ASME/ANSI B1.12–1987

(REVISION OF ANSI B1.12–1972)

REAFFIRMED 2018

Class 5 Interference-Fit Thread

The American Society of Mechanical Engineers

AN AMERICAN NATIONAL STANDARD

Class 5 Interference-Fit Thread

ASME/ANSI B1.12–1987

(REVISION OF ANSI B1.12–1972)

The American Society of Mechanical Engineers

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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.

FOREWORD

(This Foreword is not part of ASME/ANSI B1.12-1987.)

Interference-fit threads are threads in which the externally threaded member is larger than the internally threaded member when both members are in the free state and which, when assembled, become the same size and develop a holding torque through elastic compression, plastic movement of material, or both. By custom, these threads are designated as Class 5.

Tentative Class 5 fit threads were first published by the National Screw Thread Commission (1928), and alternate Class 5 appeared in the 1944 Handbook H28. These standards were helpful in stabilizing design; however, in spite of restrictive tolerances, loosening or breakage of externally threaded members has been all too frequent. Also, minimum and maximum torque values were established, the validity of which has been generally accepted.

The tentative and alternate standards, which were based on National Bureau of Standards and industry research, testing, and field study, represent the first attempt to establish an American standard for interference-fit threads. These specifications are published in Appendix A. In 1947, ASA Sectional Committee B1 on Screw Threads established Subcommittee 10 under the chairmanship of Harry Marchant to study the problems of interference fits. A subgroup of the subcommittee, chaired by W. S. Brown, conducted a comprehensive survey of design, production, and driving practices in the automotive, implement, railroad, and fastener industries and found that all were experiencing difficulty. Typical problems were:

(*a*) the variety of materials and heat treatments used for externally threaded members;

(*b*) variations resulting from rolling, cutting, or grinding external threads;

(*c*) the huge variety of chemical analyses and physical and mechanical properties encountered in the forged, cast, die cast, and rolled materials into which the externally threaded members are driven;

(*d*) the widely varying effects of chemical coatings, platings, and lubricants; and

(*e*) the inability to closely control sizes of tapped holes in various materials.

It was impossible to establish a standard at that time, but it was agreed that interference-fit threads could not be eliminated in design of equipment and that a workable standard was essential.

In 1951, Subcommittee 10, later renumbered 12, established a research subgroup which conducted extensive tests under a variety of conditions. The work of this research subgroup and a report of subsequent research and field experience is described in the article "New Class 5 Interference Fit Thread" by W. G. Waltermire, which appeared in the September 6, 1956 issue of *Machine Design*.

This Trial American Standard was predicated on the following conclusions, which were drawn from the research and field experience for developing holding torque through plastic movement of materials.

(*a*) Materials of the external and internal interference-fit threads compress elastically and flow during assembly and when assembled.

(*b*) During driving, plastic flow of materials occurs, resulting in either an increase of the external thread major diameter or a decrease in the internal thread minor diameter, or both.

(*c*) Relieving the external thread major diameter and the internal thread minor diameter to make allowance for plastic flow eliminates the main causes of seizing, galling, and abnormally high and erratic driving torques.

(*d*) Relieving the major diameter of external threads and minor diameter of internal threads requires an increase in the pitch diameter interference in order to obtain driving torques within the range established. (In driving studs, it was found that the minimum driving torque should be about 50% greater than the torque required to break loose a properly tightened nut.)

(*e*) Lubricating only the internal thread results in more uniform torques than lubricating only the external thread and is almost as beneficial as lubricating both external and internal threads. Some applications do not permit lubrication.

(*f*) For threads having truncated profile, torque increases directly as the pitch diameter interference for low interferences, but torque soon becomes practically constant and increases little, if at all, with increases of interference. Obviously, for uniformity of driving torques, it is desirable to work with greater interferences, resulting in plastic flow of materials.

(*g*) Comparatively large pitch diameter interferences can be tolerated, provided the external thread major diameter and internal thread minor diameter are adequately relieved and proper lubrication is used during assembly.

(*h*) Driving torque increases with turns of engagement, but levels off after the assembly is well advanced. (For thin wall applications, it may be desirable to use longer engagement and smaller pitch diameter interference to obtain desired driving torque.)

(*i*) Studs should be driven to a predetermined depth. Bottoming or shouldering must be avoided. *Bottoming*, which is engagement of the threads of the stud with the imperfect threads at the bottom of a shallow drilled and tapped hole, causes the stud to stop suddenly during power driving, thus inviting failure in torsional shear. Slipping clutches may permit transmission of excess torque. Bottoming can also damage parts having only a weak diaphragm at the bottom of the hole, through either mechanical or hydrostatic compression. *Shouldering*, which is the practice of driving the stud until the thread runout engages with the top threads of the hole, may create excessive radial compressive stresses and upward bulging of the material at the top of the hole. The torque, or stud holding power, produced by these radial compressive stresses is considerably relieved when the tensile load is applied to the stud, and may be inadequate to prevent backout in service.

