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ASME Y14.5, Dimensioning and Tolerancing, was adopted on 9 February 2009 for use by the Department of Defense (DoD). Proposed changes by DoD activities must be submitted to the DoD Adopting Activity: Commander, U.S. Army Research, Development and Engineering Center (ARDEC), ATTN: AMSRD-AAR-QES-E, Picatinny Arsenal, NJ 07806-5000. Copies of this document may be purchased from The American Society of Mechanical Engineers (ASME), 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900, http://www.asme.org.

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ASME Y14.5-2009

[Revision of ASME Y14.5M-1994 (R2004)]

Dimensioning and Tolerancing

Engineering Drawing and Related Documentation Practices

AN INTERNATIONAL STANDARD

The American Society of Mechanical Engineers

ASME SETTING THE STANDARD

Date of Issuance: March 27, 2009

This Standard will be revised when the Society approves the issuance of a new edition. There will be no addenda or written interpretations of the requirements of this Standard issued to this edition.

Periodically certain actions of the ASME Y14 Committee may be published as Cases. Cases are published on the ASME Web site under the Committee Pages at http://cstools.asme.org as they are issued.

The American Society of Mechanical Engineers
Three Park Avenue, New York, NY 10016-5990

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Nonmandatory Appendices

FOREWORD

This issue is a revision of ASME Y14.5M-1994, Dimensioning and Tolerancing. The main object for this revision has been to rearrange the material to better direct the thought process of the user when applying Geometric Dimensioning and Tolerancing. The subject matter of Sections 1 through 4 remains the same as in the previous revision. Sections 5 and 6 were formerly titled "Tolerances of Location" and "Tolerances of Form, Profile, Orientation, and Runout." The new order following Section 4, Datums, is Section 5, Tolerances of Form; Section 6, Tolerances of Orientation; Section 7, Tolerances of Location; Section 8, Tolerances of Profile; and Section 9, Tolerances of Runout. When applying GD&T the first consideration is to establish a datum reference frame based on the function of the part in the assembly with its mating parts. After the datum reference frame is established, the form of the primary datum feature is controlled, followed by the orientation and/or location of the secondary and tertiary datum features. After the datum features are related relative to each other, the remaining features are controlled for orientation and location relative to the datum reference framework. Further rearrangement has occurred within each section so that the basic concepts are presented first and then the material builds to the more complex. The subcommittee believes this will aid the user of the Standard to better understand the subject of Dimensioning and Tolerancing.

Three new terms that are introduced are used only with datums. The terms are "maximum material boundary (MMB)," "least material boundary (LMB)," and "regardless of material boundary (RMB)." These terms better describe that there is a boundary defined when applying datums. MMB and LMB may be a maximum material or least material boundary, respectively, or the applicable virtual condition. The MMB would be an actual maximum material boundary if the tolerance (location or orientation) for that datum feature was zero at MMC. The LMB would be an actual least material boundary if the tolerance (location or orientation) for that datum feature was zero at LMC. In the case of a feature of size as a primary datum feature, the MMB or LMB would be the actual maximum or least material boundary if the form of the feature of size was controlled by Rule #1, or a zero at MMC or LMC straightness of the axis or flatness of the center plane was applied. RMB indicates that the datum features apply to any boundary based on the actual size of the feature and any geometric tolerance applied that together generate a unique boundary.

Since many major industries are becoming more global, resulting in the decentralization of design and manufacturing, it is even more important that the design more precisely state the functional requirements. To accomplish this it is becoming increasingly important that the use of geometric and dimensioning (GD&T) replace the former limit dimensioning for form, orientation, location, and profile of part features. This revision contains paragraphs that give a stronger admonition than in the past that the fully defined drawing should be dimensioned using GD&T with limit dimensioning reserved primarily for the size dimensions for features of size. Additionally, recognizing the need to automate the design, analysis, and measurement processes, and reduce the number of "view dependent tolerances," additional symbology has been introduced for other more common tolerancing practices.

Work on this issue began at a meeting in Sarasota, Florida in January 1994. Numerous deferred comments from the public review for the previous revision, as well as proposals for revision and improvement from the subcommittee and interested parties from the user community, were evaluated at subsequent semi-annual meetings. The subcommittee divided into working groups for several meetings and then reconvened as a subcommittee as a whole to review and ensure the continuity of the revision.

Internationally, a new joint harmonization group formed in January 1993 was called the ISO/TC 3-10-57 JHG. The object was to harmonize the work and principles among ISO/TC3 Surface Texture, ISO/TC 10 SC 5 Dimensioning and Tolerancing, and ISO/TC 57 Measurement. The task of this group was to identify and suggest resolutions to problems among the three disciplines. Many representatives of the ASME Y14.5 subcommittee participated in the meetings of this group from September 1993 through June 1996. In Paris in June 1996 the ISO/TC 3-10-57 JHG became ISO/TC 213, and the responsibilities of the three other ISO committees were transferred to ISO/TC 213. Representatives of the U.S. have participated in all of the ISO/TC 213 meetings from June 1996 through January 1999. Because of difficulties, the U.S. was not represented again until January 2006, and representation is now ongoing.

