

**ASME B1.13M-2005**  
(Revision of ASME B1.13M-2001)

# **Metric Screw Threads: M Profile**

ASMENORMDOC.COM : Click to view the full PDF of ASME B1.13M 2005

**AN AMERICAN NATIONAL STANDARD**



The American Society of  
Mechanical Engineers

Intentionally left blank

ASMENORMDOC.COM : Click to view the full PDF of ASME B1.13M 2005

**ASME B1.13M-2005**  
(Revision of ASME B1.13M-2001)

# **Metric Screw Threads: M Profile**

ASMENORMDOC.COM : Click to view the full PDF of ASME B1.13M 2005

**AN AMERICAN NATIONAL STANDARD**



**The American Society of  
Mechanical Engineers**

Three Park Avenue • New York, NY 10016

Date of Issuance: March 10, 2006

The next edition of this Standard is scheduled for publication in 2010. There will be no addenda or written interpretations of the requirements of this Standard issued to this edition.

ASME is the registered trademark of The American Society of Mechanical Engineers.

This code or standard was developed under procedures accredited as meeting the criteria for American National Standards. The Standards Committee that approved the code or standard was balanced to assure that individuals from competent and concerned interests have had an opportunity to participate. The proposed code or standard was made available for public review and comment that provides an opportunity for additional public input from industry, academia, regulatory agencies, and the public-at-large.

ASME does not "approve," "rate," or "endorse" any item, construction, proprietary device, or activity.

ASME does not take any position with respect to the validity of any patent rights asserted in connection with any items mentioned in this document, and does not undertake to insure anyone utilizing a standard against liability for infringement of any applicable letters patent, nor assumes any such liability. Users of a code or standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

Participation by federal agency representative(s) or person(s) affiliated with industry is not to be interpreted as government or industry endorsement of this code or standard.

ASME accepts responsibility for only those interpretations of this document issued in accordance with the established ASME procedures and policies, which precludes the issuance of interpretations by individuals.

No part of this document may be reproduced in any form,  
in an electronic retrieval system or otherwise,  
without the prior written permission of the publisher.

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

Copyright © 2006 by  
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS  
All rights reserved  
Printed in U.S.A.

# CONTENTS

|                                                                                              |           |
|----------------------------------------------------------------------------------------------|-----------|
| Foreword .....                                                                               | vi        |
| Committee Roster .....                                                                       | viii      |
| <b>1 General</b> .....                                                                       | <b>1</b>  |
| 1.1 Scope .....                                                                              | 1         |
| 1.2 Interchangeability .....                                                                 | 1         |
| 1.3 References .....                                                                         | 1         |
| 1.4 Acceptability .....                                                                      | 1         |
| 1.5 Reference Temperature .....                                                              | 1         |
| 1.6 General Symbols .....                                                                    | 1         |
| 1.7 Units .....                                                                              | 1         |
| 1.8 Federal Government Use .....                                                             | 1         |
| <b>2 Terminology</b> .....                                                                   | <b>2</b>  |
| 2.1 Definitions .....                                                                        | 2         |
| <b>3 Screw Thread Profile</b> .....                                                          | <b>4</b>  |
| 3.1 Basic M Thread Profile .....                                                             | 4         |
| 3.2 Design M Profiles .....                                                                  | 6         |
| 3.3 Crest and Root Forms .....                                                               | 6         |
| <b>4 Series of Threads</b> .....                                                             | <b>6</b>  |
| 4.1 Standard Coarse Pitch General Purpose and Mechanical Fastener<br>Series, M Profile ..... | 6         |
| 4.2 Standard Fine Pitch M Profile Screw Threads .....                                        | 7         |
| 4.3 Preferred Sizes .....                                                                    | 7         |
| 4.4 ISO Metric Thread Series .....                                                           | 7         |
| <b>5 Allowances and Tolerances</b> .....                                                     | <b>7</b>  |
| 5.1 ISO System of Limits and Fits as Applied to Screw Threads .....                          | 7         |
| 5.2 Tolerance Grade .....                                                                    | 11        |
| 5.3 Tolerance Position .....                                                                 | 12        |
| 5.4 Allowance/Tolerance Formulas and Tables .....                                            | 12        |
| 5.5 Selected Tolerance Classes .....                                                         | 12        |
| 5.6 Length of Thread Engagement .....                                                        | 12        |
| 5.7 Circular Runout .....                                                                    | 12        |
| 5.8 Lead and Flank Angle Tolerances .....                                                    | 12        |
| 5.9 Coated or Plated Threads .....                                                           | 12        |
| <b>6 Design Formulas and Tabulated Values for Allowances and Tolerances</b> .....            | <b>12</b> |
| 6.1 General .....                                                                            | 12        |
| 6.2 Rounding Procedure for Tabulated Values .....                                            | 12        |
| 6.3 Allowances (Fundamental Deviations) .....                                                | 15        |
| 6.4 Length of Thread Engagement .....                                                        | 15        |
| 6.5 Crest Diameter Tolerances .....                                                          | 15        |
| 6.6 Pitch Diameter Tolerances .....                                                          | 15        |
| <b>7 Designation of Screw Threads</b> .....                                                  | <b>19</b> |
| 7.1 General .....                                                                            | 19        |
| 7.2 Designation of Standard Screw Threads .....                                              | 19        |

|                |                                                                                                                                                             |           |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 7.3            | Designation of Thread Fit .....                                                                                                                             | 20        |
| 7.4            | Designation of Rounded Root External Thread .....                                                                                                           | 20        |
| 7.5            | Designation of Threads Having Modified Crests .....                                                                                                         | 20        |
| 7.6            | Designation of Special Threads .....                                                                                                                        | 20        |
| 7.7            | Designation of Multiple Start Threads .....                                                                                                                 | 20        |
| 7.8            | Designation of Coated or Plated Threads .....                                                                                                               | 20        |
| 7.9            | Designation of Threads With Adjusted Size Limits .....                                                                                                      | 20        |
| <b>8</b>       | <b>Dimensional Accommodation of Coating or Plating for 60 deg Threads .....</b>                                                                             | <b>21</b> |
| 8.1            | Introduction .....                                                                                                                                          | 21        |
| 8.2            | Material Limits for Coated Threads .....                                                                                                                    | 21        |
| 8.3            | Dimensional Effects of Coating .....                                                                                                                        | 21        |
| 8.4            | External Thread With Allowance Available for Coating .....                                                                                                  | 21        |
| 8.5            | External Thread With No Allowance for Coating .....                                                                                                         | 23        |
| 8.6            | Internal Threads .....                                                                                                                                      | 24        |
| 8.7            | Electrodeposited Coatings .....                                                                                                                             | 24        |
| 8.8            | Other Considerations .....                                                                                                                                  | 25        |
| <b>9</b>       | <b>Limits of Size .....</b>                                                                                                                                 | <b>25</b> |
| 9.1            | Standard Thread Series .....                                                                                                                                | 25        |
| 9.2            | Determination of Size Limits .....                                                                                                                          | 25        |
| 9.3            | Formulas for Calculating Limiting Dimensions for M Profile<br>Screw Threads .....                                                                           | 25        |
| 9.4            | Examples of Calculations of Size Limits .....                                                                                                               | 34        |
| <b>10</b>      | <b>Lead and Flank Angle Tolerances .....</b>                                                                                                                | <b>37</b> |
| 10.1           | Lead and Flank Angle Acceptance .....                                                                                                                       | 37        |
| <b>Figures</b> |                                                                                                                                                             |           |
| 1              | Basic M Thread Profile (ISO 68-1 Basic Profile) .....                                                                                                       | 4         |
| 2              | Internal Thread, Design M Profile With No Allowance (Fundamental<br>Deviation) (Maximum Material Condition) .....                                           | 5         |
| 3              | External Thread, Design M Profile With No Allowance (Fundamental<br>Deviation) (Flanks at Maximum Material Condition) .....                                 | 5         |
| 4              | Metric Tolerance System for Screw Threads .....                                                                                                             | 6         |
| 5              | M Profile, External Thread Root, Upper and Lower Limiting Profiles for<br>$r_{min.} = 0.125P$ and for Flat Root Form (Shown for Tolerance Position g) ..... | 7         |
| 6              | Ratio of Pitch Diameter Change to Thickness of Coating on 60 deg<br>Threads .....                                                                           | 22        |
| 7              | Effects of Electrodeposited Coating on 60 deg External Threads .....                                                                                        | 23        |
| 8              | Internal Thread — Limiting M Profile, Tolerance Position $H$ .....                                                                                          | 34        |
| 9              | External Thread — Limiting M Thread Profile .....                                                                                                           | 37        |
| <b>Tables</b>  |                                                                                                                                                             |           |
| 1              | General Symbols .....                                                                                                                                       | 2         |
| 2              | Thread Data, M Profile .....                                                                                                                                | 3         |
| 3              | Limit Values for M Profile Minimum Rounded Root Radius .....                                                                                                | 8         |
| 4              | Standard Coarse Pitch M Profile General Purpose and Mechanical<br>Fastener Series .....                                                                     | 8         |
| 5              | Standard Fine Pitch M Profile Screw Threads .....                                                                                                           | 8         |
| 6              | ISO 261 Diameter/Pitch Combinations From Which the Standards<br>Were Selected .....                                                                         | 9         |
| 7              | Length of Thread Engagement (ISO 965-1) .....                                                                                                               | 13        |
| 8              | Examples of Tolerance Classes Required for Normal Gage Length Contacts<br>With Various Thread Engagement Lengths .....                                      | 14        |
| 9              | Minor Diameter Tolerances of Internal Thread, $TD_1$ (ISO 965-1) .....                                                                                      | 14        |
| 10             | Major Diameter Tolerances of External Thread, $Td$ (ISO 965-1) .....                                                                                        | 15        |

