year date when designating referenced documents unless there is a technical reason for requiring a particular revision.

A6.4 When listing referenced adjuncts, provide a brief description in this section, and a footnote of the availability. (For more specific information on adjuncts, refer to Section A28).

A7. Terminology

A7.1 Every standard should include a section on terminology. See Part E for information on Form and Style for terminology sections.

A7.1.1 All significant terms that may have a meaning more specialized than the commonly used language should be defined within a standard or the terminology standard for the relevant committee should be referenced.

A8. Summary of Test Method

A8.1 Include here a brief outline of the test method, describing in the passive voice its essential features without the details that are a necessary part of the complete statement of procedure. If desired, a brief statement of the principle of the test method may be given; this is particularly desirable in the case of chemical methods and should appear as the first paragraph. In chemical methods state the type of procedure, such as colorimetric, electrometric, and volumetric, and describe the source of color, major chemical reaction including pertinent chemical equations, etc.

A9. Significance and Use (Mandatory)

A9.1 Include in this section information that explains the relevance and meaning of the test. State the practical uses for the test and how it is typically employed. Avoid repetition of information included in the Scope (see Section A5). Include statements to provide the user with comprehensive understanding of the following:

A9.1.1 The meaning of the test as related to the manufacture and end use of the material,

A9.1.2 The suitability of the test for specification acceptance, design purposes, service evaluation, regulatory statutes, manufacturing control, development and research, and

A9.1.3 The fundamental assumptions inherent in the test method that may affect the usefulness of the results.

A9.2 Include any discretion needed in the interpretation of the results of the test.

A9.3 Include, where applicable, comparisons of the test to other similar procedures.

A10. Interferences

A10.1 If the successful application of the test method requires the inclusion of explanatory statements on interference effects, include such information here; otherwise, omit this section. List briefly the constituents or properties that are likely to cause interference and the amounts that are known to interfere. In some cases this informa-

tion is obtainable only by observation during the performance of the test. If the presence of an interfering factor affects the precision or bias of the test results and compensations are made in the calculations (Section A19), this should be explained in this section and noted in the appropriate section. In some cases, interferences may be a major factor in judging test results and explanations of their effects may become lengthy. Lengthy explanations may be placed in an annex to the standard.

A11. Apparatus

A11.1 In this section, include a brief description of the essential features of the apparatus and equipment required for the test, and, where they clarify or supplement the text, schematic drawings or photographs. Cover in separate text divisions the important features and requirements for the apparatus. Do not list common laboratory apparatus, such as flasks and beakers, but include any especially modified forms or unusual sizes of common apparatus that are required or that may require special preparation.

A11.2 Trademarks shall not be used unless a specific manufacturer's product is required for a well-defined reason (see Section F3 for regulations regarding patents in ASTM standards). In such cases an explanatory footnote shall be included giving supplementary information regarding such apparatus or material. The footnote shall state that this apparatus or material "has been found satisfactory for this purpose." When special types of glassware are required, such as heat-resistant and chemical-resistant, state the significant characteristic desired rather than a trademark. For example, use "borosilicate glass" rather than "Pyrex" or "Kimax." Specify filter paper by describing the significant characteristic such as porosity, rate of filtering, and ash content, or by reference to ASTM Specification E832, for Laboratory Filter Papers.

NOTE A1— Policies have been adopted by the Board of Directors that are applicable to standards involving patented apparatus, materials, and processes. These policies are described in the *Regulations Governing ASTM Technical Committees*. Before submitting to subcommittee or main committee ballot any draft test method that requires a specific manufacturer's product, consult the Staff Manager of your committee as to necessary conformance with the *Regulations Governing ASTM Technical Committees*

A11.3 Detailed manufacturing requirements for apparatus, unless quite brief, should preferably be placed in an annex to the test method (see A24.3), retaining in the text only a brief outline with schematic drawings or illustrations where necessary. The purpose of this outline is to provide information regarding the essential features of the apparatus, to enable the user to assemble the equipment and understand its use in the test method.

A11.4 When essentially the same apparatus is used for more than one standard and the description of the apparatus requirements is lengthy, it is recommended that the complete specifications for the apparatus be included in an annex to one standard and merely a reference be made to them in the other standard, mentioning under "Apparatus" only such modifications as may apply in each particular case.

A11.5 When the same apparatus is used in several standards, the detailed specifications should be covered by a separate ASTM standard. Examples of such standards are:

E1 Specification for ASTM Thermometers
E133 Specification for Distillation Equipment

A11.6 It is the responsibility of the sponsoring committee to assure itself that suitable apparatus is available (see Section F4).

A11.6.1 If the apparatus is special or not readily available, detailed rules for referencing sources of supply shall be followed (see Section F4).

A11.6.2 If the apparatus has to be built, blueprints, plans, etc., should be cited in a footnote in this section as available through ASTM International Headquarters as adjunct material to the standard.

A12. Reagents and Materials

A12.1 When more than one procedure is included in one standard, list the reagents and materials required for each procedure as a separate section under each subdivision.

A12.2 It is recommended that, where applicable, the following be included as secondary sections ".1" and ".2" of this section:

> 6.1 —Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society where such specifications are available.[1] Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.
>
> 6.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean reagent water as defined by Type ___ of Specification D1193.
>
> NOTE A2— The identifying number (for example 6.1 and 6.2 as above) used in recommended texts are for illustrative purposes.

1 Reagent Chemicals, American Chemical Society Specifications, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

Purity of Reagents

A12.2.1 If a different grade of water is required, add a second sentence as follows: "Water conforming to the following specifications is required" (list the specific properties, kinds of ion freedom, etc.).

A12.2.2 In standards covering two or more chemical methods these statements on purity should be made in a separate section entitled "Purity of Reagents."

A12.3 List the reagents alphabetically in separate divisions. Give the name of the reagent first, followed by any descriptive terms (see A12.7). State the desired concentration if significant; then follow with instructions for preparation and standardization (if required), using the imperative mood and concise descriptions. Spell out the full name of the reagent, and immediately after the first mention of the name include within parentheses the exact chemical formula of the reagent showing any water of crystallization, etc. Exception to this may be made in the case of organic, organometallic, or complex inorganic compounds by omitting the chemical formula. Subsequent references to compounds shall be by formula only where they can be clearly specified by this means, as in the case of most inorganic compounds. As exceptions, always spell out the word "water" and the names of substances in their elementary state; for example, use lead, *not* Pb; oxygen, *not* O_2. If the reagent is to be used as purchased, and not diluted, dissolved, or purified, state the chemical formula as given by the manufacturer.

A12.4 Do not use trademarks unless a specific manufacturer's product is required for a well-defined reason. (See Section F4.) In this case, use a superior reference number to refer to a footnote giving the required information, incorporating the phrase "has been found satisfactory for this purpose." Where particular reagents are required only for standardization or calibration, identify them by reference to an appropriate footnote such as "This reagent is used for standardization purposes only."

A12.5 Specify the reagent concentration in applicable terms, as follows:

> Concentrated acids and bases ... density, unless mass percent is more generally used or required
>
> Dilute acids and bases ... volume ratio, X + Y (X volumes of reagent added to Y volumes of water)

Nonstandardized solutions ... grams of reagent as weighed out per litre of solution

Standardized solutions ... normality, expressed decimally; or the equivalent of 1 mL of solution in terms of grams of a given element expressed as “1 mL + *xxx g* of ...”

A12.6 Wherever possible, use the same concentrations of reagents and methods of standardization as used in other similar ASTM test methods.

A12.7 Examples of reagent descriptions are as follows:

A12.7.1 *Ammonium Carbonate* $(NH_4)_2CO_3$).

A12.7.2 *Sodium Chloride Solution* (100 g/L)—Dissolve 100 g of sodium chloride (NaCl) in water and dilute to 1 L.

A12.7.3 *Potassium Hydroxide, Methanol Solution* (33 g/L)—Dissolve 33 g of potassium hydroxide (KOH) in methanol and dilute to 1 L with methanol.

A12.7.4 *Barium Chloride Solution* (100 g $BaCl_2$/L)—Dissolve 117.3 g of barium chloride dihydrate ($BaCl_2 \cdot 2H_2O$) in water and dilute to 1 L.

A13. Hazards

A13.1 *Safety Hazards*—Paragraph F2.1 specifies the generic safety hazards caveat and the types of standards in which it shall be used. Other statements on safety are subject to the following policies.

A13.1.1 *Warning Statement*—A warning statement identifies a specific hazard and provides information for avoiding or minimizing a particular hazard. When there are hazards to personnel, such as explosion, fire toxicity, or radiation, or technical hazards, such as damage to equipment, a warning statement shall be placed at the appropriate point in the text beginning with “Warning” in boldface type followed by a description of the hazard, or a reference to a description of the hazard within the body of the standard (refer to A13.1.2).

A13.1.2 *Remedial Statements*—A remedial statement provides recommendations for treating a situation resulting from an unsuccessfully controlled hazard *associated with the use of a standard*. Such remedial statements shall not be included in standards, but reference may be made in a note to authoritative sources where reliable information about remedial measures can be obtained such as the appropriate Safety Data Sheet (SDS) where applicable.

A14. Sampling, Test Specimens, and Test Units

A14.1 Under this heading give necessary special directions, in the imperative mood, for physically obtaining sample test units. If a test result is defined as a combination of the observations made on different test specimens, particularly describe how these specimens are to be selected. Give necessary special directions for storage of specimens, for preservation of specimens, and for special preparation of specimens for the test.

A14.2 Statistical aspects of sampling for a specific purpose, for example, in determining conformance of the mean properties of a lot to specifications, should be referenced or discussed in an appendix. These statistical aspects might include stratification, selection of primary and secondary sampling units, the number of such units to be selected, in the case of bulk material the number of increments combined to form a composite sample, the number of composites to be formed, the method of subsampling a composite, and the number of tests made on a subsample.

A14.3 If the method of sampling is described in an existing ASTM test method or ASTM specification, refer to that test method or specification by designation.

A14.4 If the method of sampling is detailed in a readily available publication other than an existing ASTM standard, refer to the publication in a footnote, arranging the information in accordance with the suggestions presented in the Standards Style Manual, Part G, of this publication.

A14.5 Where an existing sampling method (other than ASTM) is cited in a test method, guidelines should be given as to the use of the sampling scheme and precautions if needed. If explanatory documents regarding sampling are available, these should be cited in this section.

A14.6 A *test unit* is a unit or portion of a material that is sufficient to obtain a test result(s) for the property or properties to be measured. A *test specimen* is a test unit or portion of a test unit upon which a single or multiple observation is to be made. A *test result* refers to the value obtained for a given property from one test unit. A test unit may be a subunit of a primary (first stage) sampling unit or it may be a subunit of a composite of primary sampling units or of increments from these primary sampling units. A test result may be a single observation or a combination of a number of observations when two or more test specimens are measured for each test unit. (For additional information see Section G23.)

A14.7 The size of the test unit for chemical analysis usually is given in the “Procedure” section, but if significant in connection with pretreatment or preparation, it should be included here. When a test specimen is specified by mass, indicate the degree of precision desired.

A14.8 Include detailed requirements as to the size and number of test specimens to be used for both physical and chemical tests. Where a test specimen or test unit of a particular shape is required, the essential dimensions shall be specified, including tolerance. A drawing showing the details of the specimen or test unit may be included.

A15. Preparation of Apparatus

A15.1 Use this section only when detailed instructions are required for the initial assembly, conditioning, or preparation of the apparatus (see also A24.3.6).

A16. Calibration and Standardization

A16.1 *Apparatus*—Give detailed instructions, in the imperative mood, for calibration and adjustment of the apparatus necessary for the use of the test method.

A16.2 *Reference Standards and Blanks*—Give detailed instructions for the standardization and use of reference standards and blanks used in the test method. Describe any standard samples used to assure uniformity of the test technique, and standard specimens or photographic standards.

A16.3 *Calibration Curves and Tables*—Give detailed instructions for the preparation and use of calibration curves or tables, in accordance with the suggestions presented in the Standards Style Manual, Part G, of this publication. Include in the instructions for curve or table preparation items such as calibration, solutions, reference standards, blanks, color development, photometry, and construction.

A17. Conditioning

A17.1 Specify, in the imperative mood, the conditioning atmosphere to be used and the time of exposure to the atmosphere, as well as the atmosphere required during the test, where necessary. State whether the conditioning requirements apply to laboratory samples as well as individual specimens. Indicate any requirements for preconditioning. Where applicable, refer to ASTM Terminology E41, Terms Relating to Conditioning, and to ASTM Practice E171/E171M, for Conditioning and Testing Flexible Barrier Packaging.

A18. Procedure (Mandatory)

A18.1 Include in proper sequence detailed directions for performing the test. Describe the procedure in the imperative mood, present tense; for example: “Heat the test specimen ...” rather than “The test specimen shall be heated ...” State the number of samples to be taken, and also state the number of specimens to be tested from each sample. Describe in detail the successive steps of the procedure, grouping related operations into logical divisions. Subheadings may be used if they will help the organization of the material. Make the text of the procedure concise, to the point, and easily understandable. When alternative procedures are given, state their relative status; that is, which is the preferred or referee procedure.

A18.2 In chemical methods, specify the size of test specimen and indicate the degree of precision desired in the weighing. Consider the specimen size and its accuracy of weighing in connection with the ultimate use of the method. If the formula for a reagent has been given previously in accordance with the instructions given in A12.3, refer to the reagent by chemical formula only or name, whichever is less confusing. Otherwise, spell out the name of the reagent. The procedure shall provide for any operations necessary to obtain any correction data that may be needed.

A19. Calculation or Interpretation of Results

A19.1 *Calculation*—State the directions in the imperative mood for calculating the results of test(s) including any equations and any required significant figures (see also Section G16 and ASTM Practice E29 for Using Significant Digits in Test Data to Determine Conformance with Specifications.) See Form and Style, G16.5. If necessary for clarity, a typical calculation should be included in an explanatory note.

A19.1.1 An example of a typical equation is:

$$W_{Ai} = 0.0584[(m_A - m_B)/m_C]$$

where:

W_{Ai} = the mass fraction of aluminum oxyquinolate in the aliquot used, g/g,

m_A = the mass of aluminum oxyquinolate found in the aliquot used, g,

m_B = the mass of aluminum oxyquinolate found in the blank, g,

m_C = the mass of sample represented in the aliquot used, g, and

0.0584 is the ratio of the relative atomic mass of aluminum to the relative molecular mass of aluminum oxyquinolate.

A19.2 *Interpretation of Results*—Use this heading in place of “Calculation” when the results of the test are expressed in descriptive form, relative terms, or abstract values. List and define the descriptive terms or classifications used. The results of a test may be interpreted or expressed in terms of a rating scale. There is fairly wide agreement on five-step scales for many values or rankings of merit, with 5-good, 3-middle, 1-bad. In general, a higher score for more of a desirable property is the more satisfactory arrangement. This eliminates confusion arising from No. 1 in rank for the most of a quantity, without regard to the relative desirability.

A19.2.1 Examples of test methods that include rating systems are:

D130 Test Method for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test

D3511/D3511M Test Method for Pilling Resistance and Other Related Surface Changes of Textile Fabrics: Brush Pilling Tester Method

A20. Report

A20.1 State in this section the detailed information required in reporting the results of the test. When two or more procedures are described in a test method, the report shall indicate which procedure was used. When the test method permits variation in operating or other conditions, incorporate in the report a statement as to the particular conditions used in the test. As an aid in the calculation and uniform recording of test results a standard report form or work sheet may be used, and if desirable a facsimile of the form may be included in the test method. Introduce the section as follows: “Report the following information:”

A21. Precision and Bias (Mandatory)

A21.1 *Definitions and Additional Information:*

A21.1.1 For precise definitions of statistical terms, refer to ASTM Terminology E456, Relating to Quality and Statistics.

A21.1.2 For more information on calculation methods relating to the use of statistical procedures, refer to ASTM Practices E177 and E691.

A21.2 *Statement of Precision (Mandatory)*:

A21.2.1 Precision is the closeness of agreement between test results obtained under prescribed conditions. A statement on precision allows potential users of the test method to assess in general terms its usefulness in proposed applications. A statement on precision is not intended to contain values that can be duplicated in every user’s laboratory. Instead the statement provides guidelines as to the kind of variability that can be expected between test results when the test method is used in one or more reasonably competent laboratories.

A21.2.2 Precision shall be estimated in accordance with the interlaboratory test program prescribed in Practice E691, Conducting an Interlaboratory Study to Determine the Precision of a Test Method, or by an interlaboratory test program that yields equivalent information, for example, a standard practice developed by an ASTM technical committee. The data and details of the interlaboratory study to determine precision shall be filed as a research report at ASTM International Headquarters, provided ASTM holds copyright permissions. The precision statement shall include reference to the research report in a Note.

A21.2.3 Every test method shall contain: (*1*) a statement regarding the precision of test results obtained in the same laboratory under specifically defined conditions of within-laboratory variability (repeatability conditions); and (*2*) a statement regarding the precision of test results obtained in different laboratories (reproducibility conditions).

A21.2.4 The repeatability conditions defined in Terminology E456 shall be used; namely, within-laboratory conditions under which test results are obtained with the same test method in the same laboratory by the same operator with the same equipment in the shortest practicable period of time using test specimens taken at random from a single quantity of homogenous material. If some other within-laboratory variability is also determined (such as for longer times or different operators within a laboratory), the particular conditions shall be reported in detail, and the precision designated “intermediate precision” (see Terminology E456). If the committee formerly called this repeatability, add “(formerly called repeatability).”

A21.2.5 The statement regarding between-laboratory variability shall pertain to test results obtained with the same method on random test units from the same lot of homogeneous material in different laboratories with different operators using different equipment (reproducibility conditions).

A21.2.6 The precision statement shall include the repeatability standard deviation and reproducibility standard deviation; and shall include the 95 % repeatability limit and the 95 % reproducibility limit for the largest expected differences between two test results. The latter are numerically equal to 2.8 times the respective standard deviation for data that are known to be normally distributed, and approximately so for most other data encountered in ASTM committee work. Use a statement such as the following:

> *Precision*[1]—The repeatability standard deviation has been determined to be (insert repeatability value) and the 95 % repeatability limit is (insert value). The reproducibility standard deviation has been determined to be (insert reproducibility value) and the 95 % reproducibility limit (insert value).
>
> 1 Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR: (insert report number). Contact ASTM Customer Service at service@astm.org.

A21.3 *Statement on Bias (Mandatory):*

A21.3.1 Bias is a systematic error that contributes to the difference between the mean of a large number of test results and an accepted reference value. A discussion on bias may be found in statistical documents, such as Practices E177 and C670.

A21.3.2 The bias statement shall describe the bias and methods employed to provide corrected test results. If the bias is not known but the direction or bounds on the bias, or both, can be estimated, these shall be reported in the bias statement.

A21.4 *General Considerations:*

A21.4.1 The precision and bias section of the test method shall include a brief descriptive summary of the interlaboratory study that will permit the user of the test method to judge the reliability of the data. This summary should include number of laboratories, number of property levels tested, range of the measured average property levels, and number of replicate tests. The summary may be included in a Note.

A21.4.2 If precision or bias, or both, varies with the test level, the variation shall be described in the statement.

A21.4.3 When revising or reapproving a test method, ensure that the information reported in the Precision and Bias section and the supporting data are still valid. If there has been a change to the test method that could affect precision, a new interlaboratory study should be conducted.

A21.5 *Exceptions:*

A21.5.1 If the responsible committee decides that an interlaboratory study for a new test method should be delayed, a temporary statement shall be included which addresses only repeatability based on the results from a single operator. A repeatability limit is not included. This temporary precision statement is permitted for five years, use a statement such as the following:

> *Precision*[1]—The repeatability standard deviation from a single operator has been determined to be (insert repeatability value or values for different average property values).
>
> 1 An interlaboratory study of this test method is being conducted and a complete precision statement is expected to be available on or before (insert year).

A21.5.2 If it is not feasible to determine the reproducibility, as directed in A21.2, within five years of the first approval of the standard, use a statement such as the following:

> *Precision*[1]—The repeatability standard deviation from a single operator has been determined to be (insert the average test values and corresponding repeatability values).

1 The reproducibility of this test method is not provided at this time because (insert here the reason or reasons). The reproducibility of this test method is being determined and is expected to be available on or before (insert year).

A21.5.3 When a test method specifies that the procedure in another ASTM test method is to be used without modification, no statements of precision and bias are necessary if those in the other test method are applicable. When a test method specifies that the procedure in another ASTM test method is to be used with only insignificant modification(s), use a statement such as the following to assure the reader that precision and bias are not affected by the modification(s):

Precision and Bias—The precision and bias of this test method for measuring (insert here the name of the property) are essentially as specified in Test Method (insert here the designation of the other test method).

When a test method specifies that the procedure in another ASTM test method is to be used with significant revisions, provide statements on precision and bias as directed in A21.2 and A21.3.

A21.5.4 When a test method specifies that a test result is a nonnumerical report of success or failure or other categorization or classification based on criteria specified in the procedure, use a statement on precision and bias such as the following:

Precision and Bias—No information is presented about either the precision or bias of Test Method X0000 for measuring (insert here the name of the property) since the test result is nonquantitative.

A21.5.5 If it is not possible to provide a statement on precision (repeatability or reproducibility) as directed in A21.2, use a statement such as the following:

Precision—It is not possible to specify the precision of the procedure in Test Method X0000 for measuring (insert here the name of the property) because (insert here the reason or reasons).

Citing impracticability is not warranted if the reason is that an interlaboratory study has revealed that the precision is poor or that the standard was written before precision statements were required.

A21.5.6 If bias cannot be determined, a statement to this effect shall be included, such as the following:

Bias—No information can be presented on the bias of the procedure in Test Method X0000 for measuring (insert here the name of the property) because (insert here the reason; such as “no material having an accepted reference value is available”).

A22. Measurement Uncertainty

A22.1 Measurement uncertainty is an estimate of the magnitude of systematic and random measurement errors that may be reported along with the measurement result. An uncertainty statement relates to a particular result obtained in a laboratory carrying out the test method, as opposed to precision and bias statements which are mandatory parts of the method itself and normally derived from an interlaboratory study conducted during development of the test method.

A22.2 It is neither appropriate for, nor the responsibility of, the test method to provide explicit values that a user would quote as their estimate of uncertainty. Uncertainty values must be based on data generated by a laboratory reporting results using the test method.

A22.3 In this section include guidance for developing estimates of uncertainty to be reported with test results. Suggestions should be considered for studies to perform, listings of the potential major contributing factors to uncertainty, descriptions of how the variation due to each factor might be evaluated, and examples of how they might be combined. Information of this type is particularly useful to users of the test method seeking laboratory accreditation. Information on measurement uncertainty may be placed in an appendix if it is for information only.

A22.4 For additional guidance refer to Guide E1488.

A23. Keywords (Mandatory)

A23.1 In this section, identify the words, terms, or phrases, that best represent the technical information presented in the standard. Select the keywords from the title and body of the document and include general, vernacular, and trade terms. These keywords will be used in the preparation of the ASTM Subject Index.

A23.2 Select three or more keywords that describe the names of tests, procedures, special materials, or the specific application(s) that will facilitate the identification and retrieval of the standard.

A23.3 All selected keywords shall be stand-alone terms; the type of standard, incomplete phrases, unattached adjectives, etc., shall not be used.

A24. Annexes and Appendixes

A24.1 Additional information may be included in one or more annexes and appendixes to the test method.

A24.2 The words “Mandatory Information” shall be included directly under the title of annexes and the words “Nonmandatory Information” shall be included directly under the title of appendixes.

A24.3 *Annexes*—Include in annexes any detailed information such as that on apparatus or materials that is a mandatory part of the test method but too lengthy for inclusion in the main text. Annexes shall precede appendixes. Examples of such information are as follows:

A24.3.1 Glossary of terms used in the method,

A24.3.2 List of symbols,

A24.3.3 Detailed description of apparatus,

A24.3.4 Instructions for calibrating and standardizing apparatus,

A24.3.5 Directions for cleaning apparatus, and

A24.3.6 Operating instructions and adjustments of specific makes of apparatus.

