The American Society of Mechanical Engineers

AN AMERICAN NATIONAL STANDARD

ACME SCREW THREADS

ASME B1.5-1997
(Revision of ASME/ANSI B1.5-1988)

Date of Issuance: December 6, 1999

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

FOREWORD

When created prior to 1895, Acme screw threads were intended to replace square threads and a variety of threads of other forms used chiefly for the purpose of traversing motion on machines, tools, etc. Acme screw threads are now extensively used for a variety of purposes. Long-length Acme threads are used for controlled movements on machine tools, testing machines, jacks, aircraft flaps, and conveyors. Short-length threads are used on valve stems, hose connectors, bonnets on pressure cylinders, steering mechanisms, and camera lens movement.

The Standards Committee on the Standardization and Unification of Screw Threads, B1, was organized in June 1921, with the Society of Automotive Engineers and the American Society of Mechanical Engineers as joint sponsors under the procedure of the American Standards Association (ASA), now the American National Standards Institute (ANSI). This Committee was reorganized in May 1929, and its work was divided among five Subcommittees as follows: No. 1 on Scope and Arrangement of American Standard; No. 2 on Terminology and Form of Thread, Except Gages; No. 3 on Special Threads and Twelve Pitch Series, Except Gages; No. 4 on Acme Threads, Except Gages; and No. 5 on Screw Thread Gages.

National standardization of Acme screw threads in the United States was begun in 1932 when Subcommittee No. 4 on Acme Threads of Standards Committee B1 held its first meeting in New York. A report was presented on the types of Acme threads and the range of sizes and pitches in use in this country. It was prepared by C. W. Bettcher with the assistance of F. L. Woodcock. This report developed into a draft standard and was finally approved as an American Standard with the designation ASA B1.3-1941. It contained a section of introductory notes, and tables covering general purpose screws and general purpose nuts, basic dimensions of general purpose Acme threads with special and standard pitches, basic dimensions of 29 deg stub thread, measurements over three wires for Acme threads, basic dimensions of 60 deg stub thread, and basic proportions for modified square thread.

In December 1942, to meet the war emergency, the National Aircraft Standards Committee of the Aeronautical Chamber of Commerce requested the ASA to consider the setting up of an American War Standard for special Acme screw threads for use in aircraft construction. Recognizing the vital importance of aircraft production to the war effort, the ASA initiated this project at once and organized a Special Committee to develop the Standard. Drafts of this proposed American War Standard were submitted, first on behalf of the National Aircraft Standards Committee and later by D. R. Miller of the National Bureau of Standards. The latter draft, which was submitted also to the Interdepartmental Screw Thread Committee established by the U.S. Departments of War, Navy, and Commerce, served as the basis for the development of the American War Standard. The final draft, dated November 20, 1944, was unanimously approved by the members of the ASA War Committee on Acme Threads and the General ASA War Committee on Screw Threads. This draft received final ASA approval on January 9, 1945, and was designated American War Standard B1.5-1945.

In April 1946, the Subcommittees of the Standards Committee were reorganized to take over the job of the ASA War Committees. Subcommittee No. 2 on Acme and Stub Acme Threads revised the War Standard on Acme Screw Threads and, on March 31, 1948, distributed the January 1948 draft to industry for criticism and comment.

The final draft of the proposed revision to the 1945 Edition of this Standard was completed in June 1951. It was submitted to Standards Committee B1 for letter ballot on September 17, 1951, and was approved with minor amendments. Following approval by the sponsor organizations, the proposed Standard was submitted to the ASA for approval and designation as an American Standard. This was granted May 7, 1952.

The next revision added the no allowance Class 5G thread. Approval by ANSI was granted on March 26, 1973. Corrections were made in the revision approved May 11, 1977.

Data for Classes 5G, 5C, and 6G was transferred to Appendices D and E for reference, and this revision was approved by ANSI on January 11, 1988.

The present revision to the Standard includes the addition of gage tables and drawings for Gaging Systems 21, 22, and 23, table changes to conform to ASME B1.30M, lead and angle tolerances for product threads, measurement uncertainty values for Acme thread gages, and descriptions and drawings for indicating gages. The pitch diameter compensation table and text were deleted and replaced with data on standard gage blanks for gage length with text on pitch diameter adjustment for gage length over two diameters. Table values of gage dimensions for general purpose and centralizing Acme threads were added, along with formulas to determine diameters of multiple-start threads. Recommendation in the use of formulas and examples to calculate pitch diameter measurement over wires was revised. Additionally, the Appendix contains revision of alternate centralizing Acme threads and of multiple-start threads, and was expanded to include ball measurement of internal pitch diameter, limit gaging of setting ring gages, gaging of problem areas, Acme tolerances over 5 in., and means for determining limits of size for special diameter/pitch combinations.

This Standard was approved by the American National Standards Institute on December 9, 1997.

ASME STANDARDS COMMITTEE B1
Screw Threads

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

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E. Schwartz, Consultant

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ACME SCREW THREADS

1 GENERAL

This Standard provides for two general applications of Acme threads: namely, general purpose and centralizing.

The limits and tolerances in this Standard relate to single-start Acme threads and may be used, if considered suitable, for multiple-start Acme threads. The latter threads are used to provide relatively fast traversing motion when necessary.

The three classes (2G, 3G, and 4G) of general purpose threads have clearances on all diameters for free movement. This thread relies on the thread flanks to maintain concentric operation.

The three classes of centralizing threads have a limited clearance at the major diameters of the external and internal threads so that a bearing at the major diameter maintains approximate alignment of the thread axis and prevents wedging on the flanks of the threads.