|     |                                                                                          |    |
|-----|------------------------------------------------------------------------------------------|----|
| 11  | Pitch Diameter Tolerance of External Thread, $Td_2$ (ISO 965-1) .....                    | 16 |
| 12  | Pitch Diameter Tolerance of Internal Thread, $TD_2$ (ISO 965-1) .....                    | 17 |
| 13  | Allowance (Fundamental Deviation) for Internal and External Threads<br>(ISO 965-1) ..... | 18 |
| 14  | External Thread — Limiting Dimensions M Profile .....                                    | 26 |
| 15  | Internal Thread — Limiting Dimensions M Profile .....                                    | 35 |
| 16A | Example of External Screw Thread, Standard Size .....                                    | 39 |
| 16B | Example of Internal Metric Screw Thread, Standard Size .....                             | 41 |
| 16C | Example of External Metric Screw Thread, Non-Standard Size .....                         | 43 |
| 16D | Example of Internal Metric Screw Thread, Non-Standard Size .....                         | 45 |
| 17  | Allowable Variations in Lead and Equivalent Change in Functional<br>Diameter .....       | 47 |
| 18  | Allowable Variations in 30 deg Basic Half-Angle of Screw Threads .....                   | 50 |

#### **Nonmandatory Appendices**

|   |                                                                              |    |
|---|------------------------------------------------------------------------------|----|
| A | Standard Rules for Rounding .....                                            | 51 |
| B | Thread Strength Design Formulas .....                                        | 52 |
| C | Limiting Dimensions M Profile Screw Threads — Inch Translation .....         | 53 |
| D | Basic Dimensions for ISO Series Metric Screw Threads From ISO 724 .....      | 64 |
| E | Overtapped Nut Thread Class 6AX .....                                        | 68 |
| F | Internal Thread Allowance (Fundamental Deviation) Tolerance Position E ..... | 70 |

# FOREWORD

In 1966, ANSI Standards Committee B1 — Standardization and Unification of Screw Threads — started preparation of a document for ISO Metric Screw Threads based on the current ISO recommendations and draft documents. Since there were some uncertainties as to the acceptance of this thread by American industries, the information was published in August 1967 with the title, “Interpretative Document Metric Screw Threads B1.13.” This document was never approved as an ANSI standard.

A revision of the information based on the then current ISO standards and recommendations was published in April 1972 with the title “B1 Report — ISO Metric Screw Threads.” Again, the document was never approved as an ANSI standard. The document number was therefore removed and the status changed to a report.

Interest in metric screw threads has grown at a rapid pace over the past several years with the advent of greater import and export business. The American National Standards Institute, in April 1971, established a committee, ANSI Special Committee to Study Development of an Optimum Metric Fastener System (OMFS). Included in the scope was metric screw threads. Recommendations were submitted to a joint ISO/TC1/TC2 working group established in September 1973 to study the OMFS proposals.

An ISO/TC1/TC2 Ad Hoc Advisory Panel meeting in April 1975 in Munich reached a compromise between the OMFS recommendations and the existing ISO screw thread system. This compromise was approved, in the main, by the ISO/TC1 in its eleventh plenary meeting in Stockholm, June 1976.

(a) The first issue of this Standard, designated ANSI B1.13M, was approved as an American National Standard on February 12, 1979. It provided a system of metric screw threads for general fastening purposes in mechanisms and structures and was in basic agreement with ISO screw thread standards and resolutions current at that time. It featured detailed information for diameter-pitch combinations selected as preferred standard sizes.

(b) The 1983 issue of this Standard was designated ANSI/ASME B1.13M-1983 and was approved as an American National Standard on August 5, 1983. It updated the 1979 issue to include

- (1) the addition of the new ISO tolerance position *f*
- (2) the addition of a section on dimensional accommodation of coating or plating
- (3) the addition of a section on lead and flank angle tolerances

(c) The 1995 issue of this Standard was designated ASME B1.13M-1995 and was approved as an American National Standard on February 20, 1995. It updated the 1983 issue to include

- (1) the addition of an 8 mm pitch series
- (2) the addition of standard size M10 × 1
- (3) the provision for adjustment of internal thread tolerance class for short and long lengths of thread engagement, which may be used instead of external thread class adjustment
- (4) changes in rounding procedures that follow the principles of ASME B1.30M

(d) The 2001 issue of this Standard was designated ASME B1.13M-2001 and was approved as an American National Standard on May 22, 2001. It updated the 1995 issue to include

- (1) incorporation of changes made in the 1998 issue of ISO 261, including addition of diameters 125, 130, and 140 in the 8 mm pitch series; and changing of the 7 mm diameter from 3rd to 2nd choice in Table 6.

(2) recognition of changes made in the 1998 issue of ISO 965-1, including the stating of when International practice permits thread designation without thread class (not USA practice); and modifying the designation of multiple lead threads to be more in line with ISO practice.

(3) incorporation of the new 1998 International Standard, ISO 965-5, by adding Nonmandatory Appendix E for Class AX threads.

(4) minor changes in some thread root diameters due to modified calculation and rounding procedures added in ASME B1.30. ASME B1.30 uses rounding upward when the digit following

the last rounded place is a 5 followed by zeros. Prior to issue of ASME B1.30, rounding was to the nearest even digit. Tabulated values appearing in ISO Standards are not subject to rounding rules of ASME B1.30.

- (5) changes in Circular Runout tolerances.
- (6) other required updates and corrections.
- (e) This issue updates the 2001 edition and includes
  - (1) addition of a new Nonmandatory Appendix F to provide a new tolerance position *E*
  - (2) addition of tolerance class 6h as a preferred class
  - (3) addition of M8 x 1.25 – 6AX to Nonmandatory Appendix E
  - (4) revision of section 8 on “Dimensional Accommodation of Coating or Plating...” to include allowances at thread roots and to expand the information on internal threads
  - (5) revision of section 7 to provide thread designations in accordance with ASME Y14.6-2001
  - (6) revision of some tabulated inch translation values in Nonmandatory Appendix C and the examples of calculation of thread size values in para. 9.4, in accordance with ASME B1.30-2002
  - (7) addition of para. 7.9 for designation of a thread with adjusted size limits
  - (8) other required editorial updates and corrections

Suggestions for improvement of this Standard are welcome. They should be sent to Secretary, ASME B1 Standards Committee, Three Park Avenue, New York, NY 10016-5990.

This revision was approved as an American National Standard on September 29, 2005.