A24.4 *Appendixes*—An appendix to an ASTM standard is informative only and is not a mandatory part of the standard. Information on the following general subjects has been included in such appendixes:

A24.4.1 Notes on significance and interpretation of the test method, usually to amplify the statement in the text,

A24.4.2 Development of equations used in the calculations,

A24.4.3 Charts or supplementary information for computations,

A24.4.4 Suggested data forms for recording test results, and

A24.4.5 Commentary on rationale used in the development of the test method.

A25. References

A25.1 Include only references to publications supporting or providing needed supplementary information. Historical and acknowledgment references are not desirable. If there are five or more references, list them in an unnumbered section at the end of the standard in the order in which they appear in the text. If there are fewer than five literature references, use footnotes (see Section G21).

A26. Footnotes

A26.1 *General*—Footnotes referenced in the text are intended only for reference and shall never include any information or instructions necessary for the proper application of the method. Table footnotes are a part of the table. Use consecutive superior numerals for reference to footnotes except in connection with tables, in which case use italic capital letters.

A26.2 *Committee Jurisdiction and History*—Footnote 1 shall include in the first paragraph the committee having jurisdiction and, where the committee so requests, the subcommittee. The second paragraph shall include history information as follows: *(1)* approval date of latest revision, *(2)* month and year of publication, *(3)* designation and year of original issue, *(4)* designation and year of previous issue, and *(5)* information as to any other standards that may have been replaced by the standard, year of redesignation, etc.

A26.3 *Literature References*—Use footnotes for references if there are fewer than five. For five or more see Section A25, observing the limitations noted therein. Also see Section G21.

A26.4 *Sources of Apparatus*—Where apparatus may be special or not readily available from more than one source, the source may be referenced. (However, see Section F4 for detailed rules.)

A26.5 *Research Reports*—Reference in a footnote the availability of Research Reports (see Section A29).

A27. Notes

A27.1 Notes in the text shall not include mandatory requirements. Notes are intended to set explanatory material apart from the text itself, either for emphasis or for offering informative suggestions, which are not properly part of the standard. Clarification of the description of required apparatus or procedure and modifications required or permitted in certain cases belong in the text itself. If inclusion of the contents yields a different result, then that information is considered mandatory for the performance of the standard and shall be located in the text. Notes may be preferable for detailed description of auxiliary procedures (for example, correction of barometric pressure in a test method not primarily concerned with pressure). Table notes are a part of the table and are mandatory provisions.

A27.2 Notes appearing in a given standard shall be numbered in sequence separately in the main text, separately in sequence in the annex, and separately in sequence in the appendix and should appear at the end of the paragraph to which they pertain. If it is desired to refer to a text note in connection with a specific word or phrase in the text, that word or phrase should be followed by a reference to the note, “(NOTE 1),” etc.

A27.3 Notes in the text are preferred for the following:

A27.3.1 To refer to editorial changes made in the text,

A27.3.2 To refer to similar or companion ASTM standards,

A27.3.3 Limitations of the application of the test when not covered in the text.

A27.3.4 Description, if included under “Scope,” of experimental means for recognizing cases where the method is not applicable to the material under test.

A27.3.5 Description of additional (*not* alternative) apparatus, materials, procedures, or calculations that are not actually required; or description of merely recommended forms of construction of required apparatus.

A27.3.6 Explanation, if desired, of the reasons for a certain requirement or direction. If brief, include in the text rather than as a note.

A27.4 *Patent Disclaimer of Liability*—See Section 15 of the *Regulations Governing ASTM Technical Committees* This note, quoted in F3.2 and not numbered, is generally placed at the end of the standard. Refer questions regarding the applicability of this section to the Staff Manager of your committee.

A27.5 *General Statement of ASTM Policy*—This note, quoted in F2.3 and not numbered, is generally placed at the end of the standards after the note on Patent Disclaimer of Liability.

A28. Adjuncts

A28.1 Occasionally, it is not practicable to publish as an integral part of the standard, because of its nature, material that may be required for use of the standard. Such material is published as an adjunct.

A28.2 Include a description of the adjunct in the text of the standard. If appropriate, include a figure (illustration) of the adjunct.

A28.3 When adjunct material is indicated, it shall be made available at the time of publication of the standard.

A28.4 Include all referenced adjuncts in the Referenced Documents section (see Section A6).

A28.5 Examples of adjuncts are as follows:

A28.5.1 Comparison standards such as the copper strip corrosion standards for Test Method D130 (lithograph aluminum strips),

A28.5.2 Charts such as the viscosity-temperature charts for liquid petroleum for D341,

A28.5.3 Reference radiographs such as E155 or reference photographs, such as E125,

A28.5.4 Technical data such as the twelve volumes of D1250, Petroleum Measurement Tables, and

A28.5.5 Drawings such as detailed drawings for the construction of the smoke chamber in Test Method D2843.

A29. Research Reports (Mandatory for Precision and Bias Statements Producing Numerical Results)

A29.1 Where numerical data have been generated to establish the precision and bias of a test method, a research report is required. The research report shall include a list of participating laboratories, description of samples, a copy of the laboratory instructions, the equipment/apparatus used, the data, a statistical summary and a copy of the Precision and Bias Statement, where applicable. A guide for the research report is available at www.astm.org or from ASTM International Headquarters. The research report shall be placed on file at ASTM, provided ASTM holds copyright permissions. A number is assigned by ASTM and a copy may be obtained upon request. A footnote shall be placed in the standard stating where a copy of the research report may be obtained, giving the “RR” designation number (for equivalent information if not ASTM copyrighted material).

A30. Rationale

A30.1 The inclusion of a rationale (commentary) section in ASTM standards is encouraged to ensure that brief and concise documentation is available to the user of the standard and to provide traceability and clarification of past actions. This documentation may include: *(1)* a brief history of the development of a new standard or revision to an existing standard including when and why the effort was initiated, *(2)* reasons and justification for requirements, *(3)* documentation of factors considered, and *(4)* listing of technical sources and literature.

A30.2 If included, this information shall appear in an appendix of the standard.

A30.3 Examples of standards that include section on rationale:

E84 Test Method for Surface Burning Characteristics of Building Materials

F746 Test Method for Pitting or Crevice Corrosion of Metallic Surgical Implant Materials

A31. Summary of Changes

A31.1 If the committee chooses to provide a Summary of Changes, place this unnumbered section at the end of the standard and begin with the following introductory paragraph:

> Committee XXX has identified the location of selected changes to this standard since the last issue (insert designation and year date) that may impact the use of this standard.

A31.2 An asterisk will appear after the Scope (**Scope***) with the following wording at the bottom of the first page:

***A Summary of Changes section appears at the end of this standard.**

A31.3 Next list, by section or subsection, changes made since the last issue that may impact the use of the standard. For standards that have undergone multiple revisions in a short period of time, keep the Summary of Changes in the standard for 18 months. This will ensure that all changes from one publication of the Annual Book of ASTM Standards to the next are recorded. Brief descriptions of the changes and reasons for the changes may be included. If desired, a more extensive description of reasons for the changes should be placed in the appendix.

A31.4 An example of the list of changes is:
(1) Deleted Section 5 and renumbered subsequent sections.
(2) Updated precision statement in Section 10 to reflect the results of a recent interlaboratory study.
(3) Revised hardness requirements in Table 2.
(4) Revised Section 14 on Product Marking.

Part B
Form of ASTM Specifications

INTRODUCTION

The broad scope of ASTM International, which covers materials, products, systems, and services, and the need to provide for a variety of approaches to the writing of ASTM specifications, prevent the development of a single document or a series of documents that list all subjects to be covered in all ASTM specifications. This document, however, is intended to provide considerable guidance to the committees in their specification-writing activities.

Special instructions with respect to the legal aspects shall be followed in writing any standard. These include such matters as contractual items, caveat statements, patents, and fire standards. Assistance on development of fire standards is available from Committee E05. See Part F for details.

When a standard is being developed, the costs associated with its development and subsequent use generally should be considered. The prime objective should be the optimum use of resources to achieve satisfactory definition of the product or service. However, it should be noted that when the standard relates to the safety of persons, cost considerations are likely to become much less important than when attributes of materials or products are involved. Some standards, such as definitions, impose no cost on the user; others that include numerous and extensive requirements can entail significant expense to users of the standard. The requirements to be included should, therefore, be those that are technically relevant and yield benefits commensurate with the cost of their determination.

Cost effective statements or rationale may be included within a standard if appropriate, usually in an appendix.

Standards or sections of standards relating to the *safe use or performance* of consumer products (see NOTE B1) may be sent to Committee F15 on Consumer Products for review and comment at some appropriate stage prior to letter ballot of the originating main committee. This review is offered by Committee F15 to provide for the maximum of consumer input. Draft standards submitted to Committee F15 will receive rapid and constructive critique.

NOTE B1— Consumer products are those designed primarily for use by the consumer in and around the home, school, or recreational areas.

B1. Functions

B1.1 Specifications (see definition on p. iv) may have three functions and, although many specifications serve all three, it is well that those drafting specifications keep these functions in mind so that the primary purposes are not confused.

B1.1.1 *Purchasing*—Specifications facilitate dealings between the purchaser and the supplier. Sufficient requirements should be included to ensure that all batches, lots, or deliveries from any seller that conform to the specification will be satisfactory to the purchaser. Unnecessary requirements are likely to increase costs and should be avoided.

B1.1.2 *Standardization*—Standardization is an inevitable byproduct of most specifications. In some cases it may be the primary function. Standardization involves a deliberate and possibly arbitrary choice of a limited number from the multiplicity of qualities, sizes, compositions, etc., that may be available.

B1.1.3 *Providing Technical Data*—All specifications contain technical information, but in some cases the designer requires more information than that provided for purchase or standardization. Committees may add information of this type to specifications either as requirements or as appendixes.

B1.2 *Open-End Agreements*—There shall be no statements in specifications that allow agreement between purchaser and supplier that do not meet the minimum requirements of the specification by such means as omitting tests that are a part of the specification, substituting or modifying a test method, or by changing the specification limits to be less restrictive.

B2. Subject Headings of Text

B2.1 The following is the sequence for the text of ASTM specifications. Headings are those most generally used, but may not be all-inclusive. It may be necessary to include other headings for specialized subjects. The headings identified as “mandatory” are required. Other headings shall be included when the subject matter is pertinent to the document under development, in which case, all instructions and guidance for that particular section shall be followed. For example, if the standard does not contain reference to any standard documents within the text, it is not required to include a section on Referenced Documents. If, however, specific hazards are cited throughout the text, then the section on Hazards shall be followed. Not all of these headings may be required for a particular standard. Additional headings, which are included to cover specialized subjects, should appear in the most appropriate place and sequence depending on their relation to the sections below.

Title (mandatory)
Designation (mandatory)
Scope (mandatory)
Referenced Documents
Terminology
Classification
Ordering Information
Materials and Manufacture
Chemical Composition
Physical Properties
Mechanical Properties
Performance Requirements
Other Requirements
Dimensions, Mass, and Permissible Variations
Workmanship, Finish, and Appearance
Sampling
Number of Tests and Retests
Specimen Preparation
† Test Methods
Inspection
Rejection and Rehearing
Certification
Product Marking
Packaging and Package Marking
Keywords (mandatory)
Supplementary Requirements
Quality Assurance
Annexes and Appendixes

References
Summary of Changes

† Test methods included shall contain the mandatory headings shown in Section A1, except for title and designation.

B2.2 Subject headings in boldface type shall precede each section to orient the reader. Substitute text divisions and number in accordance with the Use of the Modified Decimal Numbering System guide in Part D of this publication.

B3. Title (Mandatory)

B3.1 The title should be as concise as possible, but complete enough to identify the material, product, system, or service covered by the specification. Titles are used in lists, table of contents, and indexes, and it is most important that they be brief but inclusive. Use the singular form: “specification.”

B4. Designation and Year Date

B4.1 *Designation (mandatory)*—The ASTM designation, assigned by Headquarters on submittal for approval, consists of the following sequential parts:

B4.1.1 A letter designation denoting in general the classification according to material, product, system, or service:

A—Ferrous metals and products
B—Nonferrous metals and products
C—Cementitious, ceramic, concrete, and masonry materials
D—Miscellaneous materials and products
E—Miscellaneous subjects
F—End-use materials and products
G—Corrosion, deterioration, weathering, durability, and degradation of materials and products

B4.1.2 A sequential number following the letter designation (for example, Specification C150).

B4.2 *Year Date:* (for example, Specification C150-01):

B4.2.1 After the designation, a hyphen is followed by the last two numbers of the year of acceptance or of last revision. If the standard is revised again during the same year, this is indicated by adding an “a” for the second revision, “b” for the third revision, etc.

B4.2.2 The parenthetical phrase (“Reapproved 20___”) to designate the year of last reapproval of a standard, if applicable.

B4.2.3 For editorial changes that do not change the year designation, a note is inserted before the text to indicate the location and date of the change and a superscript epsilon ($^{\varepsilon}$) is added after the year designation. the epsilon designations and corresponding notes are numbered chronologically and are deleted upon occasion of the next revision or reapproval.

B4.3 Designation numbers of standards that have been discontinued are not reassigned.

B4.4 *SI Standards* (see Part H and Section G24).

B5. Scope (Mandatory)

B5.1 Include in this section information relating to the purpose of the specification. Concisely state the materials, products, systems, or services to which the specification applies and any known limitations. Include, where applicable, the intended use of the specification. Do not include references to trademarks.

B5.2 Include in this section the system of units to be used in referee decisions.

B5.3 Include in this section any caveats required by ASTM policy such as *safety hazards* (see F2.1) and *fire hazards* (see F2.2) if one or more test methods are detailed other than by reference.

B5.4 For standards developed for reference in model (building) codes, include the following statement:

> The text of this standard references notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

B6. Referenced Documents

B6.1 List in alphanumeric sequence the designation and complete title all documents referenced within the standard. Refer to Section A6 for further information.

B6.2 Provide footnotes to this section to indicate the sources of these documents. When ASTM standards are referenced later in the text, use only the type of standard (that is, specification, test method, practice, classification, guide, terminology, etc.) and the designation letter and number (for example, Test Method D1310).

B6.3 Do not include the year date when designating referenced documents unless there is a technical reason for requiring a particular revision.

B6.4 When listing referenced adjuncts, provide a brief description in this section, and a footnote of the availability. (For more specific information on adjuncts, refer to Section B29).

B7. Terminology

B7.1 Every standard should include a section on terminology. See Part E for information on Form and Style for terminology sections.

B7.1.1 All significant terms that may have a meaning more specialized than the commonly used language should be defined within a standard or the terminology standard for the relevant committee should be referenced.

B8. Classification

B8.1 When more than one material, product, or system is specified, they may be separated first by *types*, which are distinguished by Roman numerals. This first subdivision shall be based upon some major property, composition, or application of the item. Designate further subdivision by *grades* according to some pertinent property or properties and identify by Arabic numbers. If necessary, make additional division into *classes*, identified by capital letters.

B8.2 The precedence of type, grade, and class, as well as the method of designation, is the ASTM preferred style, and it shall be used in the absence of any established preference.

B8.3 When a type, grade, or class has been deleted, do not use this designation again, to avoid confusion with earlier specifications. If new designations are used, they shall be of different format and preferably followed (for a limited time) by the previous designation in parentheses.

B9. Ordering Information (See also Section B25)

B9.1 When the specification covers options for purchase, such as various types, grades, classes, alloys, sizes, and mass, the purchase order or inquiry should state which particular types, alloys, sizes are desired.

B9.2 A listing of each such optional feature, together with a reference to the applicable section of the specification, will be of assistance in the wording of orders. After the attention of the purchaser is directed to all of the options in the specification, his attention might be directed to what would be furnished by the supplier if the purchaser fails to specify one or more of the options.

B9.3 It is recommended that this section be included in all specifications as a checklist of items to be included in a purchase order or contract. If this list contains any ASTM designation (including referenced documents), it is desirable to specify "year date(s)" to avoid misunderstandings between contractual parties.

B9.4 When citing a combined standard, indicate the system of units to be applied. For example:

X.X This material/product shall conform to the requirements stated in SI units of Specification A36/A36M.

B10. Materials and Manufacture

B10.1 General requirements regarding the materials and method of manufacture to be used may be included when deemed helpful to the user of the standard, such as the open-hearth, electric-furnace, or basic-oxygen bessemer processes generally specified for steel products. When the material, product, or system specified is made from two or more materials or products, this section should state briefly the general requirements of the materials or products to be used and the process to be followed in manufacture, including items such as the nature and character of any alloys, fillers, saturants, antioxidants, coatings, and plasticizers.

B11. Chemical Composition

B11.1 When necessary, detailed requirements shall be given as to chemical composition and other chemical characteristics for the material, product, or system. Frequently these are presented in tabular form. It is most important that the following information be clearly indicated: *(1)* name of each constituent specified, *(2)* whether the requirement is a maximum, minimum, or range, *(3)* whether an allowance for measurement error is incorporated in these limits, *(4)* the units applicable, *(5)* references to notes or footnotes when necessary for further clarification, and *(6)* appropriate analytical methodology.

B11.2 The sequence of items specified shall be consistent within a related group of specifications.

B11.3 The preferred introduction for this section is: "The material shall conform to the requirements prescribed in Table 1."

B11.4 *Limits on Nonspecified Elements*—It is suggested that the following statement be added to tables of chemical requirements as applicable to replace the requirements and statements presently being used regarding nonspecified elements: "By agreement between purchaser and supplier, analysis may be required and limits established for elements or compounds not specified in the table of chemical composition" (see also Section B24).

B12. Other Requirements

B12.1 When necessary, detailed requirements should be given as to characteristics to which the material, product, or system shall conform. Frequently these are presented in tabular form. It is most important that the following information be clearly indicated: *(1)* name of each property or requirements, *(2)* whether the requirement is a maximum, minimum, or range, *(3)* whether an allowance for measurement error is incorporated in these limits, *(4)*

the units applicable, *(5)* references to notes or footnotes when necessary for further clarification, and *(6)* appropriate test methodology.

B12.2 *Physical Properties*—Present the requirements for electrical, thermal, optical, and similar properties in this section, usually in tabular form.

B12.3 *Mechanical Properties*—Present the requirements for tensile strength, yield strength, elongation, and similar properties in this section.

B12.4 *Performance Requirements*—Include functional, environmental, and similar requirements in this section when necessary.

B12.5 *Other Requirements*—Include additional requirements as needed.

B12.6 In preparing a specification it is essential to make sure that there is a test procedure for determining conformance for each requirement. These shall be listed in the specification (see Section B18).

B12.7 When it is not feasible to tabular the requirements, separate text division may be used to specify the various requirements. These shall be given appropriate headings consistent with the subject matter included.

B13. Dimensions, Mass, and Permissible Variations

B13.1 Details as to the standard shapes, mass, and size ranges usually are presented best in tabular form with brief reference in the text. Separate sections may be necessary with individual tables. The tables shall clearly indicate where the various size ranges are divided; for example, ranges from 0 to 250 mm, 250 to 500 mm, 500 to 750 mm shall be more properly stated as 250 mm and under, over 250 to 500 mm, inclusive; over 500 to 750 mm, inclusive, etc.

B13.2 The permissible variations in dimensions, mass, etc., may be included in the same tables with the nominal sizes. It shall be made clear whether the tolerances specified are both plus and minus or apply in only one direction.

B14. Workmanship, Finish, and Appearance

B14.1 Requirements covering the workmanship and finish include such general requirements as the type of finish and general appearance or color, uniform quality and tempers (for metals), and whether the item is clean, sound, free of scale and injurious defects. To avoid misunderstanding, these should be spelled out clearly. Provisions for removal or repair of minor surface imperfections that are not considered cause for rejection should be stated.

B14.2 For products such as pipe and tile it is usually customary to specify absence of defects such as fractures, large or deep cracks, checks, blisters, laminations, and surface roughness. The finish and shape of the ends also should be specified.

B15. Sampling

B15.1 If a specification applies to a unit of product or material such as a piece of cloth, a coil of wire, a section of plastic pipe, or a heat of steel, from which specimens are to be taken for testing, the procedure for obtaining these specimens shall be described.

B15.2 If a specification pertains to individual units of a lot and sampling inspection is likely to be the normal procedure, it is desirable for the specification to reference or include in a supplementary section a sampling procedure for determining acceptability of the lot (see Section B25).

NOTE B2— In a single sampling plan by attributes the acceptability of a lot will be determined by the number of units of product in the sample that do not conform to the specifications. The acceptable quality level (AQL) and limiting quality level (LQL) of an acceptance sampling plan, expressed as percentages of the units nonconforming, are characteristics of the sampling plan and are not to be viewed as product specifications.

B15.3 If a specification pertains to the mean of a lot, in particular to the mean of a lot of bulk material such as cement or pig iron, the procedure for sampling the lot or the formation of sample test units, or both, shall be described or referenced. The criterion for determining conformance of the lot shall be specifically stated.

B15.4 If a specification applies to a lot of bulk material, state the number of increments required to create a sample test unit and the number of test units to be taken to determine conformance of the lot.

B15.5 The minimum amount of material required to carry out conveniently all the tests in the specification should be indicated for the convenience of the user of the specification.

B16. Number of Tests and Retests

B16.1 State the number of test units and the number of test specimens or subunits that are required to determine conformance of the material or product to the specifications. In the sampling of a lot of bulk material, state the size of the sample in terms of the number of primary (first stage) sampling units that is required to determine conformance to the specifications.

NOTE B3— When a specification pertains to several different properties of a material to be determined by a variety of test methods, a test unit is defined as a unit or portion of the material that is sufficient to obtain a single, adequate set of test results for all properties to be measured.

B16.2 If a specification allows retesting in cases where the material or product fails to pass the specification, state the rules for the retesting and the conditions under which the retesting would be permitted.

B17. Specimen Preparation

B17.1 Where special preparation is required, as for example in specifications for molding materials, this section shall be included.

B17.2 Refer to a standard test method if possible.

B17.3 If no standard test method exists, include sufficient detail in the specification to assure acceptable reproducibility of test results.

B17.4 State that specimens are to be prepared in accordance with the recommendations of the manufacturer only if neither B17.2 nor B17.3 is feasible.

B18. Test Methods

B18.1 List standard test methods for measurement of all requirements of a specification. Refer to the ASTM test methods used in testing the material to determine conformance with the specification. This includes sampling, chemical analysis, mechanical, electrical, thermal, optical, and other testing procedures. When alternative procedures are given in test methods, it is important to state which particular procedure shall be used as the basis for the specification requirement.

B18.2 When there is no ASTM test method specified for a particular quality or property of a specified material, describe the test procedure to be followed in detail in the specification, following the Form of ASTM Test Methods (Part A of this publication). Include all mandatory information listed in A1.1 (title, scope, significance and use, hazards, procedure, precision and bias).

B18.3 Where a method of some other organization is being used and the committee has not approved the test as an ASTM test method, then it is preferable to describe the test in detail in the specification and to include a footnote reference to the original source. Appropriate copyright releases shall be obtained.

B18.4 State all procedures in the imperative mood.

B19. Inspection

B19.1 The following statement has been adopted by the Board of Directors to be used when there is a substantial disagreement between producers and users within a particular committee, resulting in a blockage of progress in the acceptance of new specifications or revisions to specifications:

> Inspection of the material shall be agreed upon between the purchaser and the supplier as part of the purchase order or contract.

B19.2 Place any technical requirements on inspection such as sampling plan and physical or mechanical properties in other appropriate parts of the specification.

B20. Rejection and Rehearing

B20.1 The following statement serves as a guide to ASTM committees when there is need for a section on rejection and rehearing:

> Material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make claim for a rehearing.