For any combination of the three classes of threads covered in this Standard, some end play or backlash will result. This is unavoidable for interchangeable products. When backlash or end play is objectionable, some mechanical means should be provided to eliminate the condition. In any case, sufficient end play must be left to provide a close running fit.

In addition to limiting dimensions for the standard series of diameters and pitches of Acme single-start threads, tables of tolerances, in terms of pitch and diameter, provide for a wide choice of diameters for a given standard pitch. By using the formulas for diameter and pitch increments, the pitch diameter tolerances for special diameters and pitches can be determined for each class. Formulas and data are also provided for allowances on external threads and major and minor diameter allowances and tolerances.

The Appendices provide text and dimensions on the following:

(a) Alternate Centralizing Acme Threads. Appendix A uses the minor diameter to ensure concentric operation.

(b) Multiple-Start Acme Threads. Appendix B includes formulas for limits of size. Multiple-start threads may require additional allowances and/or tolerances for satisfactory operation.

(c) General Purpose Acme Threads, Class 5G. See Appendix C.

(d) Centralizing Acme Threads, Classes 5C and 6C. See Appendix D.

(e) Three-Wire Method of Measurement of Pitch Diameter of 29 deg External Acme Screw Threads. See Appendix E.

(f) Ball Methods for Internal Pitch Diameter Measurement of 29 deg Acme Screw Threads. See Appendix F.

(g) Go Gage Compensation, Calculation of Flank Angle, Limit Gaging of Setting Rings, and Gaging Problem Areas. See Appendix G.

(h) Tolerances for Acme Screw Thread Gages Over 5 in. See Appendix H.

(i) Determining Limits of Size for Special Diameter/Pitch Combinations. See Appendix I.

1.1 Scope

This Standard provides specifications, formulas, and tables.

1.2 Federal Government Use

When this Standard is approved by the Department of Defense and federal agencies and is incorporated into FED-STD-H28/12, Screw Thread Standards for Federal Services, Section 12, the use of this Standard by the federal government is subject to all the requirements and limitations of FED-STD-H28/12.

1.3 References

The latest issues of the following publications form part of this Standard to the extent specified herein.

ASME B1 Technical Report: Measurement Uncertainty for 60 deg Screw Thread Gage Element

ASME B1.2, Gages and Gaging for Unified Inch Screw Threads

ASME B1.3M, Screw Thread Gaging Systems for Dimensional Acceptability — Inch and Metric Screw Threads (UN, UNR, UNJ, M, and MJ)

ASME B1.7M, Nomenclature, Definitions, and Letter Symbols for Screw Threads

ASME B1.30M, Screw Threads — Standard Practice for Calculating and Rounding Dimensions

ASME B47.1, Gage Blanks

Publisher: The American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016; Order Department: 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300

1.4 Reference Temperature

The reference temperature is 68°F (20°C) for dimensions listed.

1.5 Units of Measure

All dimensions and values are expressed in inches unless otherwise noted.

1.6 Terminology

Definitions, terms, and symbols relating to Acme screw threads are found in ASME B1.7M. Explanation of ISO fundamental deviation symbols used for allowance in this Standard are:

EI: lower deviation, internal thread allowance (fundamental deviation).

es: upper deviation, external thread allowance (fundamental deviation); es is always negative for an allowance fit or zero for no allowance.

1.7 Computer-Generated Size

All computer-generated values for standard sizes herein are identical to previous Acme publications. For a nonstandard nominal size, D, apply the next larger nominal size given in the table. For computer calculation of Acme product and gage size or tolerance, use ASME B1.30M and formulas herein. Parties should be advised in contract.

2 SPECIFICATIONS FOR GENERAL PURPOSE ACME SCREW THREADS

2.1 Angle of Thread

The included angle between the flanks of the thread, measured in an axial plane, shall be 29 deg. The line bisecting this 29 deg angle shall be perpendicular to the axis of the screw thread.

2.2 Pitch and Lead of Thread

The pitch of the thread is the distance, measured parallel to its axis, between corresponding points on adjacent thread forms. The lead of a thread is the distance traversed in one revolution of a screw thread. On multiple-start threads, the lead equals pitch multiplied by the number of starts.

2.3 Height of Thread

The basic height of the thread is equal to one-half of the pitch.

2.4 Thickness of Thread

The basic thickness of the thread profile at the pitch line is one-half of the pitch.

2.5 Allowance (Minimum Clearance) at Major and Minor Diameters

A minimum diametral clearance is provided at the minor diameter of all threads by establishing the maximum minor diameter of the external thread 0.020 in. less than the basic minor diameter for 10 threads/in. and coarser, and 0.010 in. less for finer pitches.

A minimum diametral clearance at the major diameter is obtained by establishing the minimum major diameter of the internal thread 0.020 in. greater than the basic major diameter for 10 threads/in. and coarser, and 0.010 in. greater for finer pitches.

2.6 Chamfers and Fillets

External threads may have the crest corners chamfered at an angle of 45 deg with the axis to a maximum depth of $P/15$. This corresponds to a maximum width of chamfer flat of $0.0945P$.

The internal and external threads may have optional fillets; see Fig. 3.

2.7 Basic Thread Form Dimensions

The basic dimensions of the Acme thread form for the most generally used pitches are given in Table 1. The basic thread profile is symmetrical and is illustrated in Fig. 1. Design profiles are shown in Fig. 2.

2.8 General Purpose Standard Acme Thread Series

A selected series of diameters and associated pitches of Acme threads, listed in Table 2, are recommended as preferred. These diameters and pitches have been carefully selected to meet present needs with the fewest number of items in order to reduce to a minimum the inventory of both tools and gages. For sizes over 5 in., see Appendix H.