# ASME B1 COMMITTEE

## Standardization and Unification of Screw Threads

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

### STANDARDS COMMITTEE OFFICERS

**A. L. Barrows**, *Chair*  
**D. S. George**, *Vice Chair*  
**A. L. Guzman**, *Secretary*

### STANDARDS COMMITTEE PERSONNEL

|                                                                                     |                                                                                    |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| <b>G. L. Allen</b> , The L. S. Starrett Co.                                         | <b>B. Larzelere</b> , <i>Corresponding Member</i> , Deltronic Corp.                |
| <b>A. L. Barrows</b> , Kennametal-IPG                                               | <b>L. L. Lord</b> , <i>Corresponding Member</i> , Caterpillar, Inc.                |
| <b>F. G. Calderone</b> , <i>Corresponding Member</i> , Quality Systems Implementers | <b>M. H. McWilliams</b> , PMC Lonestar                                             |
| <b>L. N. Dixon, Jr.</b> , General Electric                                          | <b>D. Skierski</b> , <i>Alternate</i> , Sterling Gage and Calibration              |
| <b>R. Dodge</b> , Penney-Dodge Co.                                                  | <b>D. Miskinis</b> , Kennametal-Greenfield                                         |
| <b>G. A. Flannery</b> , <i>Corresponding Member</i> , Mercury Gage Co.              | <b>W. R. Newman</b> , <i>Corresponding Member</i> , Consultant                     |
| <b>H. N. Frost</b> , Defense Supply Center Philadelphia                             | <b>D. R. Oas</b> , Seaway Bolt and Specials Corp.                                  |
| <b>J. O. Gehret III</b> , Vermont Thread Gage                                       | <b>M. W. Rose</b> , Glastonbury Southern Gage                                      |
| <b>D. S. George</b> , Ford Motor Co.                                                | <b>W. A. Watts</b> , <i>Alternate</i> , Glastonbury Southern Gage                  |
| <b>J. R. Gervasi</b> , Kerr Lakeside, Inc.                                          | <b>E. Schwartz</b> , Consultant                                                    |
| <b>J. Greenslade</b> , Greenslade and Co.                                           | <b>R. H. Searr</b> , <i>Member Emeritus</i> , Mak Tool and Gage                    |
| <b>A. L. Guzman</b> , The American Society of Mechanical Engineers                  | <b>B. F. Sheffler</b> , Dresser-Rand Co.                                           |
| <b>R. J. Hukari</b> , SPS Technologies                                              | <b>A. D. Shepherd, Jr.</b> , Emuge Corp.                                           |
| <b>L. C. Johnson</b> , The Johnson Gage Co.                                         | <b>R. D. Strong</b> , General Motors Vehicle Engineering Center                    |
| <b>D. D. Katz</b> , Precision Fittings                                              | <b>A. F. Thibodeau</b> , <i>Member Emeritus</i> , Swanson Tool Manufacturing, Inc. |
| <b>R. P. Knittel</b> , Leitech-US Ltd.                                              | <b>R. E. Vincent, Jr.</b> , General Plug Manufacturing Co.                         |
|                                                                                     | <b>C. J. Wilson</b> , Industrial Fasteners Institute                               |

### SUBCOMMITTEE 13 — METRIC SCREW THREADS

|                                                                                     |                                                                                         |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| <b>E. Schwartz</b> , <i>Chair</i>                                                   | <b>L. L. Lord</b> , <i>Corresponding Member</i> , Caterpillar, Inc.                     |
| <b>D. Miskinis</b> , <i>Vice Chair</i> , Kennametal-Greenfield                      | <b>W. R. Newman</b> , <i>Corresponding Member</i> , Consultant                          |
| <b>A. L. Barrows</b> , Kennametal-IPG                                               | <b>R. D. Strong</b> , General Motors Vehicle Engineering Center                         |
| <b>F. G. Calderone</b> , <i>Corresponding Member</i> , Quality Systems Implementers | <b>A. F. Thibodeau</b> , <i>Corresponding Member</i> , Swanson Tool Manufacturing, Inc. |
| <b>R. Dodge</b> , Penney-Dodge Co.                                                  | <b>R. E. Vincent, Jr.</b> , General Plug Manufacturing Co.                              |
| <b>D. S. George</b> , Ford Motor Co.                                                | <b>C. J. Wilson</b> , Industrial Fasteners Institute                                    |
| <b>J. Greenslade</b> , Greenslade and Co.                                           |                                                                                         |

# METRIC SCREW THREADS: M PROFILE

## 1 GENERAL

### 1.1 Scope

This Standard contains general metric standards for a 60 deg symmetrical screw thread with a basic ISO 68-1 profile designated M profile. The M profile threads of tolerance class 6H/6g are intended for metric applications where inch class 2A/2B have been used. At the minimum material limits, the 6H/6g results in a looser fit than the 2A/2B. Tabular data is also provided for a tighter tolerance fit external thread of class 4g6g, which is approximately equivalent to the inch class 3A but with an allowance applied. Formulation and tolerancing data is included for applications requiring other fits.

NOTE: A 4H5H/4h6h is approximately equivalent to a class 3A/3B fit in the inch system.

### 1.2 Interchangeability

Threads produced to this Standard are fully interchangeable with threads conforming to other National Standards that are based on ISO 68-1 basic profile and ISO 965-1 tolerance practices.

**1.2.1 Assembly.** Threads produced in accordance with M profile and MJ profile (ASME B1.21M) design data will assemble with each other. However, external MJ threads will encounter interference on the root radii with internal M thread crests when both threads are at maximum material condition.

### 1.3 References

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

ASME B1.3, 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 B1.16M, Gages and Gaging for Metric M Screw Threads

ASME B1.21M, Metric Screw Threads: MJ Profile

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

ASME B47.1, Gage Blanks

ASME Y14.5, Dimensioning and Tolerancing

Publisher: The American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, Box 2900, Fairfield, NJ 07007-2900

ASTM F568M, Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

Publisher: The American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

ISO 3, Preferred Numbers — Series of Preferred Numbers

ISO 68-1, ISO General Purpose Screw Threads — Basic Profile — Part 1: Metric Screw Threads

ISO 261, ISO General Purpose Metric Screw Threads — General Plan

ISO 724, ISO Metric Screw Threads — Basic Dimensions

ISO 898-1, Mechanical Properties of Fasteners — Part 1: Bolts, Screws, and Studs

ISO 965-1, ISO General Purpose Metric Screw Threads — Tolerances — Part 1: Principles and Basic Data

Publisher: International Organization for Standardization (ISO), 1 rue de Varembe, Case Postale 56, CH-1211, Genève 20, Switzerland/Suisse

SAE J1199, Mechanical and Material Requirements for Metric Externally Threaded Steel Fasteners

Publisher: Society of Automotive Engineers (SAE), 400 Commonwealth Drive, Warrendale, PA 15096-0001

### 1.4 Acceptability

Acceptability of product threads shall be in accordance with ASME B1.3. Gages and gaging are in accordance with ASME B1.16M.

### 1.5 Reference Temperature

The reference temperature is 20°C for dimensions defined by this system.

### 1.6 General Symbols

The general symbols used to describe the metric screw thread forms are shown in Table 1.

### 1.7 Units

All dimensions and all values in the formulas are expressed in millimeters unless otherwise noted. Values in terms of sharp vee-thread height (height of fundamental triangle),  $H$ , are used to be consistent with ISO Standards, but actual formulations and calculations are based on values of pitch,  $P$ . See Table 2.

### 1.8 Federal Government Use

When this Standard is approved by the Department of Defense and Federal Agencies and is incorporated

Table 1 General Symbols

| Symbol<br>[Note (1)] | Explanation                                                                                                     | Symbol<br>[Note (1)] | Explanation                                                                                                                                                                      |
|----------------------|-----------------------------------------------------------------------------------------------------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $D$                  | Major diameter internal thread                                                                                  | $EI$                 | Lower deviation, internal thread allowance (fundamental deviation). See Fig. 4.                                                                                                  |
| $D_1$                | Minor diameter internal thread                                                                                  | $G, H$               | Letter designations for tolerance positions for lower deviation, internal thread                                                                                                 |
| $D_2$                | Pitch diameter internal thread                                                                                  | $g, h$               | Letter designations for tolerance positions for upper deviation, external thread                                                                                                 |
| $d$                  | Major diameter external thread                                                                                  | $es$                 | Upper deviation, external thread allowance (fundamental deviation). See Fig. 4. In the ISO System, $es$ is always negative for an allowance fit or zero for no allowance.        |
| $d_1$                | Minor diameter external thread                                                                                  | $ei$                 | Lower deviation, external thread [equals the allowance (fundamental deviation) plus the tolerance]. See Fig. 4. In the ISO system, $ei$ is always negative for an allowance fit. |
| $d_2$                | Pitch diameter external thread                                                                                  | $H$                  | Height of fundamental triangle                                                                                                                                                   |
| $d_3$                | Rounded form minor diameter external thread                                                                     | $LE$                 | Length of engagement                                                                                                                                                             |
| $P$                  | Pitch                                                                                                           | $LH$                 | Left hand thread                                                                                                                                                                 |
| $r$                  | External thread root radius                                                                                     |                      |                                                                                                                                                                                  |
| $T$                  | Tolerance                                                                                                       |                      |                                                                                                                                                                                  |
| $TD_1, TD_2$         | Tolerances for $D_1, D_2$                                                                                       |                      |                                                                                                                                                                                  |
| $Td, Td_2$           | Tolerances for $d, d_2$                                                                                         |                      |                                                                                                                                                                                  |
| $ES$                 | Upper deviation, internal thread [equals the allowance (fundamental deviation) plus the tolerance]. See Fig. 4. |                      |                                                                                                                                                                                  |

NOTE:

(1) Subscripts “bsc,” “max.” and “min.” indicate “basic,” “maximum,” and “minimum” sizes, respectively.

into FED-STD-H28/21, *Screw Thread Standards for Federal Services Section 21*, the use of this Standard by the Federal Government is subject to all the requirements and limitations of FED-STD-H28/21.

## 2 TERMINOLOGY

### 2.1 Definitions

**allowance:** the prescribed difference between the design (maximum material) size and the basic size. It is numerically equal to the absolute value of the ISO term *fundamental deviation*.