B21. Certification

B21.1 A certification section may be included in the standard when in the judgment of the committee, technical considerations make this advisable. If a certification section is included, the certification shall include reference to the standard designation and year date.

B21.2 The following are suggested statements:

> When specified in the purchase order or contract, the purchaser shall be furnished certification stating samples representing each lot have been tested and inspected as indicated in this specification and the requirements have been met. When specified in the purchase order or contract, a report of the test results shall be furnished. Test reports may be transmitted to the purchaser by electronic services. The content of the electronically transmitted document shall conform to any existing agreement between the purchaser and the seller.

B21.3 Upon the request of the purchaser in the purchase order or contract, the certification of an independent third party indicating conformance to the requirements of this specification may be considered.

B22. Product Marking

B22.1 It is customary to specify the information to be marked on the material or included on the package, or on a label or tag attached thereto. Such information typically may include the name, brand, or trademark of the manufacturer, quantity, size, weight, ASTM designation, or any other information that may be desired for a specific material. If an ASTM standard is specified, indicate “ASTM” and the designation number (for example, ASTM F2063) on the marking, when possible.

B23. Packaging and Package Marking

B23.1 When it is customary and desirable to package, box, crate, wrap, or otherwise protect the item during shipment and storage in accordance with a standard practice, it is customary to state the requirements.

B24. Keywords (Mandatory)

B24.1 In this section, identify the words, terms, or phrases that best represent the technical information presented in the standard. Select the keywords from the title and body of the document and include general, vernacular, and trade terms. These keywords will be used in the preparation of the ASTM Subject Index.

B24.2 Select three or more keywords that describe the names of tests, procedures, special materials, or the specific application(s) that will facilitate the identification and retrieval of the standard.

B24.3 All selected keywords shall be stand-alone terms; the type of standard, incomplete phrases, unattached adjectives, etc., shall not be used.

B25. Supplementary Requirements

B25.1 For some standards supplementary requirements may be specified. These should not include statements that would allow the lowering of minimum requirements of the standard (see B1.2). Usually these apply only when specified by the purchaser in the purchase order or contract. A statement to this effect shall appear in the first paragraph of the Supplementary Requirements section. The following is a suggested statement relating to special requirements:

> The following supplementary requirements shall apply only when specified by the purchaser in the purchase order or contract.

B25.2 Supplementary requirements shall appear separately in a Supplementary Requirements section.

B25.3 *Quality Assurance*—This requirement, if included, shall be qualified by the statement: “When specified in the purchase order or contract.” Reference to a suitable document, such as ASTM International, ANSI, MIL, etc., may be made by agreement between the supplier and the purchaser.

B25.4 *Qualification:*

B25.4.1 Qualification to nongovernment standards shall be based on the same justification and operated under the same rules as qualification to military or federal specifications. The justification and rules are covered in the DoD4120.24m, Enclosure 14. Briefly, qualification is justified when one or more of the following apply: *(1)* The time to conduct one of the tests exceeds 30 days, *(2)* conformance inspection will require special equipment, *(3)* specification covers life survival or emergency life-saving equipment. The committee preparing the specification that calls for qualification will be asked to show that: *(1)* there is no other practical way of obtaining evidence of the availability of products to meet the specification in a reasonable time independent of that acquisition and *(2)* two or more sources are available and willing to submit their products for qualification.

B25.4.2 When qualification is determined to be feasible and necessary, it shall be included in the Supplementary Requirements section with wording similar to:

> Items furnished under this specification shall be products that are qualified for listing on the applicable qualified products list at the time set for opening of bids.

Qualification testing (as distinct from acceptance testing) shall be specifically identified with accept/reject criteria. A statement shall be made concerning retention of qualification. This may either be a manufacturer’s periodic self-certification, a periodic submission of test results, or a complete retest of the product. A statement similar to the following shall be included:

> With respect to products requiring qualification, awards will be made only for products that are, at the time set for opening of bids, qualified for inclusion in Qualified Parts List (QPL No.) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. The activity responsible for the Qualified Parts List is (insert name and ad-

dress of qualifying organization(s)) and information pertaining to qualifications of parts may be obtained from that activity.

B26. Annexes and Appendixes

B26.1 Additional information may be included in one or more annexes or appendixes to the specification.

B26.2 The words “Mandatory Information” shall be included directly under the title of annexes and the words “Nonmandatory Information” shall be included directly under the title of appendixes.

B26.3 *Annexes*—Include in annexes any detailed information such as that on apparatus or materials that is a mandatory part of the specification but too lengthy for inclusion in the main text. Annexes shall precede appendixes.

B26.4 *Appendixes*—There are times when it is desirable to include in a specification additional information for general use and guidance, but which does not constitute a mandatory part of the specification. It is appropriate to include such informational material in appendixes. Examples of material that has been included in such appendixes are tables showing approximate relationship between tensile strength and hardness, list of preferred thickness of plate, sheet, and strip reproduced from other documents, tables of standard mass and standard sizes, information on typical applications of the material covered, and information on typical physical properties whose definite values are not prescribed in the specification.

B27. References

B27.1 Include only references to publications supporting or providing needed supplementary information. Historical and acknowledgment references are not recommended. If there are five or more references, list them in an unnumbered section at the end of the specification in the order in which they appear in the text. If there are fewer than five literature references, use footnotes (see Section G21).

B28. Footnotes

B28.1 *General*—Footnotes referenced in the text are intended only for reference and shall never include any information or instructions necessary for the proper application of the specification. Table footnotes are a part of the table. Use consecutive superior numerals for reference to footnotes except in connection with tables, in which case use italic capital letters.

B28.2 *Committee Jurisdiction and History*—Footnote 1 shall include in the first paragraph the committee having jurisdiction and, where the committee so requests, the subcommittee. The second paragraph shall include history information as follows: *(1)* approval date of latest revision, *(2)* month and year of publication, *(3)* designation and year of original issue, *(4)* designation and year of previous issue, and *(5)* information as to the other standards that may have been replaced by the standard, year of redesignation, etc.

B28.3 *Literature References*—Use footnotes for references if there are fewer than five. For five or more see Section B27, observing the limitations noted therein. Also see Section G21.

B28.4 *Sources of Apparatus*—Where apparatus may be special or not readily available from more than one source, the source may be referenced. (However, see Section F4 for detailed rules.)

B28.5 *Research Reports*—Reference in a footnote the availability of research reports (see Section B31).

B29. Notes

B29.1 Notes in the text shall not include mandatory requirements. Notes are intended to set explanatory material apart from the text itself, either for emphasis or for offering informative suggestions not properly part of the standard. Clarification of the description of required apparatus or procedure and modifications required or permitted in

certain cases belong in the text itself. If inclusion of the contents yields a different result, then that information is considered mandatory for the performance of the standard and shall be located in the text. Notes may be preferable for detailed description of auxiliary procedures (for example, correction of barometric pressure in a test method not primarily concerned with pressure). Table notes are a part of the table and are mandatory provisions.

B29.2 Notes appearing in a given standard shall be numbered in sequence and should appear at the end of the paragraph to which they pertain. If it is necessary to refer to a text note in connection with a specific word or phrase in the text, that word or phrase should be followed by a reference to the note, “NOTE 1”), etc.

B29.3 Notes in the text are preferred for the following:

B29.3.1 To refer to editorial changes made in the text.

B29.3.2 To refer to similar or companion ASTM standards.

B29.3.3 Description, if included under “Scope,” of experimental means for recognizing cases where the method is not applicable to the material under test.

B29.3.4 Description of additional (*not* alternative) apparatus, materials, procedures, or calculations that are not actually required; or description of merely recommended forms of construction of required apparatus.

B29.3.5 Explanation, if needed, of the reasons for a certain requirement or direction. If brief, include in the text rather than as a note.

B29.4 *Patent Disclaimer of Liability*—See Section 15 of the*Regulations Governing ASTM Technical Committees* This note, quoted in F3.2 and not numbered, is generally placed at the end of the standard. Questions regarding the applicability of this section should be referred to the Staff Manager of your committee.

B29.5 *General Statement of ASTM Policy*—This note, quoted in F2.3 and not numbered, is generally placed at the end of the standard after the note on Patent Disclaimer of Liability.

B30. Adjuncts

B30.1 Occasionally it is not practicable to publish as an integral part of the standard, because of its nature, material that may be required for use of the standard. Such material is published as an adjunct.

B30.2 Include a description of the adjunct in the text of the standard. If appropriate, include a figure (illustration) of the adjunct.

B30.3 When adjunct material is indicated, it shall be made available at the time of publication of the standard.

B30.4 Include all referenced adjuncts in the Referenced Documents section (see Section A6).

B30.5 Examples of adjuncts are as follows:

B30.5.1 Comparison standards such as the copper strip corrosion standards for Test Method D130 (lithograph aluminum strips),

B30.5.2 Charts such as the viscosity-temperature charts for liquid petroleum for D341,

B30.5.3 Reference radiographs such as E155 or reference photographs, such as E125,

B30.5.4 Technical data such as the twelve volumes of D1250, Petroleum Measurement Tables, and

B30.5.5 Drawings such as detailed drawings for the construction of the smoke chamber in Test Method D2843.

B31. Research Reports

B31.1 Research reports, which include historical or round-robin information, or other data, shall be sent to Headquarters, provided ASTM holds copyright permissions, where they are given a file number and may be obtained upon request. Such reports may be referenced in a footnote (see B28.5). If the specification contains a detailed test method, the requirements in Section A29 apply.

B32. Rationale (Commentary)

B32.1 The inclusion of a rationale (commentary) section in ASTM standards is encouraged to ensure that brief and concise documentation is available to the user of the standard and to provide traceability and clarification of past actions. This documentation might include: *(1)* a brief history of the development of a new standard or revision to an existing standard including when and why the effort was initiated, *(2)* reasons and justification for requirements, *(3)* documentation of factors considered, and *(4)* listing of technical sources and literature.

B32.2 If included, this information shall appear in an appendix of the standard.

B32.3 Examples of standards that include sections on rationale:

E84, Test Method for Surface Burning Characteristics of Building Materials
F746, Test Method for Pitting or Crevice Corrosion of Metallic Surgical Implant Materials
F763, Practice for Short-Term Screening of Implant Materials

B33. Part Numbering

B33.1 *General*—Part-numbering systems may be included in an ASTM specification. The part-numbering system shall be placed in the appendix, shall be called out “when specified” as a supplementary requirement, and shall be referenced to appropriately under either “product marking,” “packaging and package marking,” or both places.

B33.2 *When Used for DOD Procurement:*

B33.2.1 The inclusion of a part-numbering system should be considered by technical committees when preparing specifications. Although it is a committee decision whether or not to include part numbering, ASTM International encourages such inclusion in specifications to make them more readily usable directly in procurement and supply applications.

B33.2.2 Part numbers shall be kept short and shall not exceed 15 characters. Part numbering shall be uniform for all parts covered by the same specifications; uniformity is also preferred for all part numbers within the same group of closely related items.

B33.3 *Criteria for Inclusion of Part Numbers:*

B33.3.1 In development of standards that embrace end products, every attempt should be made to define all product variables so as to enable one product to be positively distinguished from another (from both an engineering and stocking viewpoint). Each product so covered shall be assigned a part number that:

- Is uniquely identifying.
- Includes the document (standard) number.
- Does not exceed 15 characters including dashes, slashes, spaces, etc.
- Does not include the letters “I,” “O,” “Q,” “S,” “X,” and “Z.”
- Does not change when the document is changed in a manner that does not affect interchangeability.
- Does not change when the product is modified so as to not be interchangeable. (In such instances, appropriate usage guidance will be provided if appropriate.)

B33.3.2 All standards that include part numbers shall contain a five-digit numerical manufacturers' code as assigned by the U.S. Government under the Federal Cataloging Program. (See Fig. B1.)

B33.3.3 An example of a part-numbering system appears in ASTM Specification F1667, for Driven Fasteners: Nails, Spikes, and Staples.

B34. Summary of Changes

B34.1 If the committee chooses to provide a Summary of Changes, place this unnumbered section at the end of the standard and begin with the following introductory paragraph:

> Committee XXX has identified the location of selected changes to this standard since the last issue (insert designation and year date) that may impact the use of this standard.

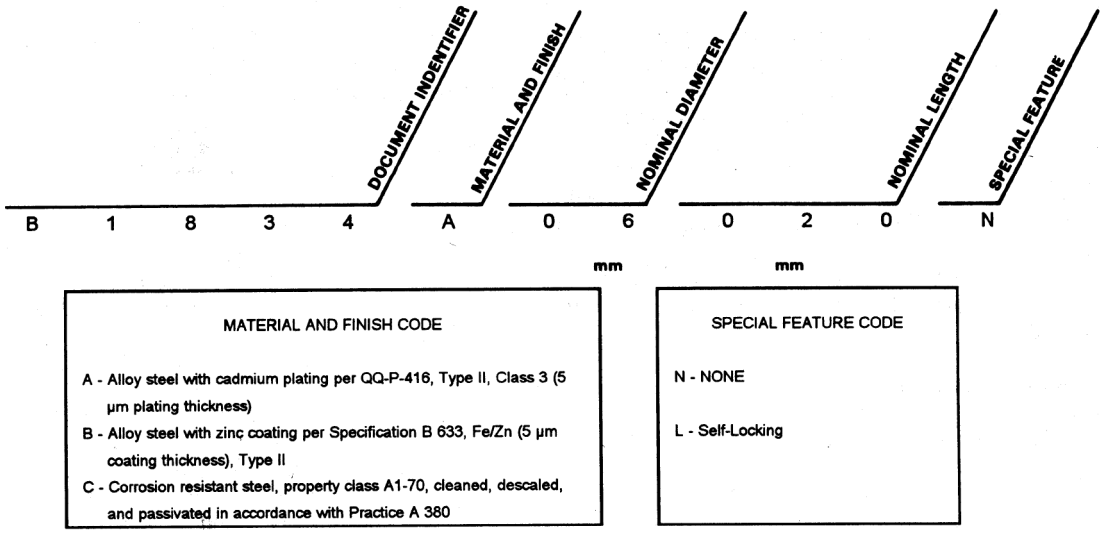
B34.2 An asterisk will appear after the Scope (**Scope***) with the following wording at the bottom of the first page:

***A Summary of Changes section appears at the end of this standard.**

B34.3 Next list, by section or subsection, changes made since the last issue that may impact the use of the standard. For standards that have undergone multiple revisions in a short period of time, keep the Summary of Changes in the standard for 18 months. This will ensure that all changes from one publication of the Annual Book of ASTM Standards to the next are recorded. Brief descriptions of the changes and reasons for the changes may be included. If desired, a more extensive description of reasons for the changes should be placed in the appendix.

B34.4 An example of the list of changes is:

(1) Deleted Section 5 and renumbered subsequent sections.
(2) Updated precision statement in Section 10 to reflect the results of a recent interlaboratory study.
(3) Revised hardness requirements in Table 2.
(4) Revised Section 14 on Product Marking.



Example: **B1834A06020N indicates a Screw Cap, Hexagon Socket Button Head, SI, made of Cadmium Plated Alloy Steel, 6 mm in diameter, 20 mm in length, and no special feature**

Figure B1. Part Numbering System Covering Standard Items Used by U.S. Government

Part C
Form of Other Types of ASTM Standards

INTRODUCTION

In addition to test methods and specifications, ASTM standards take other forms, including the following:

- Classifications
- Practices
- Guides
- Terminology or Definitions (see Part E)
- Reference Radiographs
- Reference Photographs
- Tables
- Charts

As a committee attempts to develop a standard, the question of differentiation between a practice and a guide may arise. In general, a practice underscores a general usage principle whereas a guide suggests an approach. A standard practice connotes accepted procedures for the performance of a given task. Refer to definitions given on p. iv. A guide may propose a series of options or instructions that offer direction without recommending a definite course of action. The purpose of this type of standard is to offer guidance based on a consensus of viewpoints but not to establish a standard practice to follow in all cases. A guide is intended to increase the awareness of the user concerning available techniques in a given subject area, while providing information from which subsequent testing programs can be derived.

Regarding reference radiographs, reference photographs, tables, and charts, there are relatively few subject headings, and the form of the standard is left to the jurisdiction of the sponsoring committee. The first two types listed in the introduction to Part C, however, are most common and are given greater treatment below.

Special instructions with respect to the legal aspects are included in Part F and shall be followed in writing any standard. These include such matters as contractual items, caveat statements, patents, and fire standards. Assistance on development of fire standards is available from Committee E05. The policies contained in Part F are approved by and are under the jurisdiction of the ASTM Board of Directors.

When a standard is being developed, the costs associated with its development and subsequent use generally should be considered. The prime objective should be the optimum use of resources to achieve satisfactory definition of the product or service. However, it should be noted that when the standard relates to the safety of persons, cost considerations are likely to become much less important than when attributes of materials or products are involved. Some standards, such as a definition, impose no cost on the user; others that include numerous and extensive requirements can entail significant expense to users of the standard. The requirements to be included should, therefore, be those that are technically relevant and yield benefits commensurate with the cost of their determination.

Cost effectiveness statements or rationale may be included within a standard if appropriate, usually in an appendix.

CLASSIFICATIONS

C1. Description

C1.1 "A classification is a systematic arrangement or division of materials, products, systems, or services into groups based on similar characteristics such as origin, composition, properties, or use."[1]

C1.2 Classifications provide a time- and space-saving shorthand for specifying the above description.

C1.3 Classifications may be defined by each committee differently because of the unique nature of that committee. A collection or grouping of definitions to one committee may be termed a classification while still another committee may group objects or properties in a classification.

C2. Subject Headings of Text

C2.1 The following is the sequence for the text of ASTM classifications. Headings are those most generally used but may not be all-inclusive. It may be necessary to include other headings for specialized subjects. The headings identified as "mandatory" are required. Other headings shall be included when the subject matter is pertinent to the document under development; in which case, all instructions and guidance for that particular section shall be followed. For example, if the standard does not contain reference to any standard documents within the text, it is not required to include a section on Referenced Documents. If, however, specific hazards are cited throughout the text, then the section on Hazards (see Section A13) shall be followed. Not all of these headings may be required for a particular standard. The use of footnotes and notes shall follow Sections A26 and A27 respectively. Additional headings that are included to cover specialized subjects should appear in the most appropriate place and sequence depending on their relation to the sections below.

Title (mandatory)
Designation (mandatory)
Scope (mandatory)
Referenced Documents
Terminology
Significance and Use (mandatory)
Basis of Classification (mandatory)
Test Methods and Retest
Keywords (mandatory)
Annexes and Appendixes
Summary of Changes

C3. Title (Mandatory)

C3.1 The title of a classification standard should be concise, but complete enough to identify the nature of the basis for classification, for specific materials, systems, services, and products.

C4. Designation (Mandatory)

C4.1 The ASTM designation is assigned by Headquarters on submittal for approval. Refer to Sections A3 or B4 for sequential parts of numbering.

1 From *Regulations Governing ASTM Technical Committees*.

C5. Scope (Mandatory)

C5.1 Include in this section information relating to the purpose of the classification. Concisely state what characteristics have been classified and the materials, products, systems, or services to which the classification applies. Where applicable state any limitations to the use of the classification.

C5.2 Include in this section the system of units to be used in referee decisions.

C5.3 Include, where applicable, comparisons of the classification to other similar classifications.

C6. Referenced Documents

C6.1 List here in alphanumeric sequence the designation number and complete title of all documents referenced within the classification. Refer to Section A6 for further information.

C7. Terminology

C7.1 Every standard should include a section on terminology. See Part E for information on Form and Style for terminology sections.

C7.1.1 All significant terms that may have a meaning more specialized than the commonly used language should be defined within a standard or the terminology standard for the relevant committee should be referenced.

C8. Significance and Use (Mandatory)

C8.1 Include in this section information relating to the relevance of the classification. State how the classification is used and who would typically use it.

C9. Basis of Classification (Mandatory)

C9.1 The basis of classification is in fact the most important portion of the document. This heading sets up categories in which groupings are made. For example, ASTM Classification D388, of Coals by Rank (Vol 05.06) defines classification of higher rank coals according to fixed carbon on a dry basis while lower rank coals are classed according to caloric value on the moist basis.

C10. Test Methods and Retest

C10.1 Properties enumerated in a classification may be determined in accordance with specific test methods. These methods should be referenced in this portion of the document.

C10.2 Because of variability resulting from sampling and a lack of satisfactory reproducibility, and in instances when the first test results do not conform to the requirements prescribed in this classification, then a retest option may be provided.

C11. Keywords (Mandatory)

C11.1 In this section, identify the words, terms, or phrases that best represent the technical information presented in the standard. Select the keywords from the title and body of the document and include general, vernacular, and trade terms. These keywords will be used in the preparation of the ASTM Subject Index.

C11.2 Select three or more keywords that describe the names of tests, procedures, special materials, or the specific application(s) that will facilitate the identification and retrieval of the standard.

C11.3 All selected keywords shall be stand-alone terms; the type of standard, incomplete phrases, unattached adjectives, etc., shall not be used.

C12. Annexes and Appendixes

C12.1 Supplementary information is provided herein to aid in understanding and using the standard.

C12.2 Annexes (see A24.3).

C12.3 Appendixes (see A24.4).

C13. Examples

C13.1 Examples of classifications are:

D388 Classification of Coals by Rank
D3475 Classification of Child-Resistant Packages

C14. Summary of Changes

C14.1 If the committee chooses to provide a Summary of Changes, place this unnumbered section at the end of the standard and begin with the following introductory paragraph:

Committee XXX has identified the location of selected changes to this standard since the last issue (insert designation and year date) that may impact the use of this standard.

C14.2 Next list, by section or subsection, changes made since the last issue that may impact the use of the standard. Brief descriptions of the changes and reasons for the changes may be included.

C14.3 An example of the list of changes is:

(1) Deleted Section 5 and renumbered subsequent sections.
(2) Updated precision statement in Section 10 to reflect the results of a recent interlaboratory study.
(3) Revised hardness requirements in Table 2.
(4) Revised Section 14 on Product Marking.

PRACTICES AND GUIDES

C15. Description

C15.1 A standard practice is an accepted procedure for the performance of one or more operations or functions. In certain cases practices may include one or more test methods necessary for full use of the practice. Examples of practices include selection, preparation, application, inspection, necessary precautions for use or disposal, installation, maintenance, and operation of testing apparatus.

C15.2 A standard guide is a compendium of information or series of options that does not recommend a specific course of action. Guides are intended to increase the awareness of information and approaches in a given subject area. Guides may propose a series of options or instructions that offer direction without recommending a definite course of action. The purpose of this type of standard is to offer guidance based on a consensus of viewpoints but not to establish a standard practice to follow in all cases.

C16. Subject Headings of Text

C16.1 The following is the sequence for the text of ASTM practices and guides. Headings are those most generally used but may not be all-inclusive. It may be necessary to include other headings for specialized subjects. The headings identified as “mandatory” are required. Other headings shall be included when the subject matter is pertinent to the document under development; in which case, all instructions and guidance for that particular section shall be followed. For example, if the standard does not contain reference to any standard documents within the

text, it is not required to include a section on Referenced Documents. If, however, specific hazards are cited throughout the text, then the section on Hazards (see Section A13) shall be followed. The use of footnotes and notes shall follow Sections A26 and A27 respectively.

Title (mandatory)
Designation (mandatory)
Scope (mandatory)
Referenced Documents
Terminology
Summary of Practice
Significance and Use (mandatory)
Reagents
Procedure
† Test Methods
Report
Keywords (mandatory)
Annexes and Appendixes
Summary of Changes

† Test Methods included shall contain the mandatory headings included in Section A1, except for title and designation.

C16.2 Not all of these headings may be required for a particular standard. Additional headings that are included to cover specialized subjects should appear in the most appropriate place and sequence depending on their relation to the sections listed in C16.1.

C17. Title (Mandatory)

C17.1 The title should be concise but complete enough to identify the nature of the practice. It should identify the subject of application and should be distinguishable from similar titles (see A2.1 as it applies to titles of test methods).