The Trial American Standard was issued in November 1959. On October 23, 1961, the subcommittee reviewed the standard and recommended republication, without technical change, as an American Standard. It was felt that the lack of adverse comment after 2 years existence as a Trial Standard, and the reception of favorable comments of usage, warranted this step. On May 16, 1963, the standard was formally designated an American Standard. Several errors were discovered and B1.12 was rewritten. It was approved on September 5, 1972.

The most recent research on interference-fit thread was conducted by the Portsmouth Naval Shipyard on both hardened steel and nickel–copper–aluminum (K Monel) studs assembled in alloy steel (HY-80), corrosion resistant steel, nickel–copper (Monel), copper–nickel, and nickel–chromium (Inconel) internal threads, and on nonferrous studs in nonferrous internal threads. They modified the B1.12 Class 5 specifications for plastic flow interference-fit threads when nickel–copper–aluminum external threads are assembled in many materials. They also provided more cavity space. A summary of their findings for developing holding torque through plastic flow and elastic compression of material follows.

(*a*) Pitch diameter interferences specified in ANSI B1.12 were found to be too large, resulting in excessive failures.

(*b*) Lead, flank angles, taper, straightness, and roundness are important.

(*c*) Optimum surface roughness is 63 μin. Ra.

(*d*) Difference between functional size and pitch diameter of both the internal and external threads are measured and may not exceed 50% of the pitch diameter tolerances. (One foreign standard specifies 25%.)

(*e*) Critical applications require selective fits, using measured pitch diameters on the external and internal threads, to obtain a specified interference when the external and internal threads are assembled.

(*f*) Assembly torque cannot be continuous. Several waiting periods are required to let friction heat dissipate.

(*g*) Studs are indexed to monitor their movement. Assembly is considered a failure if there is stud rotation when seating the prevailing torque nut or breaking it away.

These Portsmouth Naval Shipyard thread specifications are published in Appendix B for elastic interference where permanent distortion is not desired and Appendix C for plastic flow interference with extra allowance at both the crest and root for K Monel.

This Standard was approved as an American National Standard on July 13, 1987.

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Standardization and Unification of Screw Threads

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CLASS 5 INTERFERENCE-FIT THREAD

1 GENERAL

1.1 Scope

This Standard provides dimensional tables for external and internal plastic flow interference-fit (Class 5) threads of modified National thread form in the coarse thread series (NC) in sizes 0.250 in. through 1.500 in. This is not the ANSI B1.1 UN thread form. It is intended that designs conforming with this Standard will provide adequate torque conditions which fall within the limits shown in Table 8. The minimum torques are intended to be sufficient to insure that externally threaded members will not loosen in service; the maximum torques establish a ceiling below which seizing, galling, or torsional failure of the externally threaded components is reduced. This Standard provides for the maximum allowable interference.

Appendices A, B, C, and D contain useful information that is supplementary to this Standard, such as reprints of the obsolete tentative and alternate Class 5 standards, U.S. Navy ship specifications for elastic interference-fit coarse thread series from 0.250 in. through 2.000 in., U.S. Navy ship specifications for Class 5 Modified which includes nickel–copper–aluminum alloy external threads, and an interference metal comparison of standard to nonstandard interference-fit threads.

1.2 Field of Application

Interference-fit threads provide a high degree of resistance against turning of studs when prevailing torque nuts are used and against loosening of studs caused by load cycling and vibration. These threads are not intended for use where regular removal for component maintenance is required.

1.3 Reference Documents

1.3.1 American National Standards. The latest issues of the following standards form a part of this Standard to the extent specified herein.

ANSI B1.1
Unified Inch Screw Threads (UN and UNR Thread Form)

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

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

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

ANSI B94.9
Taps—Cut and Ground Threads

1.3.2 Other References

Metal Cutting Tool Institute.[1] *Taps, Ground Thread, Standards and Dimensions.* Cleveland, 1983.

Society of Manufacturing Engineers.[2] *Tool and Manufacturing Engineers Handbook—Volume 1, Machining.*

American Society for Metals.[3] *Metals Handbook—Volume 3, Machining.*

Metal Cutting Tool Institute.[1] *Metal Cutting Tool Handbook.*

Waltermire, W. G. ''New Class 5 Interference Fit Thread.'' *Machine Design* (September 6, 1956): 83–96.

1.4 Acceptability

Acceptability of product screw threads, based on the gaging method specified, shall be in accordance with ANSI/ASME B1.3M. Gages and gaging are in accordance with ANSI/ASME B1.2 but with gaging dimensions as specified in Tables 11 and 12. See paras. 11.1.1, 11.1.2, and 11.1.3.

[1] 1230 Keith Building, Cleveland, Ohio 44115-2180.

[2] One SME Drive, P.O. Box 930, Dearborn, Michigan 48128.

[3] Metals Park, Ohio 44073.