NOTE: *Allowance* is not an ISO metric screw thread term but will be used together with the ISO term *fundamental deviation*.

**basic thread profile:** the cyclic outline, in an axial plane, of the permanently established boundary between the provinces of the external and internal threads. All deviations are with respect to this boundary. See Figs. 1 and 4.

**bolt thread (external thread):** the term used in ISO metric thread standards to describe all external threads. All symbols associated with external threads are designated with lowercase letters. This Standard will refer only to *external threads* in accordance with U.S. practice.

**crest diameter:** the major diameter of an external thread and the minor diameter of an internal thread.

**design profiles:** the maximum material profiles permitted for external and internal threads for a specified tolerance class. See Figs. 2 and 3.

**deviation:** in ISO usage, the algebraic difference between a size (actual, maximum, minimum, etc.) and the corresponding basic size. The term *deviation* does not necessarily indicate an error.

**fit:** the general term used to signify range of tightness or looseness that results from application of a specific combination of allowances and tolerances in mating parts.

**fundamental deviation:** for standard threads, the deviation (upper or lower) closer to the basic size. It is the upper deviation,  $es$ , for an external thread and the lower deviation,  $EI$ , for an internal thread. See Fig. 4; also see *allowance* and *tolerance position*.

NOTE: The U.S. term *allowance* will be used as a primary term in this Standard, where applicable.

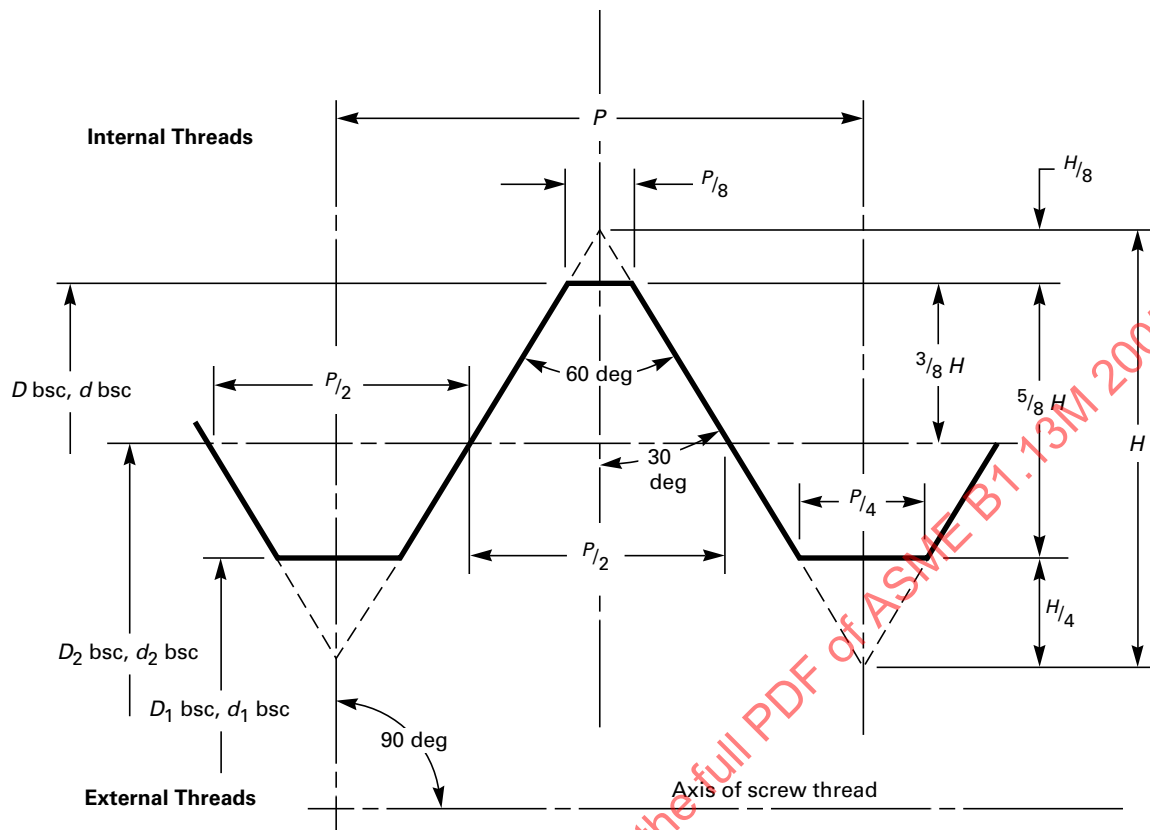
**lower deviation:** the algebraic difference between the minimum limit of size and the corresponding basic size. See para. 5.1.4.