C18. Designation (Mandatory)

C18.1 The ASTM designation is assigned by Headquarters on submittal for approval. Refer to Sections A3 and B4 for sequential parts of numbering.

C19. Scope (Mandatory)

C19.1 Include in this section information relating to the purpose of the practice or guide and to what it applies. Clearly state any limitations of the practice or guide.

C19.2 Include in this section the system of units to be used in referee decisions.

C19.3 Include in this section any caveats required by ASTM policy such as *safety hazards* (see F2.1) and *fire hazards* (see F2.2).

C19.4 For standards developed for reference in model (building) codes, include the following statement:

> The text of this standard references notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

C20. Referenced Documents

C20.1 List here in alphanumeric sequence the designation number and complete title of all documents referenced within the practice (or guide). Refer to Section A6 for further information.

C21. Terminology

C21.1 Every standard should include a section on terminology. See Part E for information on Form and Style for terminology sections.

C21.1.1 All significant terms that may have a meaning more specialized than the commonly used language should be defined within a standard or the terminology standard for the relevant committee should be referenced.

C22. Summary of Practice

C22.1 Include here a brief outline of the practice, describing its essential features without the details that are a necessary part of the complete statement of procedure and sequence. If desired, a brief statement of the principle of the practice may be given.

C23. Significance and Use (Mandatory)

C23.1 Include in this section information that explains the relevance and meaning of the practice (or guide). State the practical uses for the practice and how it is typically employed. Avoid repetition of information included in the Scope (see Section C19).

C23.2 Include separately any appropriate comments on limitations of the practice. Indicate any means of recognizing cases where the practice may not be applicable.

C23.3 Include, where applicable, comparisons of the practice (or guide) to other similar procedures.

C24. Reagents

C24.1 See Section A12.

C25. Procedure

C25.1 Include in the procedure detailed directions for performing the task outlined in the practice.

C25.2 In some cases, to aid in clarity, a diagrammatic, photographic, or schematic may be of value to the user of the practice. These shall be supplied to the ASTM editorial staff as originals. An excellent example of this type of approach is illustrated in ASTM Practice D2855, for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.

C26. Test Methods

C26.1 List standard test methods for measurement of all requirements of practices or guides. Refer to the ASTM test methods used in testing the material to determine conformance with the practice or guide. This includes sampling, chemical analysis, mechanical, electrical, thermal, optical, and other testing procedures. When alternative procedures are given in test methods, it is important to state which particular procedure shall be used as the basis for the practice or guide requirement.

C26.1.1 Examples of standard practices that include multiple test methods:

D4169 Practice for Performance Testing of Shipping Containers

E679 Practice for Determination of Odor and Taste Thresholds by a Forced-Choice Ascending Concentration Series Method of Limits

E795 Practices for Mounting Test Specimens During Sound Absorption Tests

C26.2 When there is no ASTM test method specified for a particular quality or property of a specified material, describe the test procedure to be followed in detail in the practice (or guide), following the Form of ASTM Test Methods (Part A of this publication). Include all mandatory information listed in A1.1 (title, scope, significance and use, hazards, procedure, precision and bias).

C26.3 Where a method of some other organization is being used and the committee has not approved the test as an ASTM test method, then it is preferable to describe the test in detail in the practice or guide and to include a footnote reference to the original source. Obtain appropriate copyright releases.

C26.4 State all procedures in the imperative mood.

C27. Report

C27.1 Include detailed information as to calculating, interpreting, and reporting results in this section.

C27.2 Depending upon the nature of the practice, an entire section may, by necessity, be devoted to calculation or interpretation of results, or both.

C27.3 When a practice permits variance in conditions under which the standard practice has been performed, these conditions should become part of the report.

C28. Keywords (Mandatory)

C28.1 In this section, identify the words, terms, or phrases that best represent the technical information presented in the standard. Select the keywords from the title and body of the document and include general, vernacular, and trade terms. These keywords will be used in the preparation of the ASTM Subject Index.

C28.2 Select three or more keywords that describe the names of tests, procedures, special materials, or the specific application(s) that will facilitate the identification and retrieval of the standard.

C28.3 All selected keywords shall be stand-alone terms; the type of standard, incomplete phrases, unattached adjectives, etc., shall not be used.

C29. Annexes and Appendixes

C29.1 Supplementary information is provided herein to aid in understanding and utilizing the standard.

C29.2 Annexes (see A24.3).

C29.3 Appendixes (see A24.4).

C30. Rationale

C30.1 The inclusion of a rationale (commentary) section in ASTM standards is encouraged to ensure that brief and concise documentation is available to the user of the standard and to provide traceability and clarification of past actions. This documentation might include: *(1)* a brief history of the development of a new standard or revision to an existing standard including when and why the effort was initiated, *(2)* reasons and justification for requirements, *(3)* documentation of factors considered, and *(4)* listing of technical sources and literature.

C30.2 If included, this information shall appear in an appendix of the standard.

C30.3 Examples of standards that include sections on rationale:

E84 Test Method for Surface Burning Characteristics of Building Materials
F746 Test Method for Pitting or Crevice Corrosion of Metallic Surgical Implant Materials
F763 Practice for Short-Term Screening of Implant Materials

C31. Summary of Changes

C31.1 If the committee chooses to provide a Summary of Changes, place this unnumbered section at the end of the standard and begin with the following introductory paragraph:

> Committee XXX has identified the location of selected changes to this standard since the last issue (insert designation and year date) that may impact the use of this standard.

C31.2 An asterisk will appear after the Scope (Scope*) with the following wording at the bottom of the first page:

***A Summary of Changes section appears at the end of this standard.**

C31.3 Next list, by section or subsection, changes made since the last issue that may impact the use of the standard. For standards that have undergone multiple revisions in a short period of time, keep the Summary of Changes in the standard for 18 months. This will ensure that all changes from one publication of the Annual Book of ASTM Standards to the next are recorded. Brief descriptions of the changes and reasons for the changes may be included. If desired, a more extensive description of reasons for the changes should be placed in the appendix.

C31.4 An example of the list of changes is:

(1) Deleted Section 5 and renumbered subsequent sections.
(2) Updated precision statement in Section 10 to reflect the results of a recent interlaboratory study.
(3) Revised hardness requirements in Table 2.
(4) Revised Section 14 on Product Marking.

Part D
Use of the Modified Decimal Numbering System

INTRODUCTION

In recent years, “point” systems for numbering sections of a document have come into extensive use. Many national organizations, associations, societies, industrial concerns, and government agencies are using a Modified Decimal Numbering (MDN) System. MDN is also used by standardization organizations.

In 1963, ASTM International adopted the MDN System for ASTM standards. This guide has been prepared for the use of members who are drafting or revising standards. The object of the MDN System is to assign to each division in a text a unique number that shows the relationship of the specific section to all previous sections and gives a complete designation which does not require reference to previous sections or pages.

D1. Scope

D1.1 The Modified Decimal Numbering (MDN) System is designed primarily for numbering the text division in standards.

D1.2 The MDN System is also referred to as the “Point” System.

D2. Parts of a Standard

D2.1 All documents are considered to consist of several primary divisions called primary sections. A primary section may include one or more secondary sections. A secondary section may include one or more ternary sections which in turn may include one or more quaternary sections.

D2.2 The terms “primary section,” “secondary section,” “ternary section,” and “quaternary section” shall not be used in headings or references.

D2.3 References shall be made by referring to only the number when referring to secondary, ternary, and quaternary sections. Refer to primary sections as “Section 4” or “Sections 5 to 9.”

D2.4 Either of the generic words “section” or “division” may be used in correspondence or other communication, but shall not be used in references, other than primary, as directed in D2.2 and D2.3.

D3. Assignment of Numbers

D3.1 Number the primary sections of a standard serially, beginning with 1 or “Scope,” using as many numbers as required by the number of sections.

D3.2 Assign to the successive secondary sections of any primary section a two-part number consisting of the number used for the primary section followed by a decimal point and a consecutive number, beginning with 1, using as many numbers as required by the number of secondary sections. For example, if there are eleven secondary sections in the fifth section of a standard, designate these secondary sections 5.1, 5.2, 5.3 ... 5.9, 5.10, and 5.11.

D3.3 Assign to the successive ternary sections in a secondary section a three-part number consisting of the two-part number assigned to the secondary section followed by a decimal point and a consecutive number, beginning with 1, using as many numbers as required by the number of ternary sections. For example, if there are four ternary sections in secondary section 8.4, designate the ternary sections, 8.4.1, 8.4.2, 8.4.3, and 8.4.4.

D3.4 Assign to each of the successive quaternary sections in a ternary section a four-part number consisting of the three-part number assigned to the ternary section followed by a decimal point and a consecutive number, beginning with 1, using as many numbers as required by the number of quaternary sections. For example, if there are three quaternary sections in the second ternary section of secondary section 8.4, designate them 8.4.2.1, 8.4.2.2, and 8.4.2.3.

D3.5 There shall be no further subdivision beyond that allowed by the four-part number. The judicious use of unnumbered center headings may help in the adherence to this rule.

D4. Supplementary Requirements

D4.1 Designate each supplementary requirement by the letter “S” followed by a consecutive number, beginning with 1 for the first supplementary requirement.

D4.1.1 There shall be no decimal point between the “S” and the number.

D4.1.2 Do not renumber supplementary requirement designations once deleted.

D4.2 Designate primary, secondary, and ternary sections of each supplementary requirement as shown in D3.2, D3.3, and D3.4, respectively.

NOTE D1— Primary sections of a supplementary requirement, an annex, or an appendix are numbered the same as a secondary section of the main standard (with two-part numbers); secondary and ternary sections of a supplementary requirement, an annex, or an appendix are, therefore, numbered the same as ternary and quaternary sections (with three and four-part numbers), respectively, of the standard.

D4.3 No individual supplementary requirement shall be subdivided into more than three levels in accordance with D3.5.

D5. Literature References

D5.1 Where a document includes five or more literature references, list them in a separate unnumbered section at the end of the document, preceding annexes and appendixes. Assign a one-part number of each individual reference. See Section G21 of this publication.

D6. Annexes and Appendixes

D6.1 Separate annexes and appendixes from the main text with the centered headings ANNEX(ES) and APPENDIX(ES).

D6.2 Precede the title of each annex by the letter “A” followed by a number in consecutive order, beginning with 1 for the first annex (A1, A2, A3, etc.) Precede the title of each appendix by the letter “X” followed by a number in consecutive order, beginning with 1 for the first appendix (X1, X2, X3, etc.)

D6.2.1 There shall be no decimal point between the “A” or “X” and the number.

D6.3 Designate primary, secondary, and ternary sections of each annex or appendix as shown in D3.2, D3.3, and D3.4, respectively (NOTE D1) (for example, A1.1, A1.1.1, and A1.1.1.1).

D6.4 No individual annex or appendix shall be subdivided into more than three levels in accordance with D3.5.

D7. Equations

D7.1 Equations should be numbered when two or more are included in the main text of the standard (see G16.5). Designate equations with consecutive Arabic numbers beginning with 1. Number each equation in the order that it appears in the standard, regardless of the section number in which it is referenced.

D7.2 Designate equations in annexes and appendixes by the designation of the annex or appendix followed by consecutive numbers beginning with 1 (for example, Eq A1.1, A2.4, X3.2).

D8. Tables

D8.1 Assign consecutive Arabic numbers to successive tables throughout the main text of the standard without regard to the number assigned to the section in which the table is referenced.

D8.2 Designate tables in annexes and appendixes by the designation of the annex or appendix followed by consecutive numbers beginning with 1 (for example, Table A1.1, A2.4, X3.2). Tables shall follow directly the appropriate annex or appendix.

D9. Figures

D9.1 Assign consecutive Arabic numbers to successive figures throughout the main text of the standard without regard to the number assigned to the section in which the figure is referenced.

D9.2 Designate figures in annexes and appendixes by the designation of the annex or appendix followed by consecutive numbers beginning with 1 (for example, Fig. A1.1, A2.4, X3.2). Figures shall follow directly any tables of the appropriate annex or appendix.

D10. Text Notes

D10.1 Assign consecutive numbers to successive notes throughout the main text of the standard without regard to the number assigned to the section to which the note may refer. Notes shall be indicated by the word “NOTE” followed by the number.

D10.2 Designate notes in annexes by the letter “A” and in appendixes by the letter “X,” followed by consecutive numbers, beginning with 1.

D10.3 Designate notes pertaining to figures by consecutive numbers, beginning with 1 for the first note to each individual figure.

D11. Footnotes

D11.1 Assign consecutive numbers to successive footnotes throughout the standard, including supplementary requirements, annexes, and appendixes, without regard to the number assigned to the section in which the footnotes appears.

NOTE D2— Since Footnote 1 is required for sponsoring committee and year date of a standard, the first footnote referenced in the body of the text is Footnote 2.

D11.2 Designate footnotes to tables by consecutive letters, beginning with “A” for the first footnote to each individual table.

D11.3 Footnotes shall be referenced by superscript numbers, or, in the case of tables, by superscript italic capital letters.

D12. Combination of Systems

D12.1 Do not use a combination of the MDN System and other systems for designating secondary, ternary, and quaternary sections. For example, do not divide 8.4 into 8.4 (a), 8.4 (b), and 8.4 (c), rather than the 8.4.1, 8.4.2, and 8.4.3 as directed in D3.3.

D13. Omission of Numbers

D13.1 Do not assign MDN numbers to examples that are numbered serially throughout a document.

D13.2 Do not assign numbers to centered headings when used.

D14. Introductory Sections

D14.1 Where a standard has a preliminary section with a heading such as “Introduction” or “Foreword,” do not assign this section a number so that “Scope” shall always be designated with the one-part number “1” in accordance with D3.1.

D15. General Application

D15.1 Exercise care to distinguish between successive, parallel, and alternative sections and supplementary sections such as secondary, ternary, and quaternary sections. Only the latter three require the addition of another decimal point and number. Note also the manner of handling alternative clauses within a section. For example:

10. Procedure
10.1 Dry the specimen by either (1) heating at 105EC (221EF) for 2 h, or (2) holding the specimen in a conditioned atmosphere until dry to the touch.

Note that the above example is a single sentence and no further numbering breakdown is required.

10. Procedure
10.1 Make all tests on conditioned specimens using the procedure given in 10.3 and 10.4.
10.2 Calibrate the tension testing machine and see that the oven is at the specified temperature.
10.3 *Variable Frequency Procedure:*
10.3.1 Adjust the …
10.3.2 Insert the …
10.4 *Variable Tension Procedure:*
10.4.1 Start the …
10.4.2 Clamp the …

Note that in the above example, 10.3 and 10.4 are successive subdivisions of 10, *not* subdivisions of 10.1 or 10.2.

D16. Problems

D16.1 Any problems in the implementation of the MDN System in ASTM standards should be referred to the ASTM Director of Standards Publications for resolution.

Part E
Terminology in ASTM Standards

INTRODUCTION

ASTM standard terminology is written to promote three objectives: *(1)* precise understanding and interpretation of ASTM standards, *(2)* standardization of terminology in standards, reports, and other technical writings, and *(3)* explanation of the meanings of technical terms for the benefit of those not conversant with them.

For terminology to be effective, it should be used consistently. It is, therefore, the responsibility of each technical committee to manage terminology usage in all standards for which it has jurisdiction to ensure that usage is consistent both within the committee and the Society. Part E provides guidance to technical committees and to those who review the work of technical committees regarding the principles of terminology.

Contained in this Part are general requirements for terminology management, requirements and guidance on form and style, and guidance on preparing terminology.

E1. Terminology Management

E1.1 In ASTM International, technical committees are responsible for defining terminology within technical standards and for developing terminology as a type of standard. Terminology ensures precise interpretation of ASTM standards and explains technical terms for the benefit of users who are not conversant with the language of the standard. Use terminology that is clear, explicit, and not liable to misinterpretation when referred to in technical operations, commercial contracts, or legal proceedings.

E1.2 Terminology in a technical standard may include *definitions of terms* and *definitions of terms specific to a standard* and explanations of *symbols, abbreviations,* and *acronyms* that are necessary for the reader to understand that particular standard.

E1.3 All technical standards should contain a *Terminology* section that includes *Definitions of Terms* or *Definitions of Terms Specific to this Standard*, or both. Reference to a related terminology standard(s) can be sufficient for this section. See Section E7

E1.4 All technical committees should develop and maintain a general terminology standard. Terminology, as a type of standard, is comprised of *definitions of terms* and explanations of *symbols, abbreviations*, and *acronyms* pertaining to the scope of a technical committee or a specialized field within the committee.

E2. Definitions of Terms and Definitions of Terms Specific to a Standard

E2.1 Definition of Terms:

E2.1.1 The distinction between *definitions of terms* and *definitions of terms specific to a standard* is related to the degree of application. If a term has a meaning more specialized than its commonly used language, is used by two or more subcommittees within a committee, or appears in several standards, it is labeled as a *definition of a term*.

E2.2 Definition of Terms Specific to a Standard:

E2.2.1 When the term is limited in application to the standard in which it needs to be defined, it is labeled as a *definition of a term specific to a standard*.

E2.2.2 Since *definitions of terms specific to a standard* have limited application, they do not generally appear in a technical committee's general terminology standard.

NOTE—A term may be a word, phrase, or compound word.

E2.2.3 An example of a *definition* is:

> X.x **dolly**, *n*—a low platform or structure mounted on wheels or casters, designed primarily for moving bulky loads for short distances. (Compare **pallet**)

E2.2.4 An example of a *definition specific to a standard* is:

> X.x **standard**, *n*—as used in ASTM International, a document that has been developed and established within the consensus principles of the Society and that meets the approval requirements of ASTM procedures and regulations.

Form and Style for ASTM Standards

E3. Guidelines for Writing Definitions of Terms and Definitions of Terms Specific to a Standard

E3.1 Use these guidelines when writing both *definition of terms* and *definitions of terms specific to a standard*.

E3.2 Prepare a definition when:

E3.2.1 Any term used in a standard is essential to the interpretation and application of the standard;

E3.2.2 A term used in a standard is not adequately defined in common language;

E3.2.3 Using qualitative adjectives and nouns that *could* be taken to denote or connote an *absolute, unqualified*, or *unconditional* property or capability; for example: *waterproof, stainless, unbreakable, vapor barrier, gas-free, flat, safe, rigid, pure*. Such qualitative adjectives and nouns shall not be used unless *actually used and defined* in their absolute sense;

E3.2.4 Describing a *quantitative determinable* property or capability that might cause misinterpretation or confusion; for example: *strong, high, accurate, clean*.

E3.3 Do not develop a definition when:

E3.3.1 A term is adequately defined in reference source material (print or electronic version), unless a definition is required for clarity, also see E5.5 Delimiting Phrases;

E3.3.2 A term has a well-recognized authoritative meaning such as terms defined in the International System of Units (SI);

E3.3.3 A term is defined acceptably for the committee's purposes in the *ASTM Terminology Dictionary* or the committee's terminology standard;

E3.3.4 A term that meets the committee's needs has been defined in a technical standard of another committee or subcommittee.

E4. Form of a Definition

E4.1 Write *definitions of terms* and *definitions specific to a standard* in the dictionary-definition form. Include term, part of speech, definition, and, when applicable, a delimiting phrase (see E5.5).

E4.2 Complete the definition in one sentence. If two or more phrases are needed to state the meaning, connect them with semicolons. Include any necessary supplementary information as a Discussion.

E4.3 Describe the essential characteristics of the term. Keep it simple.

NOTE—The definition should exclude details such as performance requirements or how things are made, used, or measured.

E4.4 State the definition without repeating the entire term defined. Use language that is understandable to non-experts.

NOTE—A defined term could be a word, phrase or compound word. A compound word or a phrase may require reuse of one of the base words within the definition.

E4.5 The term and its elements should appear in the following order: term; abbreviation; symbol; dimensions of quantities, measurement units; part of speech; delimiting phrase; statement of meaning, including specification limits where applicable; cross-references to synonyms or related terms; attribution.

E5. Elements of a Term

E5.1 *Abbreviations*—For terms usually represented by an abbreviation, place a comma and the preferred abbreviation following the term, and then the part of speech, for example:

average, *avg, n*—

E5.2 *Symbols*—For terms usually represented by a letter symbol, place a comma and the preferred symbol following the term, and then the part of speech. Follow the style guidance in Section G16. For example:

ampere, *A, n*—

E5.3 *Dimensions of Physical Quantities*—If the term represents a physical quantity, state its analytical dimension in upright, sans-serif capital font in square brackets immediately following the letter symbol, or if there is none, following the term itself. Follow the style guidance in G16.5. For example:

critical height, H_c[L], *n—in earth grading*, the maximum height at which a vertical or sloped bank of soil will stand unsupported under a specific set of conditions.

E5.4 *Parts of Speech*—Including the part of speech enables the user to distinguish between closely allied terms; for example:

flame resistance, *n*—the ability to withstand flame impingement or give protection from it.
flame resistant, *adj*—having flame resistance

E5.5 *Delimiting Phrases*—If a term has different meanings in other technical fields or contexts, include an italicized phrase that delimits the definition to its field of application. This phrase should follow the dash and be separated from the basic statement of meaning by a comma, for example:

beam, *n—in a balance*, the horizontal pan support.
beam, *n—in a building*, a horizontal load-carrying structural member of the building frame.
beam, *n—in optics*, a concentrated unidirectional flow of radiant energy.

E5.6 *Specification Limits*—If a definition involves specification limits applicable only to a specific standard (for example, in defining plate by specifying a thickness range), make the term specific to that standard. If, however, it is intended that this definition be broadly accepted within a specific technical committee or within ASTM International, delimit its scope, for example:

plate, *n—aluminum products*, a rolled flat product of thickness 6.4 mm (0.25 in.) or greater.

E5.7 *Cross-references*—Cross-references bring together related terms and narrower terms of a given genus. A cross-reference may take the place of a definition, or it may be appended to a definition to draw attention to related definition, for example:

flat-bed—see **truck**.

E5.8 *Discussions*—To fill in more detail of the concept being defined, supplementary information may be added as a separate discussion immediately following the definition, for example:

3.1 ***builder's model***, *n*—a reference standard of quality for specific building components, denoting, by example, the level of quality adopted by a builder.

3.1.1 *Discussion*—The examples or samples of construction material, permit examination of quality level.

E5.9 *Attributions*—If an existing definition is adopted from another reference source material (for example, technical standard, manual, or dictionary), copy it exactly and identify the original source in a boldface notation at the right margin following the definition. *(See the example given in E7.1.2 for an example of formatting an attribution in a definition.)*

E5.9.1 Notify Headquarters that permission to publish shall be obtained from the organization holding copyright. The definition shall not be published without permission.

E6. Use of Symbols, Acronyms/Initialisms, and Abbreviations as Terminology

E6.1 In standards containing numerous symbols, acronyms/initialisms, or abbreviations, these items may be listed under the appropriate subheading as a convenience to the user of the standard.

E6.1.1 *Symbols*—List the symbols alphabetically. Do not assign a number or capitalize the explanation, for example:

X.x *Symbols*:
A—cross-sectional area of specimen, m^2
B—magnetic induction, T
C_p—heat capacity at constant pressure, J/K

E6.1.2 *Acronym/Initialism*—(see Note on Initialism) An acronym is a shortened form of a compound term that uses the initial letters of the term to make a pronounceable word (such as NATO). Alphabetically list, and capitalize the acronyms/initialisms. In a few cases acronyms are written in lower case, such as laser and sonar. It is not necessary to separate acronyms and initialisms. Do not capitalize the explanation unless it is a proper noun, for example:

X.x *Acronyms/Initialisms*:
X.x.1 *CMU*, n—*concrete masonry unit*
X.x.2 *PERT*, n—*program evaluation and review technique*
X.x.3 *radar*, *n*—radio detecting and ranging

NOTE—In ASTM standards, the term 'acronym' is used to refer to both an acronym and initialism. Acronyms are compound terms that use the initial letters to make a pronounceable word (such as NATO), while initialisms are abbreviations that are pronounced separately (such as WTO).