In the U.S., a similar committee was formed following the formation of ISO/TC 213 as a home for the U.S. TAG (Technical Advisory Group) to ISO/TC 213 and also to serve as an advisory committee to the three U.S. committees and subcommittees that are parallel to the ISO groups (Surface Texture B46, Dimensioning and Tolerancing Y14.5, and Measurement B89). This new committee, called H213, was formed at a meeting in 1997 by representatives of the three U.S. committees or subcommittees. H213 does not have responsibility for all three subjects as does the ISO committee, but rather serves as an intermediary to identify and facilitate a resolution to problems that may exist among the three disciplines as well as the home for the U.S. TAG.

Suggestions for improvement of this Standard are welcome. They should be sent to The American Society of Mechanical Engineers; Attn: Secretary, Y14 Standards Committee; Three Park Avenue, New York, NY 10016.

This revision was approved as an American National Standard on February 6, 2009.

NOTE: The user's attention is called to the possibility that compliance with this Standard may require use of an invention covered by patent rights.

By publication of this Standard, no position is taken with respect to the validity of any such claim(s) or of any patent rights in connection therewith. If a patent holder has filed a statement of willingness to grant a license under these rights on reasonable and nondiscriminatory terms and conditions to applicants desiring to obtain such a license, the details may be obtained from the standards developer.

Acknowledgments

P. J. McCuistion, Ohio University, created the illustrations for this Standard.

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Engineering Drawing and Related Documentation Practices

(The following is the roster of the Committee at the time of approval of this Standard.)

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General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by proposing revisions and attending Committee meetings. Correspondence should be addressed to:

Secretary, Y14 Standards Committee
The American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016-5990

Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal including any pertinent documentation.

Proposing a Case. Cases may be issued for the purpose of providing alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee Web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the standard, the paragraph, figure or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the standard to which the proposed Case applies.

Attending Committee Meetings. The Y14 Standards Committee regularly holds meetings or telephone conferences, which are open to the public. Persons wishing to attend any meeting or telephone conference should contact the Secretary of the Y14 Standards Committee or check our Web site at http://cstools.asme.org/csconnect/.

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DIMENSIONING AND TOLERANCING

Section 1
Scope, Definitions, and General Dimensioning

1.1 SCOPE

This Standard establishes uniform practices for stating and interpreting dimensioning, tolerancing, and related requirements for use on engineering drawings and in related documents. For a mathematical explanation of many of the principles in this Standard, see ASME Y14.5.1. Practices unique to architectural and civil engineering and welding symbology are not included.

1.1.1 General

Section 1 establishes definitions, fundamental rules, and practices for general dimensioning. For tolerancing practices, see Sections 2 through 9. Additional information about tolerancing maybe found in Nonmandatory Appendices A through E.

1.1.2 Units

The International System of Units (SI) is featured in this Standard because SI units are expected to supersede United States (U.S.) customary units specified on engineering drawings. Customary units could equally well have been used without prejudice to the principles established.

1.1.3 Reference to This Standard

Where drawings are based on this Standard, this fact shall be noted on the drawings or in a document referenced on the drawings. References to this Standard shall state ASME Y14.5-2009.

1.1.4 Figures

The figures in this Standard are intended only as illustrations to aid the user in understanding the principles and methods of dimensioning and tolerancing described in the text. The absence of a figure illustrating the desired application is neither reason to assume inapplicability, nor basis for drawing rejection. In some instances, figures show added detail for emphasis. In other instances, figures are incomplete by intent. Numerical values of dimensions and tolerances are illustrative only. Multiview drawings contained within figures are third angle projection.

NOTE: To assist the users of this Standard, a listing of the paragraph(s) that refer to an illustration appears in the lower right-hand corner of each figure. This listing may not be all-inclusive. The absence of a listing is not a reason to assume inapplicability. Some illustrations may diverge from Y14 drawing practices to clarify the meanings of principles.

1.1.5 Notes

Notes herein in capital letters are intended to appear on finished drawings. Notes in lowercase letters are explanatory only and are not intended to appear on drawings.

1.1.6 Reference to Gaging

This document is not intended as a gaging standard. Any reference to gaging is included for explanatory purposes only. For gaging principles see ASME Y14.43 Dimensioning and Tolerancing Principles for Gages and Fixtures.

1.1.7 Symbols

Adoption of symbols indicating dimensional requirements, as shown in Fig. C-2 of Nonmandatory Appendix C, does not preclude the use of equivalent terms or abbreviations where symbology is considered inappropriate.

1.2 REFERENCES

The following revisions of American National Standards form a part of this Standard to the extent specified herein. A more recent revision may be used provided there is no conflict with the text of this Standard. In the event of a conflict between the text of this Standard and the references cited herein, the text of this Standard shall take precedence.

1.2.1 Cited Standards

ANSI/ASME B89.6.2-1973 (R2003), Temperature and Humidity Environment for Dimensional Measurement

ANSI/ASME B94.6-1984 (R2003), Knurling

ANSI B4.2-1978 (R2004), Preferred Metric Limits and Fits