Table 2 Thread Data, M Profile

| Pitch,<br>$P$ | Truncation of<br>Internal<br>Thread Root<br>and External<br>Thread Crest,<br>$\frac{H}{8}$ | Addendum<br>of Internal<br>Thread and<br>Truncation<br>of Internal<br>Thread,<br>$\frac{H}{4}$ | Dependence<br>of Internal<br>Thread and<br>Addendum<br>of External<br>Thread,<br>$\frac{3}{8}H$ | Difference<br>Between Max.<br>Theoretical Pitch<br>Diam. and Max.<br>Minor Diam. of<br>External Thread,<br>and Min.<br>Theoretical Pitch<br>Diam. and Min.<br>Theoretical Pitch<br>Diam. of<br>Internal Thread,<br>$\frac{H}{2}$ | Height of<br>Internal<br>Thread and<br>Depth of<br>Thread<br>Engagement,<br>$\frac{5}{8}H$ | Difference<br>Between<br>Theoretical<br>Pitch Diam.<br>and Min.<br>Design Minor<br>Diam. of<br>External<br>Thread for<br>0.125P Root<br>Radius,<br>$0.711325H$ | Twice the<br>External<br>Thread<br>Addendum,<br>$\frac{3}{4}H$ | Difference<br>Between<br>Max. Major<br>and Max.<br>Theoretical<br>Pitch Diam.<br>of Internal<br>Thread,<br>$\frac{11}{12}H$ | Height of<br>Sharp V-<br>Thread,<br>$H$ | Double<br>Height of<br>Internal<br>Thread,<br>$\frac{5}{4}H$ |
|---------------|--------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|--------------------------------------------------------------|
|               | 0.1082532P                                                                                 | 0.2165064P                                                                                     | 0.3247595P                                                                                      | 0.4330127P                                                                                                                                                                                                                       | 0.5412659P                                                                                 | 0.6160254P                                                                                                                                                     | 0.6495191P                                                     | 0.7938566P                                                                                                                  | 0.8660254P                              | 1.0825318P                                                   |
| 0.2           | 0.02165                                                                                    | 0.04330                                                                                        | 0.06495                                                                                         | 0.08660                                                                                                                                                                                                                          | 0.10825                                                                                    | 0.12321                                                                                                                                                        | 0.12990                                                        | 0.15877                                                                                                                     | 0.17321                                 | 0.21651                                                      |
| 0.25          | 0.02706                                                                                    | 0.05413                                                                                        | 0.08119                                                                                         | 0.10825                                                                                                                                                                                                                          | 0.13532                                                                                    | 0.15401                                                                                                                                                        | 0.16238                                                        | 0.19846                                                                                                                     | 0.21651                                 | 0.27063                                                      |
| 0.3           | 0.03248                                                                                    | 0.06495                                                                                        | 0.09743                                                                                         | 0.12990                                                                                                                                                                                                                          | 0.16238                                                                                    | 0.18481                                                                                                                                                        | 0.19486                                                        | 0.23816                                                                                                                     | 0.25981                                 | 0.32476                                                      |
| 0.35          | 0.03789                                                                                    | 0.07578                                                                                        | 0.11367                                                                                         | 0.15155                                                                                                                                                                                                                          | 0.18944                                                                                    | 0.21561                                                                                                                                                        | 0.22733                                                        | 0.27785                                                                                                                     | 0.30311                                 | 0.37889                                                      |
| 0.4           | 0.04330                                                                                    | 0.08660                                                                                        | 0.12990                                                                                         | 0.17321                                                                                                                                                                                                                          | 0.21651                                                                                    | 0.24641                                                                                                                                                        | 0.25981                                                        | 0.31754                                                                                                                     | 0.34641                                 | 0.43301                                                      |
| 0.45          | 0.04871                                                                                    | 0.09743                                                                                        | 0.14614                                                                                         | 0.19486                                                                                                                                                                                                                          | 0.24357                                                                                    | 0.27721                                                                                                                                                        | 0.29228                                                        | 0.35724                                                                                                                     | 0.38971                                 | 0.48714                                                      |
| 0.5           | 0.05413                                                                                    | 0.10825                                                                                        | 0.16238                                                                                         | 0.21651                                                                                                                                                                                                                          | 0.27063                                                                                    | 0.30801                                                                                                                                                        | 0.32476                                                        | 0.39693                                                                                                                     | 0.43301                                 | 0.54127                                                      |
| 0.6           | 0.06495                                                                                    | 0.12990                                                                                        | 0.19486                                                                                         | 0.25981                                                                                                                                                                                                                          | 0.32476                                                                                    | 0.36962                                                                                                                                                        | 0.38971                                                        | 0.47631                                                                                                                     | 0.51962                                 | 0.64952                                                      |
| 0.7           | 0.07578                                                                                    | 0.15155                                                                                        | 0.22733                                                                                         | 0.30311                                                                                                                                                                                                                          | 0.37889                                                                                    | 0.43122                                                                                                                                                        | 0.45466                                                        | 0.55570                                                                                                                     | 0.60622                                 | 0.75777                                                      |
| 0.75          | 0.08119                                                                                    | 0.16238                                                                                        | 0.24357                                                                                         | 0.32476                                                                                                                                                                                                                          | 0.40595                                                                                    | 0.46202                                                                                                                                                        | 0.48714                                                        | 0.59539                                                                                                                     | 0.64952                                 | 0.81190                                                      |
| 0.8           | 0.08660                                                                                    | 0.17321                                                                                        | 0.25981                                                                                         | 0.34641                                                                                                                                                                                                                          | 0.43301                                                                                    | 0.49282                                                                                                                                                        | 0.51962                                                        | 0.63509                                                                                                                     | 0.69282                                 | 0.86603                                                      |
| 1             | 0.10825                                                                                    | 0.21651                                                                                        | 0.32476                                                                                         | 0.43301                                                                                                                                                                                                                          | 0.54127                                                                                    | 0.61603                                                                                                                                                        | 0.64952                                                        | 0.79386                                                                                                                     | 0.86603                                 | 1.08253                                                      |
| 1.25          | 0.13532                                                                                    | 0.27063                                                                                        | 0.40595                                                                                         | 0.54127                                                                                                                                                                                                                          | 0.67658                                                                                    | 0.77003                                                                                                                                                        | 0.81190                                                        | 0.99232                                                                                                                     | 1.08253                                 | 1.35316                                                      |
| 1.5           | 0.16238                                                                                    | 0.32476                                                                                        | 0.48714                                                                                         | 0.64952                                                                                                                                                                                                                          | 0.81190                                                                                    | 0.92404                                                                                                                                                        | 0.97428                                                        | 1.19078                                                                                                                     | 1.29904                                 | 1.62380                                                      |
| 1.75          | 0.18944                                                                                    | 0.37889                                                                                        | 0.56833                                                                                         | 0.75777                                                                                                                                                                                                                          | 0.94722                                                                                    | 1.07804                                                                                                                                                        | 1.13666                                                        | 1.38925                                                                                                                     | 1.51554                                 | 1.89443                                                      |
| 2             | 0.21651                                                                                    | 0.43301                                                                                        | 0.64952                                                                                         | 0.86603                                                                                                                                                                                                                          | 1.08253                                                                                    | 1.23205                                                                                                                                                        | 1.29904                                                        | 1.58771                                                                                                                     | 1.73205                                 | 2.16506                                                      |
| 2.5           | 0.27063                                                                                    | 0.54127                                                                                        | 0.81190                                                                                         | 1.08253                                                                                                                                                                                                                          | 1.35316                                                                                    | 1.54006                                                                                                                                                        | 1.62380                                                        | 1.98464                                                                                                                     | 2.16506                                 | 2.70633                                                      |
| 3             | 0.32476                                                                                    | 0.64952                                                                                        | 0.97428                                                                                         | 1.29904                                                                                                                                                                                                                          | 1.62380                                                                                    | 1.84808                                                                                                                                                        | 1.94856                                                        | 2.38157                                                                                                                     | 2.59808                                 | 3.24760                                                      |
| 3.5           | 0.37889                                                                                    | 0.75777                                                                                        | 1.13666                                                                                         | 1.51554                                                                                                                                                                                                                          | 1.89443                                                                                    | 2.15609                                                                                                                                                        | 2.27332                                                        | 2.77850                                                                                                                     | 3.03109                                 | 3.78886                                                      |
| 4             | 0.43301                                                                                    | 0.86603                                                                                        | 1.29904                                                                                         | 1.73205                                                                                                                                                                                                                          | 2.16506                                                                                    | 2.46410                                                                                                                                                        | 2.59808                                                        | 3.17543                                                                                                                     | 3.46410                                 | 4.33013                                                      |
| 4.5           | 0.48714                                                                                    | 0.97428                                                                                        | 1.46142                                                                                         | 1.94856                                                                                                                                                                                                                          | 2.43570                                                                                    | 2.72211                                                                                                                                                        | 2.92284                                                        | 3.57235                                                                                                                     | 3.89711                                 | 4.87139                                                      |
| 5             | 0.54127                                                                                    | 1.08253                                                                                        | 1.62380                                                                                         | 2.16506                                                                                                                                                                                                                          | 2.70633                                                                                    | 3.08013                                                                                                                                                        | 3.24760                                                        | 3.96928                                                                                                                     | 4.33013                                 | 5.41266                                                      |
| 5.5           | 0.59539                                                                                    | 1.19079                                                                                        | 1.78618                                                                                         | 2.38157                                                                                                                                                                                                                          | 2.97696                                                                                    | 3.38814                                                                                                                                                        | 3.57236                                                        | 4.36621                                                                                                                     | 4.76314                                 | 5.95392                                                      |
| 6             | 0.64952                                                                                    | 1.29904                                                                                        | 1.94856                                                                                         | 2.59808                                                                                                                                                                                                                          | 3.24760                                                                                    | 3.69615                                                                                                                                                        | 3.89711                                                        | 4.76314                                                                                                                     | 5.19615                                 | 6.49519                                                      |
| 8             | 0.86603                                                                                    | 1.73205                                                                                        | 2.59808                                                                                         | 3.46410                                                                                                                                                                                                                          | 4.33013                                                                                    | 4.92820                                                                                                                                                        | 5.19615                                                        | 6.35685                                                                                                                     | 6.92820                                 | 8.66025                                                      |

GENERAL NOTES:

- (a) All dimensions are in millimeters.  
 (b) Rounding in accordance with ASME B1.30.



GENERAL NOTES:  $H = \frac{\sqrt{3}}{2} \times P = 0.866025 P$

$0.125 H = 0.108253 P$

$0.250 H = 0.216506 P$

$0.375 H = 0.324760 P$

$0.625 H = 0.541266 P$

**Fig. 1 Basic M Thread Profile (ISO 68-1 Basic Profile)**

*nut thread (internal thread):* a term used in ISO metric thread standards to describe all internal threads. All symbols associated with internal threads are designated with uppercase letters. This Standard will refer to the term *internal thread* in accordance with U.S. practice.

*tolerance:* the total amount of variation permitted for the size of a dimension. It is the difference between the maximum limit of size and the minimum limit of size (i.e., algebraic difference between the upper deviation and the lower deviation). The tolerance is an absolute value without sign. Tolerance for threads is applied to the design size in the direction of minimum material. Therefore, tolerances are applied as negative values on external threads and as positive values on internal threads.

*tolerance class:* the combination of a tolerance position with a tolerance grade. It specifies the allowance (fundamental deviation) and tolerance for the pitch and major

diameters of external threads and the pitch and minor diameters of internal threads.

*tolerance grade:* a numerical symbol that designates the tolerances of crest diameters and pitch diameters applied to the design profiles.

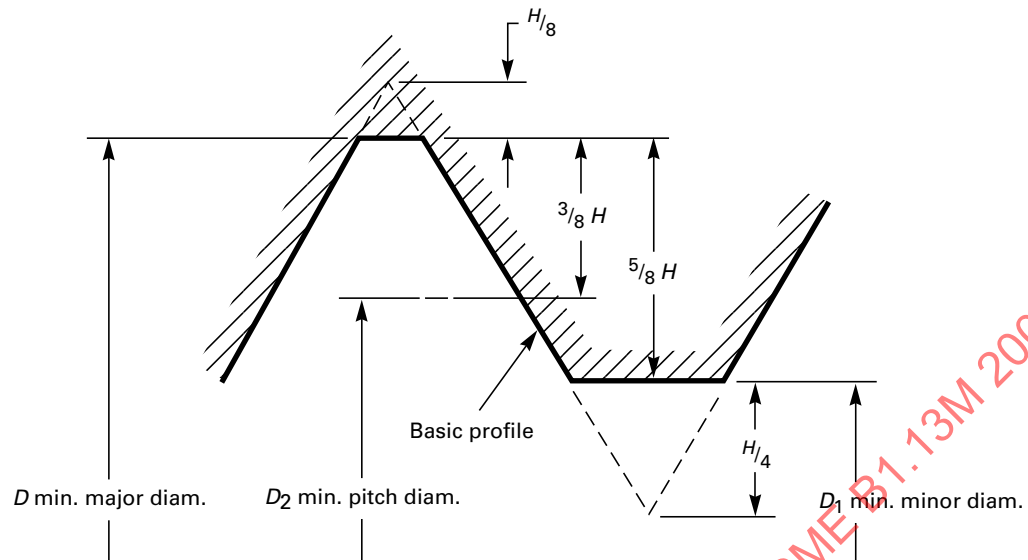
*tolerance position:* a letter symbol that designates the position of the tolerance zone in relation to the basic size. This position provides the allowance (fundamental deviation).