E6.1.3 *Abbreviations*—An abbreviation is a shortened form of a compound word or phrase. List the abbreviations alphabetically. Do not include abbreviations appearing in Section G3. Do not capitalize the explanation unless it is a proper noun, for example:

X.x *Abbreviations*:
X.x.1 *assn*—association
X.x.2 *avg*—average

FORM OF A TERMINOLOGY SECTION WITHIN A STANDARD

E7. Terminology Section within a Standard

E7.1 *Terminology Within a Standard*—This section may include paragraphs on definitions, definitions of terms specific to a standard, symbols, abbreviations, acronyms, discussions, or a combination thereof.

E7.1.1 *Definitions*—Write definitions in accordance with E2 through E5. List the terms in alphabetical order. Example follows:

3. Terminology—(Always use as the main heading.)
3.1 Definitions:
3.1.1 color blindness, n—total or partial inability to differentiate certain hues.
3.1.2 transmittance, n—of light, that fraction of the incident light of a given wavelength which is not reflected or absorbed, but passes through a substance.

E7.1.2 *Definition(s) of Term(s) Specific to This Standard*—When a standard has a definition for a term specific to this standard (see E2) list those terms separate than those in a general section on definitions. List the terms in alphabetical order. Example follows:

3. Terminology—(Always use as the main heading.)
3.1 Definitions of terms specific to this standard:
3.1.1 batch sampling, n—sampling over some time period in such a way as to produce a single test sample for analysis. **D4175**

E7.1.3 *Symbols, Abbreviations, and Acronyms*—See Section E6.

E7.1.4 *Referencing Terminology Standard*—If the terminology applicable to the standard is included in a terminology standard, cite the applicable terminology standard. Example follows:

3.1 Definitions:
3.1.1 For definitions of terms used in this test method, refer to Terminology **D1129.**

E7.1.5 An example of a Terminology section may be structured as follows (note that not all sections may be necessary):

3. Terminology (Always use as the main heading.)
3.1 Definitions of Terms:
3.1.1 For definitions of terms used in this standard, refer to Terminology XYYYY.
3.1.2 Example Definition
3.2 Definition of Terms Specific to this Standard:
3.2.1 Example Definition
3.3 Symbols:
3.3.1 Example Symbol
3.4 Acronyms:
3.4.1 Example Acronym
3.5 Abbreviations:
3.5.1 Example Abbreviation

FORM OF A TERMINOLOGY STANDARD

E8. Subject Headings of Text

E8.1 The following list shows in sequence the subjects usually covered in a terminology standard:

Title (mandatory)
Designation (mandatory)
Scope (mandatory)
Significance and Use

Terminology: Terms and Definitions (mandatory)
Symbols, Abbreviations, Acronyms
Keywords (mandatory)
Annexes and Appendixes
Bibliography or References
Summary of Changes

E9. Title (Mandatory)

E9.1 The title should be as concise as possible but complete enough to identify the subject covered by the terminology. The title of a terminology standard preferably is *Terminology of ...*, although *Terminology Relating to ...* is acceptable.

E10. Designation (Mandatory)

E10.1 The designation will be assigned by ASTM International Headquarters upon submittal of the standard for Society approval.

E11. Scope (Mandatory)

E11.1 Provide information about the field of application of the terminology. Include information on how, when, and by whom the terminology will be used. Indicate here whether the terminology standard is general or relates to a specialized field. Where the content of a terminology standard is limited or restricted, as in a specialized terminology standard, the scope statement should so indicate.

E12. Referenced Documents

E12.1 Include in this section only ASTM standards, adjuncts, and standards or codes of other organizations. All referenced documents shall be cited.

E12.1.1 Provide footnotes to this section to indicate the sources of these documents.

E12.1.2 Do not include the year date when designating referenced documents unless there is a technical reason for specifying a particular year date.

E12.1.3 When listing reference adjuncts, provide a brief description, in this section, and a footnote of their availability.

E13. Significance and Use

E13.1 When use restrictions exist, include a significance and use statement. Give a warning of them such as: "This terminology is not intended to …"

E14. Terminology (Mandatory)

E14.1 *Terms and Their Definitions (Mandatory)*—Compose a definition in the dictionary-definition form (see E4.5) and include the term, part of speech, definition, and when applicable, a delimiting phrase. Boldface the term and italicize the part of speech and delimiting phrase. Do not capitalize the term or any other components of the definition except for proper nouns, acronyms, or any other words capitalized in normal usage. List the terms unnumbered and in alphabetical sequence.

E14.1.1 Although the preferred style of listing terms and their definitions is in alphabetical sequence, in some cases it may be desirable to show the relationships in a logical family of concepts by grouping definitions according to a classification system. Place narrower or subordinate terms and their definitions in alphabetical order under the definition of the broader term, as the main entry, for example:

soil structure, *n*—an arrangement and state of aggregation of soil particles in a soil mass.

flocculent structure, n—an arrangement composed of flocs of soil particles instead of individual soil particles.

honeycomb structure, n—an arrangement of soil particles having a comparatively loose, stable structure resembling a honeycomb.

single-grained structure, n—an arrangement composed of individual soil particles, characteristic structure of coarse-grained soils.

E14.1.2 *Cross-references*—See E5.7 for rules governing cross-references.

E14.1.3 *Discussions*—See E5.8 for rules governing discussions.

E14.1.4 *Attributions*—See E5.9 for rules governing attributions.

E15. Symbols, Acronyms, and Abbreviations

E15.1 Any of these subsections can be used for the convenience of the user of the standard. Follow the guidelines detailed in Section E6.

E16. Keywords

E16.1 In this section, identify the words, terms, or phrases that best represent the technical information presented in the standard. Select the keywords from the title and body of the document and include general, vernacular, and trade terms. These keywords will be used in the preparation of the ASTM Subject Index.

E16.2 Select three or more keywords that describe the names of tests, procedures, special materials, or the specific application(s) that will facilitate the identification and retrieval of the standard. Keywords for terminology standards should include the words *definitions* and *terminology*.

E16.3 All keywords shall be stand-alone terms; incomplete phrases and unattached adjectives shall not be used.

E17. Annexes and Appendixes

E17.1 To aid in understanding and using the terminology, supplementary information such as illustrations, commentaries, or rationale may be included in annexes (mandatory information), or appendixes (nonmandatory information).

E18. Bibliography or References

E18.1 Supplementary publications, useful for consultation by users who wish to have more detailed information on the particular terminology, may be provided. If the publications are cited in the text, they should be listed in a References section at the end of the standard (see Section A25); otherwise, the section should be titled Bibliography.

E19. Summary of Changes

E19.1 This unnumbered section shall be placed at the end of the standard and begin with the following introductory paragraph:

> Committee XXX has identified the location of selected changes to this standard since the last issue (insert designation and year date) that may impact the use of this standard.

E19.2 Next list, by section or subsection, changes since the last issue that may impact the use of the standard. Brief descriptions of the changes and reasons for the changes may be included.

E19.3 An example of the list of changes is:

(1) Added the term bioconcentration.
(2) Revised scope.
(3) Modified the definition for sediment.

Part F
Caveats and Other Legal Aspects in Standards—Special Instructions

INTRODUCTION

This section contains special instructions for the use of commercial-contractual statements, caveats, patents, trademarks, specific sources of supply, references to other organization, etc., in standards. When a standard contains any one of these statements or references, the committee shall obtain the necessary guidance from ASTM International Headquarters for the inclusion in the standard.

F1. Commercial-Contractual Items in Standards

F1.1 Certain requirements, such as those listed below, shall not be included in ASTM standards. If a committee feels it is important that this type of information be given, the committee may request an exemption from the Committee on Standards for the inclusion of such requirements in an ASTM standard.

- Adjustment, settlement, and investigation of claims
- Costs of testing, retesting statements
- Effective Dates
- Open-end agreements (see B1.2)
- Prices
- Purchasing

F1.2 The matter of who shall pay for services should be stated in the agreement or purchase order and not in the standard. Statements covering inspection (follow Section B19), rejection and rehearing (follow Section B20), testing and retesting (follow B16.2), marking (follow Section B22), and certification (follow Section B21) are suitable when they do not contain mandatory requirements covering the costs involved.

F2. Caveat Statements and Policies in Standards

F2.1 The generic caveat on *safety hazards* specified below shall appear in the Scope section of *(1)* test methods; *(2)* specifications where test methods are detailed other than by reference; and *(3)* practices and guides that involve the use of material, operations, or equipment.

> This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health and environmental practices and determine the applicability of regulatory limitations prior to use.

F2.1.1 When the standard does not involve the use of hazardous materials, operations, or equipment, a request for an exception to the inclusion of the generic caveat shall be presented to the ASTM Standing Committee on Standards.

F2.1.2 Specific *warning* statements shall be included in the standard (see Section A13 for the use of warning statements). These statements shall not prescribe specific remedial measures and actions. However, reference may be made to authoritative sources where reliable information concerning remedial measures can be obtained.

F2.1.3 Where there exists in a standard a specific warning statement(s), reference to the appropriate section(s) shall be made following the generic safety hazards caveat in the scope.

F2.2 *Fire Standards:*

F2.2.1 Every fire standard shall state its purpose, specify the known limitations of the standard, and specify the significance of the data that are generated (including relevance to human life and property, where appropriate). Use precise terminology (see Part E, Terminology in ASTM Standards), and include the appropriate caveat as listed below. Standards should include, when practical, sufficient background or explanatory material to guide users in properly applying ASTM fire standards.

F2.2.2 ASTM fire standards include fire-test-response standards, fire hazard assessment standards, and fire risk assessment standards. Other types of fire standards shall also be permitted, including terminologies, guides, specifications, and practices. The following criteria shall be followed by fire standards:

F2.2.2.1 Fire-test-response standards provide a means for measuring the response of materials, products, or assemblies to heat and flame under controlled conditions of test. ASTM fire-test-response standards shall contain the following caveat:

> This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire hazard or fire risk assessment of the materials, products, or assemblies under actual fire conditions.

F2.2.2.2 Fire-hazard assessment standards provide a method for assessing the potential for harm for materials, products, or assemblies that could be anticipated under specified fire conditions. ASTM fire-hazard assessment standards shall contain the following statement:

> This standard is used to predict or provide a quantitative measure of the fire hazard from a specified set of fire conditions involving specific materials, products, or assemblies. This assessment does not necessarily predict the hazard of actual fires which involve conditions other than those assumed in the analysis.

F2.2.2.3 Fire-risk assessment standards provide a method for assessing the probability of loss resulting from a given fire situation involving interaction between the material, product, or assembly with its environment. ASTM fire-risk assessment standards shall contain the following statement:

> This standard is used to establish a means of combining the potential for harm in fire scenarios with the probabilities of occurrence of those scenarios. Assessment of fire risk using this standard depends upon many factors, including the manner in which the user selects scenarios and uses them to represent all scenarios relevant to the application. This standard cannot be used to assess fire risk if any specifications are different from those contained in the standard.

F2.2.2.4 ASTM develops fire standards other than fire-test-response standards, fire-hazard assessment standards, or fire-risk assessment standards, which provide information on fire issues that is not associated with a quantitative output (where quantitative outputs include a binary pass/fail option or a classification into categories). Such ASTM fire standards shall contain the following statement:

> This fire standard cannot be used to provide quantitative measures.

F2.2.2.5 The following generic caveat is appropriate for fire standards that do not describe a fire test but do produce quantitative results that are calculated measures of fire-test-response characteristics and not by themselves measures of fire hazard or fire risk.

> This standard is used to determine certain fire-test responses of materials, products, or assemblies to heat and flame under controlled conditions by using results obtained from fire-test-response standards. The results obtained from using this standard do not by themselves constitute measures of fire hazard or fire risk.

F2.2.2.6 The following caveat is required for fire test methods:

> Fire testing is inherently hazardous. Adequate safeguards for personnel and property shall be employed in conducting these tests.

F2.2.3 *Titles and Criteria for Fire-Hazard and Fire-Risk Assessment Standards*—All standards developed, approved, or reapproved for the analysis and control of fire hazard or fire risk shall contain the words "FIRE-HAZARD ASSESSMENT" or "FIRE-RISK ASSESSMENT" in the title. The results of all such assessments shall be expressed in terms that relate the item in question to the anticipated fire environment. When appropriate, the standard may also contain acceptance or classification criteria and a statistical sampling plan as a guide to its use.

F2.2.4 ASTM Committee E05 on Fire Standards is available to provide review of fire standards developed by other ASTM committees.

F2.3 *General Policy Caveat*—The Board of Directors approved the inclusion of a General Statement of ASTM Policy in all standards:

> This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing, you should make your views known to the ASTM Committee on Standards, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

This statement shall appear in a note at the end of the standard, following the note on ASTM Disclaimer of Liability as to Patented Inventions (see Section F3 on Patents in ASTM Standards).

F2.4 *Working Document Caveat*—The Board of Directors approved the use of the "Working Document" statement to be stated on the front page of every draft document or manuscript from a committee. The following statement shall be typed or stamped on the document:

> This document is not an ASTM standard; it is under consideration within an ASTM technical committee but has not received all approvals required to become an ASTM standard. You agree not to reproduce or circulate or quote, in whole or in part, this document outside of ASTM Committee/Society activities, or submit it to any other organization or standards bodies (whether national, international, or other) except with the approval of the Chair of the Committee having jurisdiction and the written authorization of the President of the Society. If you do not agree with these conditions, please immediately destroy all copies of the document. *Copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. All Rights Reserved.*

Anyone requesting an ASTM committee draft document is entitled to receive a copy. However, after receipt of this document, they shall adhere to the caveat.

F2.5 *Professional Judgment Caveat*—When a Technical Committee is developing a Standard Guide or Practice that may involve professional judgment, the following caveats may be used:

> Standard Guide—This guide offers an organized collection of information or a series of options and does not recommend a specific course of action. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this guide may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.
>
> Standard Practice—This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title means only that the document has been approved through the ASTM consensus process.

F2.6 *Mercury Caveat*—When a standard includes reference to the element of mercury or products containing mercury, the following caveat shall appear in the Scope section.

> *Warning—Mercury has been designated by many regulatory agencies as a hazardous substance that can cause serious medical issues. Mercury, or its vapor, has been demonstrated to be hazardous to health and corrosive to materials. Use caution when*

handling mercury and mercury-containing products. See the applicable product Safety Data Sheet (SDS) for additional information. The potential exists that selling mercury or mercury-containing products, or both, is prohibited by local or national law. Users must determine legality of sales in their location.

F2.7 *International Standard Caveat*—The Board of Directors approved the inclusion of the following International Standard Caveat in all standards.

This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of international Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

F3. Patents in ASTM Standards

F3.1 When a committee has determined an item covered by a patent or a pending patent may be necessary in a proposed standard, the committee shall include a statement in the balloting process and a footnote in the draft standard, indicating a willingness to consider alternative(s). ASTM standards submitted to ANSI for approval as American National Standards shall conform to the ANSI patent policy. The ANSI patent policy may be obtained on the ANSI website (www.ansi.org).

F3.1.1 *Statement in Balloting Process*—The statement with the ballot shall include a request for an alternative(s) as follows:

The (name of material, product, process, apparatus) is covered by a patent. If you are aware of an alternative(s) to the patented item, please attach to your ballot return a description of the alternatives. All suggestions will be considered by the committee. If alternatives are identified, the committee shall reconsider whether the patented item is necessary. The committee, in making its decision, shall follow Regulation 15.

F3.1.2 *Statement in Footnote of Standard*—A footnote shall be included in the standard as follows:

The (name of material, product, process, apparatus and may include the patent number for reference) is covered by a patent. Interested parties are invited to submit information regarding the identification of an alternative(s) to this patented item to the ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.

The footnote shall be cited in the specific section of the standard where the patented item is first mentioned. Information describing the patented item will be set forth once in the standard, in this footnote.

F3.2 *Disclaimer of Liability as to Patented Inventions*—Neither ASTM International nor an ASTM committee shall be responsible for identifying all patents under which a license is required in using an ASTM document or for conducting inquiries into the legal validity of those patents which are brought to the Society's attention. Where applicable, an ASTM document shall include a note worded as follows:

"ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility."

F4. Use of Trademarks and Specific Sources of Supply for Apparatus, Reagents, and Materials in ASTM Standards

F4.1 ASTM International is authorized to certify products, equipment or services.

F4.1.1 ASTM International has a registered certification mark, along with other registered marks.

F4.1.2 ASTM International does not permit its trademarks to be used in a manner that suggests it has approved any product, equipment or services other than in relation to an ASTM Certification Program.

F4.1.3 ASTM International does not permit the use of third-party trade- or service marks in ASTM standards in a manner that could suggest ASTM International's endorsement, approval, sponsorship, or certification of the trademarked item or service.

F4.1.4 Requiring participation in or that a product meet an ASTM Certification Program to comply with an ASTM standard is prohibited.

F4.2 *Trademarks:*

F4.2.1 Trademarks shall not be used in ASTM standards, unless the trademark is used to refer to a specific source of supply and such use conforms to the requirements of F4.3.

F4.2.2 Trademarks in ASTM standards shall not be used in a manner that: is false or misleading; violates the rights of the Mark's owner; violates any law, regulation or other public policy; or mischaracterizes the relationship between the Society and the material, product, system or service represented by the Mark, including but not limited to any use of a Mark that might reasonably be construed as an endorsement, approval, sponsorship, or certification by the Society of the material, product, system or service, or that might be reasonably construed as support or encouragement to purchase or utilize the material, product, system or service represented by the Mark. Judgment is at the sole discretion of the Committee on Standards.

F4.2.3 If ASTM International staff decides permission should be obtained to use a trademark, such permission shall be obtained by ASTM International Headquarters from the holder of the Mark.

F4.2.4 The first reference to the trademark in the standard shall include a footnote containing the name of the trademark holder. Trademark symbols shall not be included. "Trademark" shall be used as an adjective.

F4.3 *Sources of Supply:*

F4.3.1 To allow the widest possible use of ASTM standards, it is the responsibility of the sponsoring committee to ensure that sources of supply exist for unique or difficult-to-obtain apparatus, reagents, and materials.

F4.3.2 Reference to specific commercial sources of supply are permitted only when there is a sole source of supply.

F4.3.2.1 Information on the sole source of supply shall be included in a footnote. Include wording such as:

> The sole source of supply of the apparatus known to the committee at this time is (name and address of the supplier). If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.

F4.3.3 If the apparatus is not widely available, but more than one source of supply is known, or if apparatus that is widely available needs to be checked for suitability in the application specified, the committee can reference criteria for evaluating the apparatus. This reference can be to a section of the standard, to a separate existing standard or other published document, or can be in the form of an annex or appendix to the standard, or filed as an ASTM research report or adjunct.

F4.3.3.1 Text referencing the availability of such criteria, and any requirement on the use of such criteria, should be included in the appropriate section of the standard. Include wording such as:

> All available apparatus may not be suitable for this application. Apparatus considered for use in this application shall be checked for suitability in accordance with the requirements of (insert reference to appropriate evaluation document).

F5. Reference to Standards of Other Organizations

F5.1 When referencing standards of other organizations, include the designation and title for the document in the *Referenced Documents* sections.

F5.1.1 In all cases, information on the title, designation, and source availability of the reference standards shall be included. Do not include the year date of reference documents unless there is a technical reason for requiring a particular revision.

F5.2 When it is necessary to quote portions of a non-ASTM standard, permission to republish shall be obtained from the organization holding copyright by ASTM International Headquarters.

F5.3 Joint logos shall not be printed on ASTM standards, except with the authorization of the Board of Directors. When a standard has been developed in cooperation with another organization(s), a note may appear in the standard, crediting the other organization's participation.

F5.3.1 In cases of disagreement on implementation of this policy, the matter shall be referred to the Committee on Standards for decision.

Part G
Standards Style Manual

G1. Styling

G1.1 Check the draft standard against the rules given in this style manual. Many technical committees have editorial subcommittees that review draft standards before submittal to Headquarters. The ASTM editorial staff does the final styling and is available to assist members. There are a number of forms of assistance available to the ASTM standards-writer, such as the following: on-line templates to write standards and access to the latest *Form and Style for ASTM Standards*, the *ASTM Online Dictionary of Engineering Science and Technology* (see www.astm.org), *Committee White Papers* (supplements to this manual), and editorial workshops. Also, see the Introduction to this manual.

G1.2 Of the instructions that follow, some are included because they are deviations from the standard references, some because they are used frequently and are therefore listed here for convenience. Sections on various points of ASTM style appear in the following alphabetical order:

G2. Electronic Standard Preparation

G2.1 *Rationale for Ballot*—A rationale explaining the reason for the ballot is mandatory for all ballots.

G2.2 *New Standard*—For help in writing new standards, go to www.astm.org and use the online draft standard templates.

G2.3 *Revisions*—Clearly indicate proposed changes by providing strikethroughs for deletions, underlines for additions, using a track changes tool, or otherwise clearly identifying additions or deletions.

G2.3.1 When revisions are so extensive they can make the ballot item cumbersome to follow, a clean version may be provided in addition to the version that has clearly identified the changes for ballot. The rationale should explain that both versions have been included in the ballot.

G3. Abbreviations and Unit Symbols

G3.1 The value of a quantity is its magnitude expressed as the product of a number, fixed space, and a unit symbol, the space being regarded as a multiplication sign. Therefore, in the text, use unit symbols after numbers denoting a definite quantity. Example: “The length is 25 mm [1.0 in.].”

G3.1.1 For SI units, write the values of quantities so that it is clear to which unit symbols the numerical value of the quantities belong. For example, write 50 g ± 1 g or (50 ± 1) g, but *not* 50 ± 1 g. For additional SI guidance, see IEEE/ASTM SI-10.

G3.1.2 See G14.1 for formats involving compound adjectives and SI units.

G3.2 Use unit symbols in tables and figures, and in lists defining symbols used in equations.

G3.3 Use unit symbols and abbreviations in the singular only. Thus “fifty kilograms” shall be designated “50 kg,” *not* “50 kgs.” Exceptions: Figs., Nos., Eqs., Refs, Vols.

G3.4 When a long word or phrase for which there is no standard abbreviations is used frequently, it may be replaced by an abbreviation that is explained when it first occurs. Examples: below top dead center (btdc), relative centrifugal force (rcf).

G3.5 Commonly accepted abbreviations for names of societies, associations, government agencies, etc., may be used, provided the name is spelled out the first time it is used. Use no periods and run together. Examples: ASTM International, TAPPI, NASA, ARPA.

G3.6 The standard unit symbols and abbreviations for use in Society publications in the list below are so common that they may be used without explanation. A comprehensive list of SI units and symbols is provided in IEEE/ASTM SI-10 American National Standard for Metric Practice; information is also available in the SI Quick Reference Guide (Annex A) and Part G and Part H. If a discrepancy exists between these documents, follow Part G and Part H of the Form and Style Manual.

COMMON NON-SI UNITS

absolute	abs
academic degrees	use periods and run together (M.S., Ph.D., etc.)
alternating current	ac
American	Am.[A]
American wire gauge	AWG
angstrom	Å
ante meridian	a.m.

Association	Assn.[B]
atmosphere	atm
average	avg
barrel	bbl
becquerel	Bq
billion electronvolts	(use GeV, gigaectronvolts)
Birmingham wire gauge	BWG
brake horsepower	bhp
brake-horsepower hour	bhp·h
Brinell hardness number	HB (see ASTM E10)
British thermal unit	Btu
Brown and Sharpe (gauge)	B&S
bushel	Bu
calorie	cal
candela	cd
centipoise	cP
centistokes	cSt
circular mil	cmil
coefficient	*spell out*
Company	Co.[B]
Corporation	Corp.[B]
coulomb	C
cubic	use exponential form [C]
curie	Ci
cycles per minute	cpm
cycles per second	(use Hz, hertz)
day	*spell out*
decibel	dB
degree (angle)	°
degree Fahrenheit	°F
degree Rankine	°R
degrees of freedom	df
Department	Dept.[B]
diameter	dia (in figures and tables)
differential	d
direct current	dc
Division	Div.[B]
dollar	$
effective horsepower	ehp
electromotive force	emf
Engineers	Engrs.[A]
equation(s)	Eq(s)
figure(s)	Fig(s).[D]
foot	ft
footcandle	fc
foot pound-force	ft·lbf (use for work, energy) (see lbf·ft)

gallon	gal
gauss	G
gilbert	Gb
grain	*spell out*
gravity (acceleration)	g
gray	Gy
half hard	SH
horsepower	hp
horsepower hour	hp·h
hour	h
Hurter and Driffield scale (film density)	H&D
hydrogen ion concentration, negative logarithm of	pH
inch	in.
inch of mercury	in.Hg
inch of water	in.H_2O
inch pound-force	in.·lbf (use for work, energy) (see lbf·in.)
inclusive	incl (in figures and tables only)
Incorporated	Inc.[B]
indicated horsepower	ihp
inside diameter	ID (in figures and tables only)
Institute	Inst.[B]
integrated neutron flux	nvt, n/cm^2
Iron pipe size	IPS
K alpha radiation	Kα
kilocalorie	kcal
kilocycle per second	(see note on cycles per second)
kilogram-calorie	kg·cal
kilogram-force	kgf
kilovolt ampere	kVA
kiloelectronvolt	keV
kilovolt peak	kVp
kilowatt hour	kWh
kip (1000 lbf)	*spell out*
kip (1000 lbf) per square inch	ksi
Knoop hardness number	HK (see ASTM E384)
lambert	L
linear	*spell out*
logarithm (common)	log
logarithm (natural)	ln
magnetomotive force	mmf
mass-to-charge ratio	*m/e*
maximum	max (in figures and tables only)
maxwell	Mx
median effective concentration	EC_{50}
median effective dose	ED_{50}

median lethal concentration	LC_{50}
median lethal dose	LD_{50}
megacycles per second	(see note on cycles per second)
meta	*m*
microcurie	µCi
microinch	µin.
micro-micro (prefix, use pico)	p
mil	*spell out*
mile	*spell out*
miles per hour	mph
milli-angstrom	mÅ
millicurie	mCi
milliequivalent	meq
millimetre of mercury	mmHg
million electronvolts	MeV
milliroentgen	mR
minimum	min (in figures and tables only)
minute	min (spell out when used with minimum)
molal	*spell out*
molar	*M*
mole	mol
month (When followed by a date use Jan., Feb., March, April, May, June, July, Aug., Sept., Oct., Nov., Dec. When there is no date, spell out. Examples: Jan. 15, 1995; January 1995)	*spell out*
National	Nat.[A]
normal	*N*
number(s) (This abbreviation can often be omitted entirely. It is usually understood (as in STP 325, Specimen 8, Test 14, etc.))	No(s).[D]
oersted	Oe
ortho	*o*
ounce	oz
outside diameter	OD (in figures and tables only)
page	p.
pages	pp.
para	*p*
parts per billion	ppb
parts per million	ppm
pascal	Pa
per	use the diagonal line in expressions with unit symbols[E]
pint	Pt
poise	P
Poisson's ratio	µ (v is preferred in applied mechanics)
post meridian	p.m.

pound	lb
pound-force	lbf
pound-force foot	lbf·ft (use for torque) (see ft·lbf)
pound-force inch	lbf·in. (use for torque) (see in·lbf)
pound-force per square foot	lbf/ft^2
pound-force per square inch	psi or $lbf/in.^2$
pound-force per square inch absolute	psia
pound-force per square inch gauge	psig
quart	qt
rad (dose unit)	rd
radian	rad
radio frequency, *n*	rf
radio frequency, *adj*	r-f
radius	R (in figures and tables only)
Railway	Ry.[B]
Railroad	R.R.[B]
reference(s)	Ref(s)
relative humidity	RH (in figures and tables only)
revolution per minute	r/min, rpm
revolution per second	r/s
Rockwell hardness, C scale	HRC (see ASTM E18)
roentgen	R
root mean square	rms
Saybolt Furol seconds	SFS
Saybold Universal seconds	SUS
secondary	*sec*
Society	Soc. [B]
socket joint (tables and drawings only)	Sj
specific gravity	sp gr
square	use exponential form (exception: psi, ksi)[C]
standard taper (tables and drawings only)	TS
stokes	St
tensile strength	*spell out*
tertiary	*tert*
tesla	T
thousand pounds	kip
thousand pounds-force per square inch	ksi
ton	*spell out*
torr	*spell out*
United States, *n*	*spell out*
United States, *adj*	U.S.
United States Pharmacopeia	USP
versus	*spell out*
Vickers hardness number	HV (see ASTM E384)
Volt-ampere	VA
volume (of a publication)	Vol[D]

watt hour	Wh
week	*spell out*
yard	yd
year	*spell out*
Young's modulus	E

A In footnotes and references only.
B At end of name only.
C With unit symbols only.
D Only when followed by a number.
E Exceptions: cpm, mph, psi.

COMMON SI UNITS

ampere	A
ampere hour	A·h
centimetre	cm
cubic centimetre	cm^3
cubic decimetre	dm^3
degree Celsius	°C
electronvolt	eV
farad	F
gram	g
henry	H
hertz	Hz
joule	J
kelvin	K
kilogram	kg
kilogram metre	kg·m
kilometre	km
kilovolt	kV
kilowatt	kW
litre	L
lumen	lm
lux	lx
megagram	Mg
megawatt	MW
metre	m
microampere	µA
microfarad	µF
microgram	µg
microhenry	µH
microlitre	µL
micrometre (formerly micron)	µm
microroentgen	µR
microsecond	µs
microvolt	µV
microwatt	µW

milliampere	mA
milligram	mg
millihenry	mH
millilitre	mL
millimetre	mm
millisecond	ms
millivolt	mV
milliwatt	mW
nanometre (formerly millimicron)	nm
newton	N
ohm	Ω
percent	%
pico (prefix)	p
picofarad	pF
second	s
siemens	S
steradian	sr
thousand electronvolts	KeV
volt	V
watt	W
weber	Wb

G4. Alloy Designations

G4.1 Use the following for alloy designations:

3135 steel
2024-T4 aluminum
Ti-4Al–3V-Mo
Ti-6Al–4V
0.5Ti molybdenum alloy or molybdenum with 0.5 % titanium or
0.5Ti alloy (where molybdenum is understood)

G4.2 ASTM and SAE have jointly developed a unified numbering system (UNS) for alloy identification (Practice E527).

G5. And/Or

G5.1 Do not use this expression. For example, when “A and/or B” is truly the case, write “A or B, or both.” For example, when “A, B, and/or C” is truly the case, write “A, B, or C, or combinations thereof.”

G6. Capitalization

G6.1 Use capitals sparingly.

G6.2 In headings and titles, capitalize all nouns, pronouns, verbs, adjectives, adverbs, and all other words of five or more letters. Do not use initial caps on abbreviations (except see G6.6), or the phrase “et al.” or in the word “to” in the infinitive form of a verb.

G6.3 Use initial cap for “committee” where used in a title, as “Committee A01,” “Committee on Publications.” Everywhere else use lowercase, as “The committee recommends ...” This rule also applies to use of “symposium,” etc.

G6.4 Use initial cap on Society, Staff, and Headquarters when referring to ASTM International, its Staff, and its Headquarters.

G6.5 Capitalize trademarks. The initial cap becomes lowercase after the word is accepted into the language as generic. When in doubt, capitalize. The following are now lowercase: babbitt, bunsen, cellophane, diesel, kraft, neoprene, nylon, portland cement, saran.

G6.6 Use initial cap in referring to volumes, figures, tables, etc., as Vol 2, Fig. 2, Table 2. Use lowercase in less direct references such as: “This volume contains ...,” “In the same figure is shown ...”

G6.7 Use initial caps in such expressions as: Test 1, Specimen A, Cement B, Type 1, Class C, Grade B, etc.

G6.8 It is permissible to use all caps in directions such as: “Turn the machine to OFF position” or “Turn the dial to TITRATE.”

G7. Chemical Formulas

G7.1 Chemical formulas should be used freely in tables and figures. In text in which chemical formulas are mentioned infrequently, spell out the names. Where they are mentioned frequently, spell out the name in the first reference to it, followed by the formula in parentheses. The formula alone may be used subsequently. Do not use chemical formulas for organic or complex inorganic compounds. Always spell out the word “water” and the name of the elements (use lead, *not* Pb). Isotopes may be written as carbon-14 or as ^{14}C.

G8. Contractual Parties

G8.1 Terms describing contractual parties shall be limited to the following:

G8.1.1 *Party of First Part*, producer, supplier, seller, or manufacturer.

G8.1.2 *Party of Second Part*, purchaser or user.

G9. Crystal Planes and Directions

G9.1 Use the following symbols for crystallographic planes and directions:

plane (111)
family of planes {111}
direction [111]
family of directions <111>

G10. Dictionaries and Other Reference Publications on Style

G10.1 For spelling, punctuation, capitalization, and foreign words, use a reference source material, such as *Merriam-Webster’s Collegiate Dictionary* or *Webster’s Third New International Dictionary* (print or electronic versions). For other information on style use *Manual of Style*, The University of Chicago Press (print or electronic version).

G11. Dilution Ratio

G11.1 Use the form “9+1” rather than “9:1” for dilution ratios. This means that the 1 part solute is to be mixed with the 9 parts solvent. Specify whether volumes, weights or mass are being used, for example, volume/volume, weight/volume, mass/volume, etc. For SI units, the term weight should not be used to mean mass, use mass/volume.

G12. Creating and Submitting Figures for Ballot

G12.1 *Definition*—A figure can be a technical drawing (vector line art), information visual (chart/graph/schematic), or a photograph, or a combination of these.

G12.2 Please include figure(s) with your ballot submission to ensure timely publication of your standards.

G12.2.1 Size each figure up to 30 picas in width (approximately 125 mm or 5 in.) This is the maximum.

G12.3 *How do I create and save non-photographic images (for example, graphs, drawings, schematics) or digital photographs from a hard copy original or from computer-generated artwork?*

G12.3.1 Keep in mind that the larger the original, the greater potential for a better reproduction.

G12.3.2 Size each figure to 30 picas in width (approximately 5 in.). For full-page/landscape figures, size to 42 picas in width (approximately 7 in.). These are the maximum allowable widths.

G12.3.3 When taking digital photographs, use the highest resolution possible on the camera. Absolute minimum resolution is 1200 × 960 pixels. 1936 × 1296 pixels is better, and 2896 × 1944 pixels is even better.

G12.3.4 Check the image quality and the brightness and contrast levels.

G12.3.5 Submit artwork in its original file source/extension. ASTM graphic designers can work with most file formats, including CAD. (SVG, EPS, or AI files are preferred for technical drawings. TIFF or JPG preferred for photographs or halftones. GIF is discouraged as a generally low-resolution file type.)

G12.3.6 If you need to scan hard copy, adjust the resolution on your scanner as follows:

G12.3.6.1 Technical drawing or other information visual FTP—Please scan the line art at 1200 dpi (dots per inch).

G12.3.6.2 Photograph FTP—Please scan at 600 DPI. If the image is to be enlarged, increase the percentage of the scanned image.

G12.3.6.3 ASTM can also scan for you (see G12.5).

G12.3.7 Furnish short titles or captions for each figure.

G12.4 *How do I submit the file?*

G12.4.1 **E-mail** your staff manager or editor.

G12.4.2 **FTP**—Please contact the ASTM Help Desk for assistance at 1-877-909-2786.

G12.4.3 **DVD/CD-ROM**

G12.4.4 *Hard copy can be mailed to ASTM Headquarters, in case ASTM cannot use the electronic file. See the following instructions.*

G12.5 *How do I submit hard copy?*

G12.5.1 Provide camera-ready figures of professional quality, because the printer will scan what is submitted, and it will appear in the standard exactly as you have supplied it. To this end:

G12.5.1.1 Use a laser or other high-quality printer.

G12.5.1.2 Do not handwrite on the figure.

G12.5.1.3 Do not use a faxed or photocopied figure.

G12.5.1.4 Furnish short titles or captions for each figure.

G13. Footnotes

G13.1 For footnotes in tables, use superior italic capital letters, beginning anew for each table. Type the footnotes below the table.

G13.2 For all other footnotes, use superior numbers.

G13.3 Do not use footnotes in figure captions. Either cite a previous footnote or reference (for example, "see Footnote 3," or "taken from Ref (**4**)"), or write out the reference in the caption. For style of publication footnotes, see Sections G21 and G22.

G14. Hyphens

G14.1 In ASTM standards, hyphenate compound adjectives, such as: "low-alloy steel," "cold-drawn wire." Compound adjectives involving SI units should use a space, such as: "50 mm gauge." Write expressions such as the following *with* the hyphen after the first word: "high- and low-temperature tests." For the sake of appearance, omit hyphens in such expressions as "3 % nickel alloy" or "3EC rise in temperature." Also do not hyphenate chemical compounds and the words "stainless steel" and "cast iron."

G14.2 Do not hyphenate an adverb-adjective combination when the adverb ends with "ly."

G14.3 Spelled-out fractions used as nouns are not hyphenated (one third of the load); used as adjectives, they *are* hyphenated (a one-third share).

G15. Italic Font

G15.1 *Scientific Text and Equations:*

G15.1.1 Use italic fonts (irrespective of the typeface used in the surrounding text) for symbols representing physical quantities that can have a numerical value (quantity symbols) or variables. Italicize symbols for:

G15.1.1.1 Physical quantities that can have a numerical value (quantity symbols), such as *m* and *C* representing mass and heat capacity, respectively.

G15.1.1.2 Fundamental physical quantities, such as *R* (the molar gas constant) and N_A (Avogadro constant).

G15.1.1.3 Representing variables in mathematical equations, such as *y* and *x* in the equation $y = mx + c$, or parameters that may be considered constant in a given context, such as m and c in the given equation.

G15.1.1.4 For additional guidance on formatting of scientific text and equations, such as in the use of subscripts, superscripts, parentheses, vectors and tensors, see NIST Special Publication 811.

G15.1.1.5 *For chemistry:*

a) *N* (normal), *M* (molar), *c* (concentration);
b) *o, m,* and *p* as ortho, meta, and para; for example, *p*-cresol;
c) *sec* and *tert* (abbreviations for secondary and tertiary); for example, *tert*-butyl alcohol;
d) *iso* when used in *iso*octane.

G15.1.1.6 *Transistor Type*—Use *n-p-n, p-n-p, n*-type, etc.

G15.2 *Running Text:*

G15.2.1 *Italicize:*

G15.2.1.1 Letters in parentheses used to identify listings in text or subdivisions of illustrations, “Fig. 1(*a*).”

G15.2.1.2 *Titles*—of books, including ASTM books, such as *Annual Book of ASTM Standards* and *ASTM STP 379*.

G15.2.1.3 *Foreign Words*—Use a reference source material, such as *Merriam-Webster’s Collegiate Dictionary* or *Webster’s Third New International Dictionary* (print or electronic version) as a guide to foreign words.

G15.3 *Do not italicize:*

G15.3.1 Use roman (upright) fonts (irrespective of the typeface used in the surrounding text) for symbols representing units, or numbers, or words that are descriptive in nature, such as labels, names, compounds, and elements. For example:

G15.3.1.1 Symbols for units or their prefixes; for example, 3 m, 30 km.

G15.3.1.2 Symbols for mathematical constants that never change such as p (3.141 59…), e (2.718 28…), i (square root of -1).

G15.3.1.3 Symbols for numbers, names, or descriptive terms or labels that cannot have a range of values.

G15.3.1.4 Symbols for the dimensions of a quantity but also use sans-serif, capital fonts (that is, L, M, T, I, Θ, N, J).

G15.3.1.5 Symbols used in subscripts, superscripts, and parentheses qualifying a quantity if they represent:

a) names or descriptive terms or labels; for example, N_A, where A stands for Avogadro, C_g, where g denotes gas, or μ_r, where r stands for relative.
b) numbers such as c_3, where 3 represents third.

G15.3.1.6 *Chemistry*—Symbols for the elements (Fe, N, Na, etc.). Exception: italicize *N* for nitrogen when it is used to denote position, as in *N*-methylaniline.

G15.3.1.7 *Metallurgy*—A_1 point, A_{r1}, etc.

G15.3.1.8 *Abbreviations*—pH (this is an exception to the general rule G15.1.1 for quantities), sin, cos, tan, log, d (for derivative).

G15.3.1.9 Letters used to subdivide a categorical classification, such as Method A, Cement B, Class C, Grade D, Type E, Sample F.

G16. Mathematical Material

G16.1 Mathematical material can appear in the standard text or as equations. In all cases, submit clear copy, without ambiguities arising from carelessly placed subscripts or superscripts, confusion between Greek and Roman letters, incomplete fraction lines, and so on. When there is a possibility of confusion (for example capital letter O and zero), include an editorial note nearby to clarify with more description. For example:

$$l=1\times10^{\wedge}3\mu m$$

Editorial Note: Lowercase “L” equals number one times 10 superscript 3 Greek mu meters

G16.1.1 Do not mix text and mathematical symbols, for example:

use “mass of copper equals 3 g.”
Do not use “mass of copper = 3 g.”

G16.1.2 For legends, such as those that clarify an equation, use the equals symbol. See G16.5.5 for example.

G16.2 *Greek Symbols*—If unclear, type out the name of the Greek symbol in an editorial note.

G16.3 Superscripts (superior symbols) should be marked with a caret or type “superscript” in an editorial note. Subscripts (inferior symbols) should be marked with an inverted caret or type “subscript” in an editorial note.

G16.4 Indicate what symbol is preferred to show multiplication (for example, times symbol, middle dot, or asterisk).

G16.5 *Equations:*

G16.5.1 Type on a separate line and number as described in Section D7.

G16.5.2 Use numerical values for any constants.

G16.5.3 Spell out quantity names in the text but use letter symbols in the equations. For specific guidance on SI formatting of symbols, see IEEE/ASTM SI 10.

G16.5.3.1 For guidance on the use of italic fonts for symbols and roman (upright) fonts for symbols and the formatting of equations, see Section G15.

G16.5.3.2 In equations, use symbols (for variables and quantities), values, and operators (e.g., +, -, x, /) and avoid text or units. For example, do not write “Bending stress, Pa” on the left hand side of the equation. See G16.5.6.

G16.5.4 Define each letter symbol immediately under the equation, unless it was defined previously. See also G16.1.1.

G16.5.4.1 Indicate the reference point on which the calculations are based, such as on the sample as received or dry basis, and the units in which the results are reported.

G16.5.5 The format for a typical numbered equation is:

$$\sigma_b = Md / I$$

where:
σ_b = bending stress, psi or Pa,
M = bending moment, lbf·in. or N·m,
d = distance from neutral axis to outermost fiber, in., or m, and
I = second moment of area, $in.^4$ or m^4.

G16.6 *Exp versus e*—If the exponent is relatively short and on one line, without superscripts or subscripts, use e:

$$e^{(a-b)cx}$$

If it is relatively long or has superscripts or subscripts, use exp:

$$\exp\left[x^2/2 - \ln\left(x/a\right)\right]$$

G16.7 *Fractions*—Use the solidus (diagonal line) in the text:

Use the built-up fraction (with a horizontal line) in an equation. If you use a built-up fraction on one side of an equation, use it on the other side:

$$\frac{a}{b} = \frac{c - d}{e - f_2} \times 12$$

Use parentheses liberally to clearly show the complete numerator or denominator. For example, does log *a/b* mean log (*a/b*) or (log *a*)/b? Use the parentheses to clarify. If you write *a/b* + c but mean *a*/(b + c), use parentheses.

G16.8 *Statistical Data*—For data that are treated statistically, follow the recommendations in the *ASTM Manual on Presentation of Data and Control Chart Analysis (MNL7)*. Committee E11 on Quality and Statistics, which is responsible for *MNL7*, is prepared to cooperate with other technical committees in helping them present data most effectively. In particular:

G16.8.1 To present the essential information contained in a set of observations from one population, give the average, the standard deviation or coefficient of variation, and the number of observations.

G16.8.2 Whenever you give an average, give also the number of observations on which the average is based.

G16.8.3 Use the following symbols, where needed:

X = average (arithmetic mean)
σ = root-mean square deviation
n = number of observations
s = standard deviation
v = coefficient of variation

G17. Numbering

G17.1 See Part D.

G18. Numerals

G18.1 Use Arabic numerals in designating figures and tables, thus: “Fig. 3,” “Table 6.”

G18.2 Spell out all numbers from one through twelve, with the following exceptions:

G18.2.1 Use numerals when the quantity is partly fractional, as: 1.15, 1½.

G18.2.2 Use numerals when followed by an expression having a standard unit symbol, as: 25 mm, 45 kg, 9 %.

G18.2.3 If for any reason the standard abbreviation or unit symbol of the expression following the number is not used, or if the expression does not admit of abbreviation (as *year*, *ton*, etc.), the use of numerals is optional, unless covered in the following paragraphs:

G18.2.4 In statements containing two or more numbers, one of which is greater than twelve, express all numbers as numerals, such as “2 tests and 16 weighings.”

G18.2.5 In a series of connected numerical statements implying precision, use numerals, as “5 months, 3 days.”

G18.2.6 Use numerals after abbreviations, as: Vol 26, Fig. 2.

G18.3 Use numerals for all numbers exceeding twelve, with the following exceptions:

G18.3.1 Do not begin a sentence with a numeral. When the numeral is spelled out, also spell out the unit following, as “One gram is usually sufficient.”

G18.3.2 Spell out round numbers used in an indefinite sense, such as, “a *hundred* metres or so.”

G18.3.3 Spell out numbers when used in the following manner: “*fifteen* 25 mm rods” (or 15 twenty-five-millimetre rods).

G18.3.4 In decimal numbers having no units, place a zero before the decimal point, as: “0.65 mm,” *not* “.65 mm.”

G18.4 In pointing off numbers of more than four figures, use spaces instead of commas in the text, illustrations, and tabular matter (1 234 567). Do not point off numbers of four figures (1234) except in tables when they occur in a column containing numbers of more than four figures.

G18.5 In expressing ratios (except dilution ratios) use 1 to 10 or 1:10, *not* 1-10. Dilution ratios are expressed 1+10; see G11.1.

G18.6 In expressing grades of, for example, emery paper, use 3/0, *not* 000.

G19. Percent, Percentage Points, and the % Symbol

G19.1 Use the format “mass fraction is 3 %” or “*w* = 3 %”, where *w* is the symbol for the quantity mass fraction. Similarly write “volume fraction is 2 %”, *not* “2 % (by vol)”.

G19.2 Do not use “3 % (by mass)”, “3 % m/m”, “3 % (m/m)”. The same stricture applies to all similar variants and to the quantities volume and amount of substance.

G19.3 Do not use phrases such as “percentage by mass” or “percent by volume.”

G19.4 When a quantity is reduced from 40 to 30, it is reduced by 25 %. When a quantity decreases from 40 % to 30 %, it decreases by 10 *percentage points*.

G20. Polymers

G20.1 Where the name of the monomer is one word, the prefix “poly” is simply run in, as: polystyrene, polyisobutylene, etc. Where the name of the monomer is two words, they are enclosed in parentheses and the prefix “poly” added, as in the following words: poly(vinyl chloride), poly(methyl methacrylate).

G21. References, Other Documents

G21.1 If there are fewer than five references cited in the standard, use footnotes. If five or more references are cited, type them in a separate list of references at the end of the manuscript, following annexes and appendixes, if any. Assign a consecutive Arabic number to each reference. Indicate the reference in the text by enclosing the number in parentheses and using boldface. Show a footnote reference after the first boldface reference number, stating in the footnote: “The boldface numbers in parentheses refer to the list of references at the end of this standard.” If it is necessary to use the word “reference,” use the style: “According to Ref (**3**) ...” It is preferable, however, to use the author’s name, as “According to Jones (**3**) ...” If there are two authors, use both names, as: “According to Jones and Smith (**3**)...” If there are three or more authors, use “et al,” as: According to Jones et al (**3**) ...”