*upper deviation:* the algebraic difference between the maximum limit of size and the corresponding basic size. See para. 5.1.3.

### 3 SCREW THREAD PROFILE

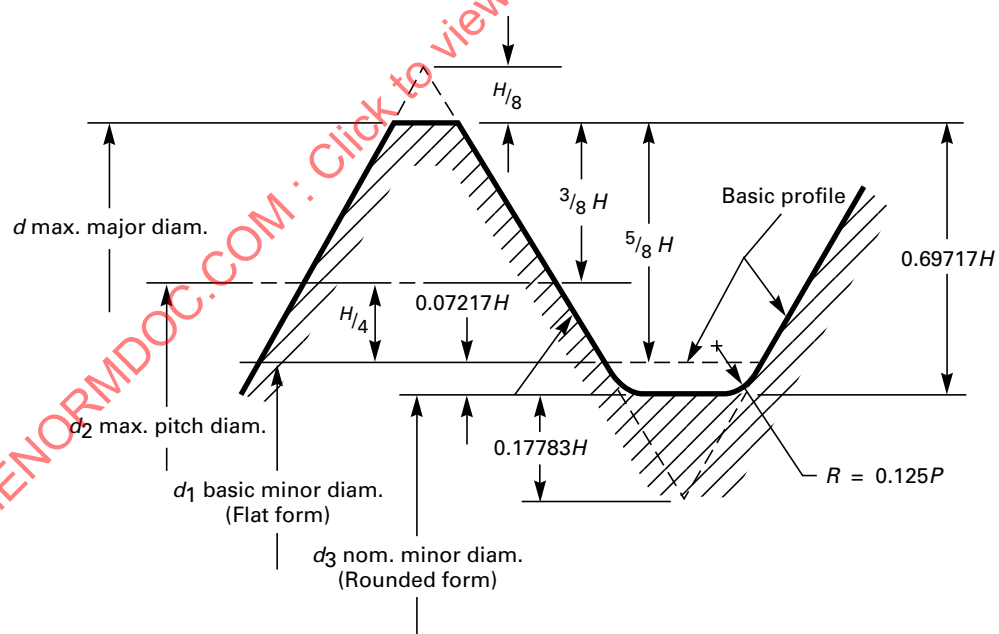
#### 3.1 Basic M Thread Profile

The basic M thread profile also known as the ISO 68-1 Basic Profile for metric screw threads is depicted in Fig. 1 with the associated dimensions listed in Table 2.



GENERAL NOTE: For dimensions, see Table 2.

**Fig. 2 Internal Thread, Design M Profile With No Allowance (Fundamental Deviation) (Maximum Material Condition)**



GENERAL NOTE: For dimensions, see Table 2.

**Fig. 3 External Thread, Design M Profile With No Allowance (Fundamental Deviation) (Flanks at Maximum Material Condition)**

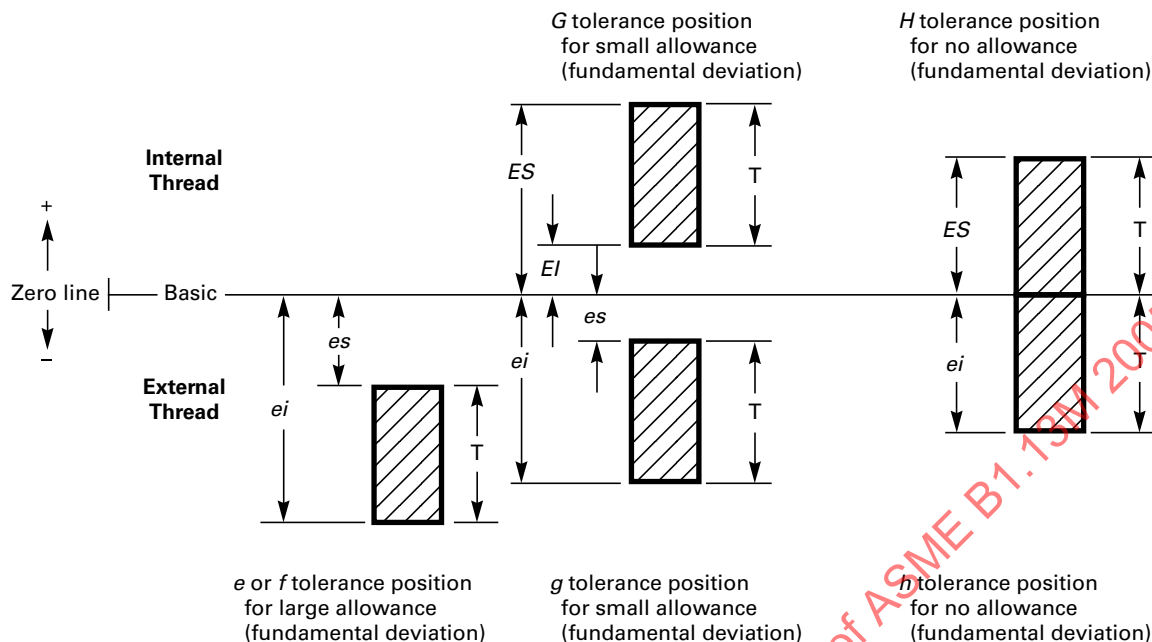


Fig. 4 Metric Tolerance System for Screw Threads

## 3.2 Design M Profiles

**3.2.1 Internal Thread.** The design M profile for the internal thread at the no allowance maximum material condition is the basic ISO 68-1 profile. See Fig. 2 and thread data in Table 2.

**3.2.2 External Thread.** The design M profile for the external thread at the no allowance maximum material condition is the basic ISO 68-1 profile except where a rounded root is required. For the standard  $0.125P$  min. radius, the ISO 68-1 profile is modified at the root with a  $0.17783H$  truncation blending into two arcs with radii of  $0.125P$  tangent to the thread flanks. See Fig. 3 and thread data in Table 2.

## 3.3 Crest and Root Forms

**3.3.1 Rounded Crest and Root Forms.** The crest and root tolerance zones at the major and minor diameters will permit rounded crest and root forms in both the external and internal threads.

**3.3.2 External Thread Root.** The root profile of the thread shall lie within the section lined tolerance zone shown in Fig. 5. For the rounded root thread, the root profile of the external thread shall lie within the section lined rounded root tolerance zone shown in Fig. 5. The profile shall be a continuous smoothly blended nonreversing curve, no part of which shall have a radius of less than  $0.125P$ , which is tangential to the thread flank.

The profile may comprise tangent flank arcs that are joined by a tangential flat at the root. The limit values of the root radius  $r$  are specified in Table 3. The maximum truncation is:

$$\frac{H}{4} - r \min. \left\{ 1 - \cos \left[ 60 \text{ deg} - \arccos \left( 1 - \frac{Td_2}{4r \min.} \right) \right] \right\}$$

and the minimum truncation is  $0.14434H$ . (See Fig. 5.) The M profile with a minimum root radius of  $0.125P$  on the external thread is desirable for all threads but is required for threaded mechanical fasteners of SAE J1199, ASTM F 568M, and ISO 898-1 property class 8.8 (minimum tensile strength 800 MPa) and stronger. (See Fig. 5.)