G21.2 Do not list ASTM standards as references; list them in the section on Referenced Documents (see also Section A6). Do not list as references documents that are not readily accessible to the reader, such as unpublished theses and private correspondence.

G21.3 Type references (and publication footnotes) as follows:

G21.3.1 *Books*—Type author's name or names (initials last), complete title of book (italic, no quotation marks), name of publisher (no abbreviations), address of publisher (city and state), year of publication, and page number, if reference is to a page number. Example:

Jones, J. J., *Plasticity and Creep*, John Wiley & Sons, Inc., New York, NY, 1958, p. 250.

G21.3.2 *Magazines, Journals* (including *Standardization News*)—Type author's name or names (initials last), title of paper (in quotation marks), complete title of journal (italic, no quotation marks), volume number, issue number (this may be omitted if the journal page numbers are continuous throughout the volume), date of publication, and page numbers. Example:

Jones, J. J., and Smith, R. R., "Correlation of Brinell Hardness and Tensile Strength," *Materials in Design Engineering*, Vol 10, No. 2, February 1958, pp. 52-67.

G21.3.3 *Proceedings, Transactions, Reports, Bulletins, etc.*—Type author's name or names (initials last), complete title of paper (in quotation marks), name of publication (italic, no quotation marks), name of publisher, volume number, if any, date of publication, and page numbers. Examples:

Jones, J. J., "Lubrication Problems in Space Vehicles," *Transactions*, American Society of Mechanical Engineers., Vol 52, 1948, pp. 135-140.

Jones, J. J., "Classification of Bitumens," *Journal of the Institute of Petroleum*, Vol 38, 1952, p. 121.

Jones, J. J., "Fatigue of Aircraft Structures," *NASA TR-108*, National Aeronautics and Space Administration, 1959.

Jones, J. J., "Effect of Carbon Content on Notch Properties of Aircraft Steels," *Bulletin 642*, Engineering Experiment Station, University of Illinois, 1957.

G21.3.4 *Symposium Volumes or Other Books Comprising Collections of Papers*—Follow style for books in G21.3.1 and add title of paper, in quotes, after author's name.

G21.3.5 *Patents*—Type patent number and date. Example: U.S. Patent No. 2 232 185, Feb. 18, 1941.

G21.3.6 *Annual Book of ASTM Standards*—Cite referenced ASTM standards in section on Referenced Documents, *not* in references (see Section G22).

G21.3.7 *ASTM Proceedings*—McVetty, P.G., "The Interpretation of Creep Tests," *Proceedings*, ASTM International, Vol 34, Part II, 1934, p. 105. (Volume 38 was the last to be issued in two parts.)

G21.3.8 *ASTM Special Technical Publication:*

G21.3.8.1 *Whole Book:*

Symposium on Synthetic Bioabsorbable Polymers for Implants. ASTM STP 1396, ASTM International, 2000.

G21.3.8.2 *Single Paper:*

Gorna, K., and Gogolewski, S., "Novel Biodegradable Polyurethanes for Medical Applications,"*Symposium on Synthetic Bioabsorbable Polymers for Implants, ASTM STP 1396,*ASTM International, 2000, p. 39.

G21.3.8.3 *Journal Reference to Website:*

Name of Author(s), "Name of Paper," *Title of Journal*, Volume, Number, Issue Number, Paper Identification Number, Online, Available: URL, Access Date.

Example:

Aydilek, A. H. and Edil, T. B., "Evaluation of Woven Geotextile Pore Structure Parameters Using Image Analysis," *Geotechnical Testing Journal*, Vol. 27, No.1, ID GTJ111070, Online, Available: www.astm.org, 12 January 2004.

G22. References, Standards

G22.1 Refer to ASTM standards first in the section on Referenced Documents. Follow the designation (without year) with the full title, and use a footnote to refer to the appropriate publication. The footnote should read: For referenced ASTM standards, visit the ASTM website, www.astm.org or contact ASTM Customer Service at Service@astm.org. For the *Annual Book of ASTM standards* volume information, refer the standard's Document Summary page on the ASTM website. Thereafter use simply the abbreviated designation (Test Method D1708, Practice E691, Specification A250/A250M, etc.) Do not include the word "Standard." Do not use quotes on titles of standards, whether those of ASTM International or other organizations.

G22.2 Any reference to a combined standard shall include the entire designation, for example, Specification A36/A36M. When only one system of units is applicable, this may be indicated where the reference is cited; for example:

> This material shall conform to the general requirements stated in SI units of Specification A36/A36M.

G22.3 Do not refer to a specific paragraph, section, table, or figure of another standard unless necessary to avoid confusion. For example, say, "the section on Impregnation Time of Methods D202."

G23. Sample Versus Specimen

G23.1 In general, the word "sample" should be used only to describe a piece or quantity of bulk material that has been selected by some sampling process. Pieces or quantities taken from the sample for testing are called "specimens." Quantities of liquid or bulk aggregate are usually called "samples," because a sampling procedure is usually used to obtain them.

G23.2 To describe the piece on which a test is made, use "specimen" or "test specimen," *not* "piece" or "sample."

G24. SI Units

G24.1 SI units shall be included in all ASTM standards in accordance with IEEE/ASTM SI-10, the SI Quick Reference Guide (Annex A) and Part G and Part H. If a discrepancy exists between these documents, follow Part G and Part H of the Form and Style Manual.

G24.2 Combined Standards—Both units of measure are included, and either system is to be regarded separately as the standard. The combined designation format: A36/A36M. (See also A3.4.)

G25. Spelling

G25.1 Included in the following list are those spellings of words commonly found in ASTM standards. For words that do not appear in this list, use a reference source material. If using words for which multiple spellings are allowed, then consistently apply a single spelling within a standard. *See Section G10 on Dictionaries and Other Reference Publications on Style*.

A
airborne
alignment
appendixes (pl)

B
babbitt metal (lc)
Brinell (cap)

C
catalog (*not* catalogue)
CODEN

D
Disk
disc (CD)
Diskette (Floppy)
drier (comp. of dry)
dryer (apparatus)

E
ensure (meaning be sure)
et al.
eutectic (noun)
eutectoid (adj.)

F
fireclay (adj.)

G
gastight
gauge (measurement, instrument)
Geiger-Muehller tube
gray (*not* grey)

H
heat treat (verb)
heat-treated (adj.)
Hooke's law (lc "l")

I
indexes (pl)
in situ (roman)
insofar
isooctane (all other "iso's" roman)

K
kerosine/kerosene

L
litre/liter

M
magnetic particle inspection (*not* Magnaflux)
metre/meter
microscopic (meaning very small)
microscopical (meaning pertaining to use of a microscope)

N
neoprene (lc)
nital (lc)
nitrile rubber (butadiene) (lc)
Normal Law integral (cap N and L)

P
pipet (*not* pipette)
plaster of paris (*not* plaster of Paris)

R
Rockwell (cap)

S
sigma phase (spell out sigma)
siliceous
SR-4 strain gage
Stokes' law (lc "l")

U
Usage

V
V-Notch (noun and adj.)

x
X ray (noun)
X-ray (adj and verb)

G26. Symbols

G26.1 In general, avoid the use of symbols in text except in accordance with Sections G3 and G7. (See G16.1.1). When stating dimensions, use “by” *not* ×, for example, “254 mm by 127 mm” or “(254 by 127) mm”. Show tolerances, for example, as “254 mm by 127 mm ± 6 mm” or (254 by 127 ± 6) mm.” Do not use a hyphen or a dash for the word “to” except in tables where needed to conserve space. Do not use (') or (") for feet and inches in text, tables, or figures.

G26.2 In combination with words not having symbols, spell out entirely, for example, “bubbles per minute.”

G27. Tables and Graphs

G27.1 *Tables:*

G27.1.1 Number each table with an Arabic numeral (see Section D8) and give it a title that is complete and descriptive.

G27.1.2 In column headings, write the quantity being tabulated, followed by a comma, a space, and then the units, for example:

“Tensile Strength, min, psi.”
“Mass Fraction NaCl, %” or “*w*(NaCl), %”
“Temperature, °C” or “t, °C”;

G27.1.3 If quantity symbols are used in headings, they should be defined carefully and italicized (see G15.1). For specific guidance on SI recommended symbols, see IEEE/ASTM SI 10.

G27.1.4 *Powers of ten*—Do not use powers of ten in the column heading, because it is not clear whether the numbers in the table have been or are to be multiplied by the power of ten. Instead, indicate the multiplication (for example, “1.45×10^6”) in the first entry in the table; or use an expression such as “Young’s Modulus, millions of psi” in the column heading.

G27.1.5 For more options on SI formatting for tables, such as the use of the solidus symbol (“/”),see IEEE/ASTM SI 10.

G27.1.6 *Footnotes*—See G13.1.

G27.1.7 Use horizontal rules under column headings. Use vertical rules only when the complexity of the table de- mands them for clarity. Use leaders (three periods) in any space that represents a blank entry.

G27.1.8 *Notes*—Additional information can be included in a note that appears below the title.

G27.1.9 When two (or more) separate systems of units are both listed in one table (for example, SI and inch-pound units), separate the units by using separate columns or rows, or parentheses, or brackets.

G27.1.9.1 When the size of a table and limitations of space (on the printed page) make it impractical to expand the table to include SI unit equivalents, duplicate the table.

G27.1.9.2 When following the instructions given in G27.1.9 or G27.1.9.1 is impractical, because of the size and the number of tables, include the pertinent conversion factors as footnotes under each table instead of attempting to include the actual converted numbers themselves.

G27.2 *Graphs:*

G27.2.1 *General*—For clarity, all entries on the line of the graph axes should be simply numbers with the scale and units of measurement expressed unambiguously.

G27.2.2 Graphs are a type of figure. They should be given a title that is complete and descriptive and a figure number as described in Section D9. See Section G12 for more information on figures.

G27.2.3 Label axes of graphs as described for table headings in G27.1.2 and G27.1.3.

G28. Tension/Compression/Flexure Tests

G28.1 The words “tension,” “compression,” and “flexure” are used adjectivally to modify “specimen,” “test,” or “testing.” Examples: tension test, compression testing, flexure specimen. To modify other nouns, the adjectives “tensile,” “compressive,” and “flexural” are used. Examples: tensile strength, compressive force, flexural data.

G28.2 In some areas (notably the textile industry) there is a difference between a “tension test” and a “tensile test,” and in these cases the appropriate terminology shall be used.

G29. Thermal Conductivity

G29.1 The form to be used for the unit for thermal conductivity *k* is: Btu•in./h•ft^2• F[SI units: W/(m•K)].

G30. Thermometers

G30.1 Whenever possible, refer to thermometers described in ASTM Specification E1 or E2251, for ASTM Thermometers. Reference to an ASTM thermometer of the desired range should be as follows:

> Thermometer—ASTM (name) Thermometer having a range from ___ to ___ (°C or °F, whichever applies) and conforming to the requirements for Thermometer (give thermometer number; for example, 16F) as prescribed in Specification (E1 or E2251, whichever applies).

G30.2 Do not specify both temperature scales unless there is a definite need for them.

G31. Trademarks

G31.1 Avoid the use of trademarks whenever possible. For example, use aluminum oxide instead of Aloxite, petroleum jelly instead of Vaseline. When trademarks are used, they should, of course, be initial cap and the owner of the trademark indicated by footnote.

Aloxite (trademark, use aluminum oxide)
Alundum (trademark)
Bakelite (trademark)
Carborundum (trademark)
Celite (trademark)
Chromel-Alumel (trademark)
Haydite (trademark)
Inconel (trademark)
Invar (trademark)
Kel-F (trademark, use polychlorotrifluoroethylene)
Lucite (trademark, use poly(methyl methacrylate) (PMMA))
Magne-Gage (trademark)
Masonite (trademark)
Monel metal (trademark)
Muntz metal (trademark)
Mylar (trademark, use polyester film)

Nichrome (trademark)
Nujol (trademark, use light mineral oil)
Plexiglas (trademark, use poly(methyl methacrylate) (PMMA))
Pyrex (trademark, use borosilicate)
Scotch tape (trademark, use pressure-sensitive tape)
Teflon (trademark, use TFE-fluorocarbon or polytetrafluoroethylene (PTFE))
Thiokol (trademark, use as an adjective, as “Thiokol polysulfide rubber”)
Transite (trademark)
Tygon (trademark, use vinyl)
Vaseline (trademark, use petroleum jelly)
Vycor (trademark, use high-silica)

Part H
Use of SI Units in ASTM Standards

H1. Scope

H1.1 This part is intended to guide technical committees in the use of the standard formats for denoting the use of the International System of Units (SI), non-SI units (usually inch-pound), or both in ASTM standards.

H1.2 SI units of measurement shall be included in all ASTM standards.

H1.2.1 Each technical committee shall have the option of using SI units, or non-SI (usually inch-pound) units, or both, as the standard units of measure.

Discussion—Given ASTM's mission to be the foremost developer and provider of voluntary consensus standards with global recognition and use, ASTM technical committees are urged to give diligent consideration to the use of SI (metric) units as the standard unit of measurement.

H1.2.2 Follow the procedures given in IEEE/ASTM SI-10, the SI Quick Reference Guide and Part G and Part H. If a discrepancy exists between these documents, follow Part G and Part H. IEEE/ASTM SI-10 appears in the *Annual Book of ASTM Standards*, and is also available as a separate publication.

H1.2.2.1 For committees that have special considerations with the use of SI units in ASTM Standards, it is permissible to develop committee specific technical guidance for clarification. Examples of such documents are as follows:

ASTM Committee B05 Guide for Editorial Procedures and Form of Product Specifications for Copper and Copper Alloys (https://www.astm.org/COMMIT/B0950.doc)

A994 Guide for Editorial Procedures and Form of Product Specifications for Steel, Stainless Steel, and Related Alloys

H2. Terminology

H2.1 *SI unit, n, in ASTM standards*—unit of the International System of Units (SI) and other units specifically approved in IEEE/ASTM SI-10 as a unit, for use with SI.

H2.2 *inch-pound unit, n, in ASTM standards*—(also known as U.S. Customary Units) the most common non-SI unit, based on the inch and the pound, used in the United States of America and defined relative to SI by the National Institute of Standards and Technology.

Discussion—Inch-pound units are one system of non-SI units. Other systems of non-SI units are acceptable, for example, the centimetre gram second (cgs) system.

H2.3 *substitution, n, in ASTM standards*—(formerly *rationalization* or *hard conversion*) the planned simplification of a converted value achieved by modifying the value to reflect dimensions or physical characteristics of existing real measurements or configurations; as a result of this change the object or quantity is not necessarily interchangeable with the original.

Discussion—In substitution, a new rational SI (metric) size is used for the value of the measurement for the item being converted. While conversion maintains the original standard value (rounded appropriately for accuracy and precision), substitution defines a new standard value for the measurement. Substitution should not be confused with rounding. The committee shall determine the most appropriate standard unit of measurement. For examples of converting values, see IEEE/ASTM SI-10, Annex B.

H2.4 *SI standard, n*—an ASTM standard in which SI units are the only system of units declared as standard; inch-pound (or other non-SI) units may be included for information only.

H2.5 *combined standard, n*—an ASTM standard in which SI units and inch-pound (or other non-SI) units are included in the same standard, with each system of units to be regarded separately as standard. (For example, Specification A36/A36M).

H3. Format Requirements for Standards in SI Units

H3.1 For a standard citing SI units of measurement as the standard units of measurement, select the type of standard to be written and follow the appropriate format requirement listed below:

H3.1.1 *SI Standards:*

H3.1.1.1 *Scope*—Include one of the following in the scope as a numbered paragraph:

> 1.X Units—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

> 1.X Units—The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

H3.1.1.2 *Units*—Within the text, include only SI units as standard. If inch-pound (or other non-SI) units are included for information only, SI units shall appear first with inch-pound (or other non-SI) units in parentheses, and all units shall appear consistently throughout the text of the standard.

H3.1.2 *Combined Standards:*

H3.1.2.1 *Scope*—Include the following in the scope as a numbered paragraph, replacing “inch-pound” with other applicable non-SI units, such as centimetre gram second (cgs), as necessary:

> 1.X Units—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

H3.1.2.2 *Units*—Within the text, it is recommended that SI units appear first followed by the inch-pound (or other non-SI) units in brackets. However, a technical committee can opt to reverse the order in which the units appear (i.e., inch-pound (or other non-SI) units shown first, followed by SI units in brackets) if the following additional conditions are met: all units appear in a consistent order throughout the text of the standard; all combined standards under the technical committee’s jurisdiction apply the same convention. See also H5 for special format considerations.

H3.1.2.3 *Specifying Selected Units in Combined Standard*—When citing a combined standard and applying only one system of units, indicate the system of units to be applied (see B9.4).

H4. Format Requirements for Standards in Inch-Pound (or other Non-SI) Units

H4.1 For a standard citing inch-pound (or other non-SI) units of measurement as the standard units of measurement, follow the format requirement below:

H4.1.1 *Scope*—Include the following in the scope as a numbered paragraph, replacing “inch-pound” with other applicable non-SI units, such as centimeter gram second (cgs), as necessary:

> 1.X Units—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

H4.2 *Units*—Within the text, inch-pound (or other non-SI) units shall appear first followed by converted SI units in parentheses.

H5. Special Format Considerations

H5.1 *Repetitive Equivalents*—For standards in which inch-pound (or other non-SI) units are regarded as standard, insert a specific repetitive SI equivalent only the first time it occurs in each paragraph of a standard.

H5.2 *Expressing General Units*—When a standard specifies units for reporting results, the preferred unit in each system should be stated, especially in the case of compound units. For example, “Report twist of yarn in twists per inch (twists per metre)”; *not* “... in twists per inch (25.4 mm).”

H5.3 *Using Percentages for Tolerance Limits*—When appropriate, eliminate the need for equivalents in the case of tolerances by expressing the limits in percentages.

H5.4 *Sieve Sizing*—When a standard cites sieve sizes, use the standard sieve sizes given in Table 1 of ASTM Specification E11, Wire Cloth and Sieves for Testing Purposes.

H5.5 Where it has been long-standing practice to use SI units alone (such as stating temperatures only in degrees Celsius), equivalents may be omitted.

H6. Tables

H6.1 For instructions on including SI units in tables, see Section G27.

Annex A
SI QUICK REFERENCE GUIDE

INTRODUCTION

In support of ASTM's mission to be recognized as an international standards developer, technical committees are urged to diligently consider the use of SI units as the standard unit of measurement. Throughout the ASTM Form and Style Manual references are made to the use of SI units, and in most cases, suggests that more detailed guidance can be found in IEEE/ASTM SI-10 American National Standard for Metric Practice.

This SI Quick Reference Guide was developed from content within IEEE/ASTM SI 10 to assist in applying SI units in the development of ASTM International standards. This section is intended to provide references on the more common SI units used, and frequently asked questions for SI units. For more detailed information, please refer to IEEE/ASTM SI 10 American National Standard for Metric Practice.

SI QUICK REFERENCE GUIDE:
International System of Units (SI)
*The Modern Metric System**

1. UNITS

The International System of Units (SI) is based on seven base units:

Base Units

Quantity	*Typical Quantity Symbol*[A]	*Name*	*Symbol*
length	*l, x, r,* etc.	meter	m
mass	*m*	kilogram	kg
time	*t*	second	s
electric current	*I, I*	ampere	A
thermodynamic temperature	*T,*	kelvin	K
amount of substance	*n*	mole	mol
luminous intensity	I_v	candela	cd

[A] The symbols for quantities are suggestions only and alternative symbols may be used, as indicated for length and electric current. See 3.5.1.2 (c) in IEEE/ASTM SI-10.

and a number of derived units which are combinations of base units and which may have special names and symbols:

Examples of Derived Units

Quantity	*Expression*	*Name*	*Symbol*
acceleration			
angular	rad/s^2		
linear	m/s^2		
angle			
plane	dimensionless	radian	rad
solid	dimensionless	steradian	sr
area	m^2		
Celsius temperature	K	degree Celsius	°C
density			
heat flux	W/m^2		
mass	kg/m^3		
current	A/m^2		
energy, enthalpy			
work, heat	N·m	joule	J
specific	J/kg		
entropy			
heat capacity	J/K		
specific	J/(kg·K)		
flow, mass	kg/s		
flow, volume	m^3/s		
force	$kg·m/s^2$	newton	N
frequency			
periodic	1/s	hertz	Hz
rotating	rev/s		
inductance	Wb/A	henry	H
magnetic flux	V·s	weber	Wb
mass flow	kg/s		
moment of a force	N·m		
potential, electric	W/A	volt	V
power, radiant flux	J/s	watt	W
pressure, stress	N/m^2	pascal	Pa
resistance, electric	V/A	ohm	Ω
thermal conductivity	W/(m·K)		
velocity			
angular	rad/s		
linear	m/s		
viscosity			
dynamic (absolute) (μ)	Pa·s		
kinematic (ν)	m^2/s		
volume	m^3		
volume, specific	m^3/kg		

** For complete information see IEEE/ASTM SI-10.*

2. SYMBOLS

Symbol	*Name*	*Quantity*	*Formula*
A	ampere	electric current	base unit
Bq	becquerel	activity (of a radio nuclide)	1/s
C	coulomb	electric charge	A·s
°C	degree Celsius	temperature interval	°C = K
cd	candela	luminous intensity	base unit
F	farad	electric capacitance	C/V
Gy	gray	absorbed dose	J/kg
g	gram	mass	kg/1000
H	henry	inductance	Wb/A
Hz	hertz	frequency	1/s
ha	hectare*	area	10 000 m^2
J	joule	energy, work, heat	N·m
K	kelvin	temperature	base unit
kg	kilogram	mass	base unit
L	liter/litre	volume	m^3/1000
lm	lumen	luminous flux	cd·sr
lx	lux	illuminance	lm/m^2
m	meter/metre	length	base unit
mol	mole	amount of substance	base unit
N	newton	force	$kg·m/s^2$
Ω	ohm	electric resistance	V/A
Pa	pascal	pressure, stress	N/m^2
rad	radian	plane angle	m/m (dimensionless)
S	siemens	electric conductance	A/V
Sv	sievert	dose equivalent	J/kg
s	second	time	base unit
sr	steradian	solid angle	m^2/m^2 (dimensionless)
T	tesla	magnetic flux density	Wb/m^2
t	tonne, metric ton	mass	1000 kg; Mg
V	volt	electric potential	W/A
W	watt	power, radiant flux	J/s
Wb	weber	magnetic flux	V·s

* allowed with SI

3. USE OF SYMBOLS

3.1 General

3.1.1 Symbol for product—use the raised dot (·).

Examples: N·m; mPa·s; $W/(m^2·K)$

3.1.2 Symbol for quotient—use one of the following forms:

Examples: m/s or m⁄s or use the negative exponent.

Note: Use only one solidus (/) per expression and parentheses to avoid any ambiguity.

3.1.3 The correct use of symbols is important because an incorrect symbol may change the meaning of a quantity. Some SI symbols are listed in the Symbol table.

3.1.4 Unit symbols are mathematical entities, *not* abbreviations. Therefore, no periods follow a symbol except at the end of a sentence.

Examples: A, *not* amp; s, *not* sec; SI, *not* S.I.

3.2 Unit Symbols

3.2.1 Symbols appear in lower case unless the unit name has been taken from a proper name. In this case the first letter of the symbol is capitalized.

Examples: m, meter; Pa, pascal; W, watt

Exception: L, liter

3.2.2 Symbols and prefixes are printed in upright (roman) type regardless of the type style in surrounding text.

Example: … a distance of 73 km *between …*

3.2.3 Unit symbols are the same whether singular or plural.

Examples: 1 mm, 100 mm; 1 kg, 65 kg

3.2.4 Do not modify unit names or symbols by adding information about the quantity in parentheses or subscripts.

Examples: kPa(gauge); MWe; Vac or VAC, "volts ac", "megawatts electrical power"

3.2.5 Do not mix unit symbols and names in the same expression.

Examples: radians per second or rad/s,
not radians/second; *not* radians/s
m/s or meters per second,
not meters/second; *not* meters/s
J/kg or joules per kilogram,
not joules/kilogram; *not* joules/kg

3.2.6 Make it clear to which unit symbol a numerical value belongs and which mathematical operation applies to the value of a quantity.

Examples: 35 cm by 48 cm, *not* 35 by 48 cm
20 °C to 30 °C or (20 to 30) °C, *not* 20 °C – 30 °C;
not 20 to 30 °C

123 g ± 2 g or (123 ± 2) g, *not* 123 ± 2 g
70 % ± 5 % or (70 ± 5) %, *not* 70 ± 5 %

3.2.7 Leave a space between the value and the unit symbol, including the % symbol, even when the value of the quantity is used as an adjective.

Examples: 115 W, *not* 115W; 0.75 L, *not* 0.75L
3.5 %, *not* 3.5%
88 °C, *not* 88°C or 88° C
50 mm gauge, *not* 50-mm gauge

Exception: No space is left between the numerical value and the symbols for degree, minute, or second of plane angle.

Examples: 73°35'9", *not* 73 ° 35 ' 9 "

Note: Symbol for coulomb is C; for degree Celsius it is °C

3.3 Quantity Symbols

3.3.1 Symbols for quantities are set in italic font to distinguish them from unit symbols. Authors may choose their own symbols, provided they are clearly defined. Preferably, use recommended symbols (see SI 10-2016, 3.5.1.3.b) and single Latin or Greek letters.

Examples: m, A, V, T and ρ are the recommended symbols for mass, area, volume, Celsius temperature and density, respectively.

3.3.2 Because precision parameters are quantities, their symbols are written in italic font.

Examples: S, ip, and *R* denoting, standard deviation, intermediate precision and reproducibility, respectively.

3.3.3 Quantity symbols may be qualified by further information in subscripts, superscripts or in parentheses.

Examples: C_p (heat capacity at constant pressure),
w_{Pb} (mass fraction of lead)

3.3.4 To avoid ambiguity, when reporting concentrations of solutions (for example mass and volume fractions), ensure that all quantities are defined.

Examples: "mass fraction of sodium chloride is 2.1 %",
not "sodium chloride content is 2.1 % (by mass)"
not "amount of sodium chloride is 2.1 % m/m"
"mass fraction of sulfur is 3.2 x 10^{-6}"
not "sulfur content is 3.2 ppm"

3.3.5 Ambiguity can also be avoided by using the ratio of the two units involved.

Examples: volume fraction of ethanol is 3.5 cL/L
(as opposed to 3.5 % or 0.035)
mass fraction of sulfur is 3.2 mg/kg
(as opposed to 3.2 x 10^{-6})

3.3.6 In equations, do not use text to represent quantities; use symbols instead.

Example: Write $F = ma$
where:
F = force, N,
m = mass, g, and
a = acceleration, m/s^2.

Do not write "Force, $N = ma$" because text and mathematical symbols such as the equals sign should not be combined.

4. PREFIXES

4.1 General

4.1.1 Most prefixes indicate orders of magnitude in steps of 1000 and provide a convenient way to express large and small numbers and to eliminate nonsignificant digits and leading zeroes in decimal fractions.

Examples: 64 000 watts is the same as 64 kilowatts*
0.057 meter is the same as 57 millimeters
16 000 meters is the same as 16 kilometers*

*except when a specific number of significant digits is needed

4.1.2 Do not insert a space or hyphen between the prefix and unit name.

Examples: mmol and millimole, *not* m mol or milli-mole
kilometer *not* kilo meter or kilo-meter;
milliwatt *not* milli watt or milli-watt

4.1.3 When a prefix ends with a vowel and the unit name begins with a vowel, retain and pronounce both vowels.

Example: kiloampere

Exceptions: hectare; kilohm; megohm

Prefix	*Symbol*	*Represents*
yotta	Y	10^{24}
zetta	Z	10^{21}
exa	E	10^{18}
peta	P	10^{15}
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
hecto	h*	10^{2}
deka	da*	10^{1}
deci	d*	10^{-1}
centi	c*	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}
atto	a	10^{-18}
zepto	z	10^{-21}
yocto	y	10^{-24}

4.1.4 To realize the full benefit of the prefixes when expressing a quantity by numerical value, choose a prefix so that the number lies between 0.1 and 1000. For simplicity, give preference to prefixes representing 1000 raised to an integral power (i.e., mm, μm, km).

**Exceptions:* In expressing area and volume, the prefixes hecto, deka, deci, and centi may be required; for example, cubic decimeter (L), square hectometer (hectare), cubic centimeter.

Tables of values of the same quantity.

Comparison of values.

For certain quantities in particular applications. For example, the millimeter is used for linear dimensions in architectural and engineering drawings even when the values lie far outside the range of 0.1 mm to 1000 mm; the centimeter is usually used for anatomical measurements and clothing sizes.

4.2 Compound Units. A compound unit is a derived unit expressed with two or more units. The prefix is attached to a unit in the numerator.

Examples: V/m *not* mV/mm
MJ/kg *not* kJ/g

4.3 Compound prefixes formed by a combination of two or more prefixes are not used. Use only one prefix.

Examples: 2 nm *not* 2 mμm; 6 m^3*not* 6 kL;
6 mPa *not* 6 kkPA

4.4 Exponential Powers. An exponent attached to a symbol containing a prefix indicates that the multiple (of the unit with its prefix) is raised to the power of 10 expressed by the exponent.

Examples: 1 $mm^3 = (10^{-3}\ m)^3 = 10^{-9}\ m^3$
1 $ns^{-1} = (10^{-9}\ s)^{-1} = 10^9\ s^{-1}$
1 $mm^2/s = (10^{-3}\ m)^2/s = 10^{-6}\ m^2/s$

5. NUMBERS

5.1 General

International practice separates the digits of large numbers into groups of three, counting from the decimal to the left and to the right, and inserts a space to separate the groups. In numbers of four digits, the space is not necessary except for the uniformity in tables.

Examples: 6.358 568; 85 365; 51 845 953; 88 000;
0.246 113 562; 7 258

5.1.2 Small Numbers. When writing a number between one and minus one, put a zero before the decimal marker.

Note: This applies to large numbers which have an exponent: as -0.1×10^6. This rule is given colloquially as "never use a naked decimal point."

5.1.3 Decimal Marker. The recommended decimal marker is a dot on the line (period). (In some countries, a comma is used as the decimal marker.)

5.1.4 Because **billion** means a million million in most countries but a thousand million in the United States, avoid using billion in technical writing.

6. GENERAL GUIDANCE

6.1 General

6.1.1 The units in the international system of units are called SI units—*not* Metric Units and *not* SI Metric Units.

6.1.2 Non-SI units include inch-pound units, old metric units and many other units. Inch-pond units (IP) refers to sets of units which contain inches and pounds. These include so-called customary units, US customary units, conventional units, imperial units, and English units.

6.1.3 Treat all spelled out names as nouns. Therefore, do not capitalize the first letter of a unit name except at the beginning of a sentence or in capitalized material such as a title.

Examples: watt; pascal; ampere; volt; newton; kelvin

Exception: Always capitalize the first letter of Celsius.

6.1.4 Do not begin a sentence with a unit symbol—either rearrange the unit names or write the unit name in full.

6.1.5 Use plurals for spelled out unit names when required by the rules of grammar.

Examples: meter—meters; henry—henries;
kilogram—kilograms; kelvin—kelvins
1.1 meters *but* 0.9 meter
Irregular: hertz—hertz; lux—lux; siemens—siemens

6.1.6 When a derived unit name is formed by multiplication, leave a space between units that are multiplied.

Examples: newton meter, *not* newton-meter;
volt ampere, *not* volt-ampere

6.1.7 Use the modifier "squared" or "cubed" after the unit name.

Example: meter per second squared
Exception: For area or volume the modifier may be placed before the units.
Example: square millimere; cubic meter

6.1.8 When derived units are formed by division, use the word *per*, *not* a solidus (/).

Examples: meter per second, *not* meter/second; watt per square meter, *not* watt/square meter

6.1.9 Do not use weight as a synonym to mean mass.

Example: The sample mass is 5 kg, *not* the sample weight is 5 kg.

7. SELECTED CONVERSION FACTORS

CAUTION: These conversion values are rounded to three or four significant figures, which is sufficiently accurate for most application. When making conversions, remember that a converted value is no more precise than the original value. Round off the final value to the same number of significant figures as those in the original value. See ANSI SI 10 for additional conversions with more significant figures.

To Convert From	*To*	*By*
acre	ha	0.4046873
atmosphere, standard	kPa	*101.325
bar	kPa	*100
barrel (42 US gal, petroleum)	L	159
Btu, (International Table)	kJ	1.055
Btu/lb·°F (specific heat, C^P)	kJ/(kg·K)	4.184
bushel	m^3	0.03524
calorie, kilogram (kilocalorie)	kJ	4.187
candle, candlepower	cd	*1.0
centipoise, dynamic viscosity, μ	mPa·s	*1.00
centistokes, kinematic viscosity, ν	mm^2/s	*1.00
ft	m	*0.3048
ft	mm	*304.8
ft/min, fpm	m/s	*0.00508
ft/s, fps	m/s	*0.3048
ft of water	kPa	2.99
ft^2	m^2	0.09290
ft^2/s, kinematic viscosity, ν	mm^2/s	92 900
ft^3	L	28.32
ft^3	m^3	0.02832
ft^3/h, cfh	mL/s	7.866
ft^3/min, cfm	L/s	0.4719
ft^3/s, cfs	L/s	28.32
footcandle	lx	10.76
ft·lb_f (torque or moment)	N·m	1.36
ft·lb_f (work)	J	1.36
ft·lb_f/lb (specific energy)	J/kg	2.99
ft·lb_f/min (power)	W	0.0226
gallon, US (*231 in^3)	L	3.785
gph	mL/s	1.05
gpm	L/s	0.0631
gpm/ft^2	$L/(s·m^2)$	0.6791
gr/gal	g/m^3	17.1
horsepower (550 ft·lb_f/s)	kW	0.746
inch	mm	*25.4
in of mercury (60°F)	kPa	3.377
in of water (60°F)	Pa	248.8
in·lb_f (torque or moment)	mN·m	113
in^2	mm^2	645
in^3 (volume)	mL	16.4
in^3 (section modulus)	mm^3	16 400
in^4 (section moment)	mm^4	416 200
km/h	m/s	0.278
kWh	MJ	*3.60
kip/in^2 (ksi)	MPa	6.895
liter	m^3	*0.001
micron (μm) of mercury (60°F)	mPa	133
mil (0.001 in.)	mm	*25.4
mile	km	1.61
mile, nautical	km	1.85
mph	km/h	1.61
mph	m/s	0.447
millibar	kPa	*0.100
mm of mercury (60°F)	kPa	0.133
mm of water (60°F)	Pa	9.80
ounce (mass, avoirdupois)	g	28.35
ounce (force of thrust)	N	0.278
ounce (liquid, US)	mL	29.6
ounce (avoirdupois) per gallon	kg/m^3	7.49
pint (liquid, US)	mL	473
pound		
lb_m (mass)	kg	0.4536
lb_m (mass)	g	453.6
lb_f (force or thrust)	N	4.45
lb_m/ft (uniform load)	kg/m	1.49
$lb_m/(ft·h)$ (dynamic viscosity, μ)	mPa·s	0.413
$lb_m/(ft·s)$ (dynamic viscosity, μ)	mPa·s	1490
$lb_f·s/ft^2$ (dynamic viscosity, μ)	mPa·s	47 880

To Convert From	*To*	*By*
lb_m/min	kg/s	0.00756
lb_m/h	g/s	0.126
lb_f/ft^2	Pa	47.9
lb_m/ft^2	kg/m^2	4.88
lb_m/ft^3 (density, ρ)	kg/m^3	16.0
lb_m/gallon	kg/m^3	120
ppm (by mass)	mg/kg	*1.00
psi	kPa	6.895
quad (10^{15} Btu)	EJ	1.06
quart (liquid, US)	L	0.946
rpm	rad/s	0.105
tablespoon (approx.)	mL	15
teaspoon (approx.)	mL	5
therm (100,000 Btu)	MJ	105.5
ton, short (2000 lb)	Mg; t (tonne)	0.907
yd	m	*0.9144
yd^2	m^2	0.836
yd^3	m^3	0.7646

*Conversion factor is exact.
Note: In this list the kelvin (K) expresses temperature intervals. The degree Celsius symbol (C) may be used for this purpose as well.

Summary of Changes

The following changes were made since the April 2023 edition and published in this edition.

(1) Editorially revised Part E, Terminology in ASTM Standards.

The following changes were made since the September 2022 edition and published in this edition.

(1) Revised Part E, Terminology in ASTM Standards, to include terminology guidance from Part A. This revision also required changes to Parts A, B, and C.

The following changes were made since the April 2020 edition and published in this edition.

(1) Revised G2.3 and removed G2.4.

The following changes were made since the October 2018 edition and published in this edition.

(1) Revised Annex A5.5.
(2) Revised A13.1.2.
(3) Revised A21.2.2.
(4) Revised A29.1.
(5) Revised B31.1.
(6) Revised F2.4.

The following changes were made since the April 2018 edition and published in this edition.

(1) Revised Annex A, SI Quick Reference Guide.
(2) Revised G16.1.2.
(3) Revised G18.3.3.

The following changes were made since the October 2017 edition and published in this edition.

(1) Revised A7.2.4 to better align with ASTM/IEEE SI-10.
(2) Revised Section A19 to update example equation and better align guidance with ASTM/IEEE SI-10.
(3) Revised Section E5 to add references to Section G16 for style guidance.
(4) Revised E6.1.1 to improve grammar, change equal signs to long dashes as appropriate for terminology, and add an example.
(5) Revised F2.6 to remove permissive language.
(6) Revised Section G3 to add information about values of quantities and a reference to G14.1 for information on compound adjectives, and updated list at G3.6 with new information on symbols and SI versus non-SI units.
(7) Revised Section G15 to provide additional guidance on the use of italics and to better align with ASTM/IEEE SI-10.
(8) Revised Section G16 to include directions not to mix text and mathematical symbols with the exception of legends, and to add guidance on the formatting of equations, including a new example equation.
(9) Revised G18.5 to include guidance on dilution ratios.
(10) Revised Section G19 to add guidance on the use of the % symbol and better align with ASTM/IEEE SI-10.
(11) Revised G25.1 to encourage consistent spelling when using words for which multiple spellings are allowed.
(12) Revised G26.1 to better align with ASTM/IEEE SI-10's guidance on values of quantities.
(13) Revised Section G27 to add guidance on graphs and better align with ASTM/IEEE SI-10.
(14) Revised H2.3 to remove permissive language.
(15) Revised H3.1.2.1 to remove permissive language.
(16) Revised H3.1.2.2 to add reference to H5.

The following changes were made since the April 2017 edition and published in this edition.

(1) Revised Part H to improve consistency of the term non-SI units, better align with ASTM/IEEE SI-10 in the use of the term ‘substitution’ and allow committees the non-mandatory option of including non-SI units when SI units are considered standard.
(2) Revised F2.6 to follow ASTM guidelines regarding and/or.

The following changes were made since the October 2016 edition and published in this edition.

(1) Revised the generic safety caveat in Section F2.1.

The following changes were made since the April 2016 edition and published in this edition.

(1) Added F2.7, International Standard Caveat.

The following changes were made since the September 2015 edition and published in this edition.

(1) Included alternative spellings for metre and litre in the abbreviations list.
(2) Revised G25.1 to include alternative spellings for litre and metre.

The following changes were made since the January 2015 edition and published in this edition.

(1) Revised Sections G3.6, G11.1, G19.1.
(2) Replaced "arabic" with "Arabic" in D7.1, D8.1, D9.1, G18.1, G21.1 and G27.1.

The following changes were made since the March 2014 edition and published in this edition.

(1) Revised Sections G3.6, G24.1, and H1.2.2 to reference IEEE SI 10, the SI Quick Reference Guide, and Part G and Part H. The ASTM Form and Style is the default document for formatting so that the spelling of litre and metre can be maintained.
(2) Revised G14.1 and G18.3.3 to reflect using space rather than hyphen for compound adjectives using SI units.
(3) Added the SI Quick Reference Guide to the Form and Style Manual as Annex A.
(4) General revisions were made to reflect current practices.

The following changes were made since the October 2013 edition and published in this edition.

(1) Added F2.6, Mercury Caveat.

The following changes were made since the March 2013 edition and published in this edition.

(1) Revised Section F1 on Commercial-Contractual Items in Standards.
(2) Editorially revised Section G12 on Creating and Submitting Figures for Ballot

The following changes were made since the October 2012 edition and published in this edition.

(1) Editorially revised B22.1 on Product Marking.

The following changes were made since the March 2012 edition and published in this edition.

(1) Revised Section A21 on Precision and Bias.

The following changes were made since the October 2011 edition and published in this edition.

(1) Clarified use of the term “dictionary” to mean print or electronic reference materials in A7.1.1, E2.1, E3.3.1, E5.9, G10.1, G15.1.5, and G25.1.

(2) Editorially updated ASTM standards references in A17.1, A19.2, and the table in G3.6 (Vickers Hardness number)

The following changes were made since the October 2010 edition and published in this edition.

(1) Clarified language in Section F1.
(2) Revised Ordering Information, B9.3, to focus on the importance of referenced documents within a specification, and to encourage the use of year dates.
(3) Editorially changed A27.4 and A29.4 to correct a reference in the *Regulations Governing ASTM Technical Committees*.
(4) Editorially updated the title of IEEE/ASTM SI-10 in G3.6.

The following changes were made since the March 2010 edition and published in this edition.

(1) Editorially removed reference to ANSI Y10.3M in A19.1 since it was withdrawn without replacement.
(2) Revised D4 with the addition of D4.1.2 to modify language on the current editorial practice for Supplementary Requirements.
(3) Editorially changed E3.3.3 to update the referenced title to *ASTM Online Dictionary of Engineering Science and Technology*.
(4) Revised F4.1 to include ASTM Certification Programs.

The following changes were made since the September 2009 edition and published in this edition.

(1) Added “kerosene” as an acceptable spelling in G25.1.

The following changes were made since the March 2009 edition and published in this edition.

(1) Revisions of A27.1 and B29.1 for better clarity.
(2) Replaced G12 with a new procedure for creating and submitting figures for ballot.
(3) Editorial changes were made to C2, C16, A26.4, and B28.4.

The following changes were made since the March 2008 edition and published in this edition.

(1) Insertion of new sections F2.2.2.5 and F2.2.2.6 dealing with Fire Standards Safety Caveats.

The following changes were made since the October 2007 edition and published in this edition.

(1) Revisions were made to Part G dealing with Styling, Electronic Manuscript Preparation, Abbreviations, Figures, Mathematical Material, and Thermometers.

The following changes were made since the October 2006 edition and published in this edition.

(1) Removal of the ‘separated by a space’ requirement in standard designation numbers found in A3.1.2 and B4.1.2.
(2) Insertion of new section G16.6.1 and an example for clarifying how to place a multiplication symbol in an equation.
(3) Revision of G27.7 for better clarity.
(4) Revision of H1.2.1 for better clarity, as well as to include a *Discussion* on the use of SI units in standards.
(5) Reversal of the order of appearance of Sections H3 and H4.

The following changes were made since the March 2006 edition and published in this edition.

(1) Insertion of a new section F4.1 to clarify ASTM’s policy on certification and accreditation.

(2) Reversal of the order of appearance of the *Trademarks* section with the *Sources of Supply* section for a more logical flow.
(3) Removal of the word *reference* where used as an adjective in the term *reference materials* to expand this section to cover all materials – not just *reference materials*.
(4) Insertion of new language as F4.2.2 to make trademark language consistent with *Regulations Governing ASTM Technical Committees* and Board Policy.

The following changes were made since the October 2005 edition and published in this edition.

(1) Revisions were made to A21.4.1, A21.4.2, and A21.5.4 to clarify the intent of the language.
(2) Sections A29 and B31 on Research Reports were revised to make clearer the instructions on how the research report is to be referenced in a standard.
(3) Revision to F2.4, Working Document Caveat, in order to remain consistent with ASTM policy.
(4) Revisions were made to Sections F4 and F4.2 dealing with Use of Trademarks.

The following changes were made since the March 2005 edition and published in this edition.

(1) Revision to Working Draft Caveat, F2.4, in order to remain consistent with ASTM policy.
(2) Section G25.1, added (measurement, instrument) to “gauge” and deleted spelling “gage.”

The following changes were made since the September 2004 edition and published in this edition.

(1) Section A18.3 was deleted. Including this section was redundant and could lead to confusion.
(2) New Section H1.2.2.1 was added pertaining to rounding of SI Units.

The following changes were made since the April 2004 edition and published in this edition.

(1) New Section A21.4.5 pertaining to precision and bias was added.
(2) A revision was made in B1.2 for clarification.

The following changes were made since the September 2003 edition and published in this edition.

(1) Revisions to A1.4 clarify how to identify different test methods within a standard.
(2) New Section A22 on Measurement Uncertainty was added.
(3) Revision to F1 was made and new Section F1.4 was added concerning effective dates.
(4) Revisions were made to F3.1, F3.1.1, and F3.1.2 dealing with patents.

The following changes were made since the March 2003 edition and published in this edition.

(1) The following sentence was added in B25.1. “These should not include statements that would allow the lowering of minimum requirements of the standard (seeB1.2).”
(2) Megagram (Mg) was added to G3.6.

The following changes were made since the September 2002 edition and published in this March 2003 edition.

(1) New definitions for “publication date” and “approval date” were added to p. viii on Definitions
(2) Sections A31.3, B34.3, and C31.3 on Summary of Change Sections were revised to permit standards that have undergone multiple revisions in a short period of time to retain changes for 18 months.
(3) The statement in A21.5.3 was revised to correct ambiguity in the requirement for precision and bias.

The following changes were made editorially since the March 2002 edition and are published in the September 2002 edition.

(1) Replaced the verbiage “year of issue” and “date of issue” with “year date” throughout.

(2) Standardized the terms “purchase order or contract” in Part B.
(3) An additional sentence was included in F3.1 regarding the ANSI patent policy.

The sections shown below have been editorially changed since the October 2001 edition and are published in the March 2002 edition.

(1) Section G2 on Electronic Manuscript Preparations was replaced.
(2) Additional sentences were included in the suggested statement in B21.2.

The following changes were made since the March 2001 edition and published in the October 2001 edition.

(1) Deletion of A3.1.3 and A5.4 regarding companion standards. The same changes were made to B4.1.3 and B4.4.1
(2) Mandatory for Standards Producing Numerical Results was added to the heading of Section A29 on Research Reports.
(3) New section F2.2.2.4 dealing with a fire risk assessment statement.
(4) Deletion of G24.2 dealing with companion standards.

The following changes were made since the February 2000 edition and are published in the March 2001 edition.

(1) Revisions to Section B21 on Certification.

The following changes were made since the December 1998 edition and are published in the February 2000 edition.

(1) Revision to Section A13 to revised A13.1.1 on Warning Statement, delete A13.1.2 on Precautionary Statement, and delete A13.2 on Technical Hazards. Revise F2.1.2 and F2.1.3 to eliminate wording dealing with precautionary statements.

The following changes were made since the January 1996 edition and published in the December 1998 edition.

(1) Revision to Part H dealing with the use of SI units in ASTM standards. Revision to G38. These were the results from Circular Letter #713.
(2) Added new F2.5 Professional Judgment Caveat.

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