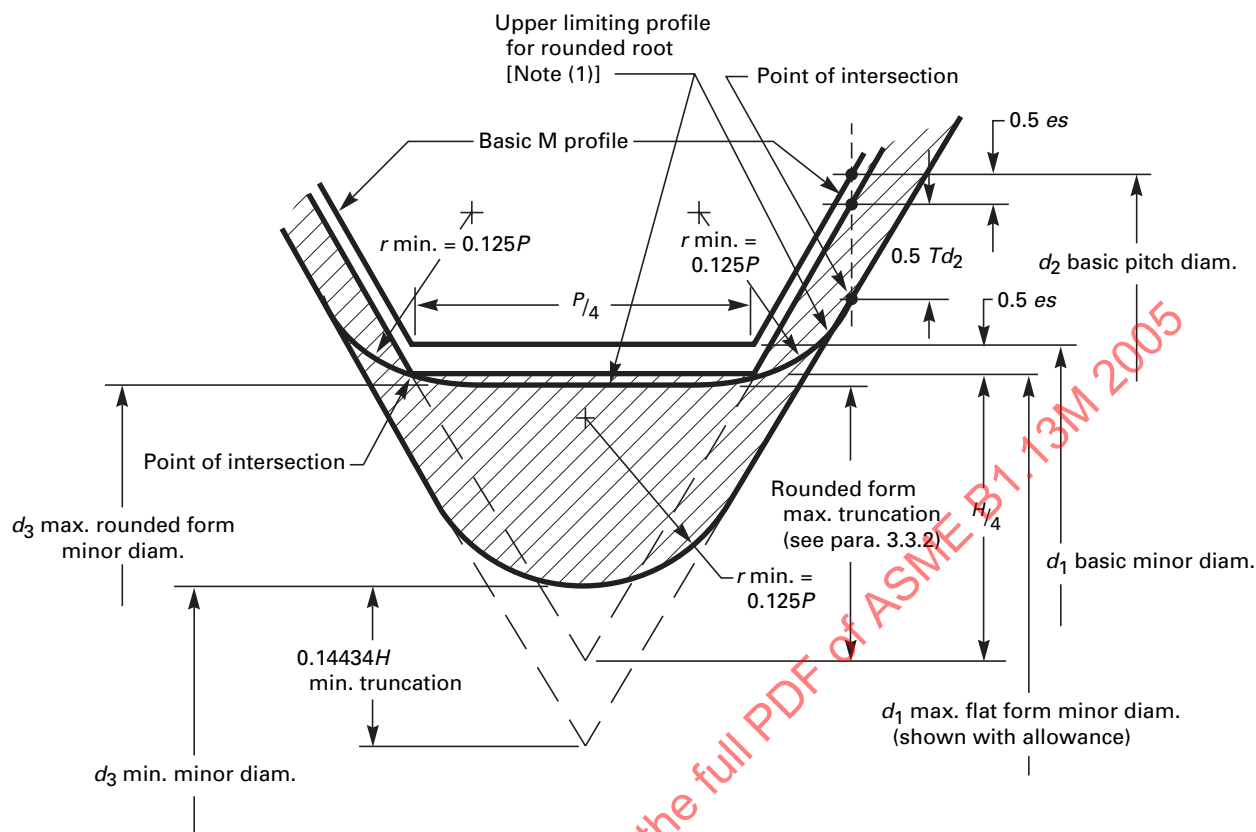
**3.3.3 Internal Thread Root.** The root profile shall not be smaller than the basic profile. The maximum major diameter shall not be sharp.

## 4 SERIES OF THREADS

### 4.1 Standard Coarse Pitch General Purpose and Mechanical Fastener Series, M Profile

The standard metric screw thread series for general purpose equipment's threaded components design and mechanical fasteners is a coarse thread series. Their diameter/pitch combinations are listed in Table 4.

NOTE: The words *coarse* and *fine* are given in order to conform to usage. No concept of quality shall be associated with these



GENERAL NOTE: Section-lined portions identify tolerance zone and unshaded portions identify allowance (fundamental deviation).

NOTE:

- (1) The upper limiting profile for rounded root form allows no tolerance for flank wear of a tool producing it and is therefore not to be used as a design profile. Rather, it is an indication of the limiting acceptable condition for the rounded root form which will pass a GO thread gage.

**Fig. 5 M Profile, External Thread Root, Upper and Lower Limiting Profiles for  $r \min. = 0.125P$  and for Flat Root Form (Shown for Tolerance Position  $g$ )**

words. Coarse pitches only indicate the largest metric pitches used in current practice.

## 4.2 Standard Fine Pitch M Profile Screw Threads

Table 5 lists additional diameter/pitch combinations that are standard for general purpose equipment's threaded components design.

## 4.3 Preferred Sizes

Diameter/pitch combinations shown in Table 4 are the preferred sizes and should be the first choice, as applicable.

## 4.4 ISO Metric Thread Series

The Thread Series given in Table 6 are identical to those published in ISO 261 for diameters of 1.6 mm and larger. Diameter/pitch combinations from Tables 4 and

5 are shown in boldface. Selection of series shown in regular type shall be limited to unusual requirements where the selections in accordance with paras. 4.1, 4.2, and 4.3 cannot be used.

# 5 ALLOWANCES AND TOLERANCES

## 5.1 ISO System of Limits and Fits as Applied to Screw Threads

**5.1.1 General.** The international metric tolerance system is based on a system of limits and fits. The limits of the tolerances on the mating parts and their allowances (fundamental deviations) determine the fit of the assembly. For simplicity, the system is described for cylindrical parts. Holes are equivalent to internally threaded surfaces and shafts to externally threaded surfaces.

**Table 3 Limit Values for M Profile Minimum Rounded Root Radius**

| $P$  | Min. Root Radius, $0.125P$ | $P$  | Min. Root Radius, $0.125P$ |
|------|----------------------------|------|----------------------------|
| 0.2  | 0.025                      | 1.25 | 0.156                      |
| 0.25 | 0.031                      | 1.5  | 0.188                      |
| 0.3  | 0.038                      | 1.75 | 0.219                      |
|      |                            | 2    | 0.250                      |
| 0.35 | 0.044                      | 2.5  | 0.313                      |
| 0.4  | 0.050                      | 3    | 0.375                      |
| 0.45 | 0.056                      |      |                            |
|      |                            | 3.5  | 0.438                      |
| 0.5  | 0.063                      | 4    | 0.500                      |
| 0.6  | 0.075                      | 4.5  | 0.563                      |
| 0.7  | 0.088                      |      |                            |
|      |                            | 5    | 0.625                      |
| 0.75 | 0.094                      | 5.5  | 0.688                      |
| 0.8  | 0.100                      | 6    | 0.750                      |
| 1    | 0.125                      | 8    | 1.000                      |

GENERAL NOTE: All dimensions are in millimeters.

**Table 4 Standard Coarse Pitch M Profile General Purpose and Mechanical Fastener Series**

| Nominal Size | Pitch | Nominal Size | Pitch          |
|--------------|-------|--------------|----------------|
| 1.6          | 0.35  | 20           | 2.5            |
| 2            | 0.4   | 22           | 2.5 [Note (1)] |
| 2.5          | 0.45  | 24           | 3              |
|              |       | 27           | 3 [Note (1)]   |
| 3            | 0.5   | 30           | 3.5            |
| 3.5          | 0.6   |              |                |
| 4            | 0.7   | 36           | 4              |
|              |       | 42           | 4.5            |
| 5            | 0.8   | 48           | 5              |
| 6            | 1     |              |                |
| 8            | 1.25  | 56           | 5.5            |
|              |       | 64           | 6              |
| 10           | 1.5   | 72           | 6 [Note (2)]   |
| 12           | 1.75  |              |                |
| 14           | 2     | 80           | 6 [Note (2)]   |
| 16           | 2     | 90           | 6 [Note (2)]   |
|              |       | 100          | 6 [Note (2)]   |

GENERAL NOTE: All dimensions are in millimeters.

NOTES:

- (1) For high strength structural steel fasteners only.  
 (2) Designated as part of 6 mm fine pitch series in ISO 261.

**5.1.2 Basic Size.** This is the zero line or surface at assembly, where the interface of the two mating parts have a common reference.

**5.1.3 Upper Deviation.** This is the algebraic difference between the maximum limit of size and the basic size. It is designated by the French term *écart supérieur* (*ES* for holes and *es* for shafts).

**Table 5 Standard Fine Pitch M Profile Screw Threads**

| Nominal Size | Pitch | Nominal Size | Pitch |
|--------------|-------|--------------|-------|
| 8            | 1     | 55           | 1.5   |
| 10           | 0.75  | 56           | ...   |
| 12           | 1     | 60           | 1.5   |
| 14           | ...   | 64           | ...   |
|              |       | 65           | 1.5   |
| 15           | 1     | 70           | 1.5   |
| 16           | ...   | 72           | ...   |
| 17           | 1     | 75           | 1.5   |
| 18           | ...   | 80           | 1.5   |
| 20           | 1     | 85           | ...   |
|              |       | 90           | ...   |
| 22           | ...   | 95           | ...   |
| 24           | ...   | 100          | ...   |
| 25           | 1.5   | 105          | ...   |
| 27           | ...   | 110          | ...   |
| 30           | 1.5   |              |       |
|              |       | 120          | ...   |
| 33           | ...   | 130          | ...   |
| 35           | 1.5   | 140          | ...   |
| 36           | ...   | 150          | ...   |
| 39           | ...   | 160          | ...   |
| 40           | 1.5   |              |       |
|              |       | 170          | ...   |
| 42           | ...   | 180          | ...   |
| 45           | 1.5   | 190          | ...   |
| 48           | ...   | 200          | ...   |
| 50           | 1.5   |              |       |

GENERAL NOTE: All dimensions are in millimeters.

**5.1.4 Lower Deviation.** This is the algebraic difference between the minimum limit of size and the basic size. It is designated by the French term *écart inférieur* (*EI* for holes and *ei* for shafts).

**5.1.5 Fundamental Deviations (Allowances).** These are the deviations that are closest to the basic size. In Fig. 4 they would be *EI* and *es*. Fundamental deviations are designated by alphabetical letters. See para. 5.3.

**5.1.6 Fits.** Fits are determined by the fundamental deviation, which may be positive or negative, assigned to the mating parts. The selected fits can be clearance, transition, and interference. To illustrate fits schematically, a zero line is drawn to represent the basic size. By convention, the shaft always lies below the zero line and the hole lies above the zero line (except for interference fits). This makes the fundamental deviation negative for the shaft and equal to its upper deviation, *es*. The fundamental deviation is positive for the hole and equal to its lower deviation, *EI*. See Fig. 4.

**5.1.7 Tolerance.** Defined by a series of numerical grades, each grade provides numerical values for nominal sizes corresponding to the standard tolerance. See para. 5.2. When the tolerance is applied to the schematic

**Table 6 ISO 261 Diameter/Pitch Combinations From Which the Standards Were Selected**

| Nominal Diameters       |                         |                         | Pitches        |                |     |     |                 |     |      |     |      |      |     |
|-------------------------|-------------------------|-------------------------|----------------|----------------|-----|-----|-----------------|-----|------|-----|------|------|-----|
| Col. 1<br>1st<br>Choice | Col. 2<br>2nd<br>Choice | Col. 3<br>3rd<br>Choice | Fine           |                |     |     |                 |     |      |     |      |      |     |
|                         |                         |                         | Coarse         | 3              | 2   | 1.5 | 1.25            | 1   | 0.75 | 0.5 | 0.35 | 0.25 | 0.2 |
| 1.6                     |                         |                         | 0.35           | ...            | ... | ... | ...             | ... | ...  | ... | ...  | ...  | 0.2 |
|                         | 1.8                     |                         | 0.35           | ...            | ... | ... | ...             | ... | ...  | ... | ...  | ...  | 0.2 |
| 2                       |                         |                         | 0.4            | ...            | ... | ... | ...             | ... | ...  | ... | ...  | 0.25 | ... |
|                         | 2.2                     |                         | 0.45           | ...            | ... | ... | ...             | ... | ...  | ... | ...  | 0.25 | ... |
| 2.5                     |                         |                         | 0.45           | ...            | ... | ... | ...             | ... | ...  | ... | 0.35 | ...  | ... |
| 3                       |                         |                         | 0.5            | ...            | ... | ... | ...             | ... | ...  | ... | 0.35 | ...  | ... |
|                         | 3.5                     |                         | 0.6            | ...            | ... | ... | ...             | ... | ...  | ... | 0.35 | ...  | ... |
| 4                       |                         |                         | 0.7            | ...            | ... | ... | ...             | ... | ...  | 0.5 | ...  | ...  | ... |
|                         | 4.5                     |                         | 0.75           | ...            | ... | ... | ...             | ... | ...  | 0.5 | ...  | ...  | ... |
| 5                       |                         |                         | 0.8            | ...            | ... | ... | ...             | ... | ...  | 0.5 | ...  | ...  | ... |
|                         |                         | 5.5                     | ...            | ...            | ... | ... | ...             | ... | ...  | 0.5 | ...  | ...  | ... |
| 6                       |                         |                         | 1              | ...            | ... | ... | ...             | ... | 0.75 | ... | ...  | ...  | ... |
|                         | 7                       |                         | 1              | ...            | ... | ... | ...             | ... | 0.75 | ... | ...  | ...  | ... |
| 8                       |                         |                         | 1.25           | ...            | ... | ... | ...             | 1   | 0.75 | ... | ...  | ...  | ... |
|                         |                         | 9                       | 1.25           | ...            | ... | ... | ...             | 1   | 0.75 | ... | ...  | ...  | ... |
| 10                      |                         |                         | 1.5            | ...            | ... | ... | 1.25            | 1   | 0.75 | ... | ...  | ...  | ... |
|                         |                         | 11                      | 1.5            | ...            | ... | ... | ...             | 1   | 0.75 | ... | ...  | ...  | ... |
| 12                      |                         |                         | 1.75           | ...            | ... | 1.5 | 1.25            | 1   | ...  | ... | ...  | ...  | ... |
|                         | 14                      |                         | 2              | ...            | ... | 1.5 | 1.25 [Note (1)] | 1   | ...  | ... | ...  | ...  | ... |
|                         |                         | 15                      | ...            | ...            | ... | 1.5 | ...             | 1   | ...  | ... | ...  | ...  | ... |
| 16                      |                         |                         | 2              | ...            | ... | 1.5 | ...             | 1   | ...  | ... | ...  | ...  | ... |
|                         |                         | 17                      | ...            | ...            | ... | 1.5 | ...             | 1   | ...  | ... | ...  | ...  | ... |
|                         | 18                      |                         | 2.5            | ...            | 2   | 1.5 | ...             | 1   | ...  | ... | ...  | ...  | ... |
| 20                      |                         |                         | 2.5            | ...            | 2   | 1.5 | ...             | 1   | ...  | ... | ...  | ...  | ... |
|                         | 22                      |                         | 2.5 [Note (2)] | ...            | 2   | 1.5 | ...             | 1   | ...  | ... | ...  | ...  | ... |
| 24                      |                         |                         | 3              | ...            | 2   | 1.5 | ...             | 1   | ...  | ... | ...  | ...  | ... |
|                         |                         | 25                      | ...            | ...            | 2   | 1.5 | ...             | 1   | ...  | ... | ...  | ...  | ... |
|                         |                         | 26                      | ...            | ...            | ... | 1.5 | ...             | ... | ...  | ... | ...  | ...  | ... |
|                         | 27                      |                         | 3 [Note (2)]   | ...            | 2   | 1.5 | ...             | 1   | ...  | ... | ...  | ...  | ... |
|                         |                         | 28                      | ...            | ...            | 2   | 1.5 | ...             | 1   | ...  | ... | ...  | ...  | ... |
| 30                      |                         |                         | 3.5            | (3) [Note (3)] | 2   | 1.5 | ...             | 1   | ...  | ... | ...  | ...  | ... |
|                         |                         | 32                      | ...            | ...            | 2   | 1.5 | ...             | ... | ...  | ... | ...  | ...  | ... |
|                         | 33                      |                         | 3.5            | (3) [Note (3)] | 2   | 1.5 | ...             | ... | ...  | ... | ...  | ...  | ... |
|                         |                         | 35 [Note (4)]           | ...            | ...            | ... | 1.5 | ...             | ... | ...  | ... | ...  | ...  | ... |
| 36                      |                         |                         | 4              | 3              | 2   | 1.5 | ...             | ... | ...  | ... | ...  | ...  | ... |
|                         |                         | 38                      | ...            | ...            | ... | 1.5 | ...             | ... | ...  | ... | ...  | ...  | ... |
| 39                      |                         |                         | 4              | 3              | 2   | 1.5 | ...             | ... | ...  | ... | ...  | ...  | ... |

**Table 6 ISO 261 Diameter/Pitch Combinations  
From Which the Standards Were Selected (Cont'd)**

| Nominal Diameters       |                         |                         | Pitches |      |     |     |     |     |     |
|-------------------------|-------------------------|-------------------------|---------|------|-----|-----|-----|-----|-----|
| Col. 1<br>1st<br>Choice | Col. 2<br>2nd<br>Choice | Col. 3<br>3rd<br>Choice | Coarse  | Fine |     |     |     |     |     |
|                         |                         |                         |         | 8    | 6   | 4   | 3   | 2   | 1.5 |
| 42                      | 45                      | 40                      | ...     | ...  | ... | ... | 3   | 2   | 1.5 |
|                         |                         |                         | 4.5     | ...  | ... | 4   | 3   | 2   | 1.5 |
|                         |                         |                         | 4.5     | ...  | ... | 4   | 3   | 2   | 1.5 |
| 48                      | 52                      | 50                      | 5       | ...  | ... | 4   | 3   | 2   | 1.5 |
|                         |                         |                         | ...     | ...  | ... | ... | 3   | 2   | 1.5 |
|                         |                         |                         | 5       | ...  | ... | 4   | 3   | 2   | 1.5 |
| 56                      |                         | 55                      | ...     | ...  | ... | 4   | 3   | 2   | 1.5 |
|                         |                         |                         | 5.5     | ...  | ... | 4   | 3   | 2   | 1.5 |
|                         |                         | 58                      | ...     | ...  | ... | 4   | 3   | 2   | 1.5 |
| 64                      | 68                      | 60                      | 5.5     | ...  | ... | 4   | 3   | 2   | 1.5 |
|                         |                         | 62                      | ...     | ...  | ... | 4   | 3   | 2   | 1.5 |
|                         |                         |                         | 6       | ...  | ... | 4   | 3   | 2   | 1.5 |
| 72                      | 76                      | 65                      | ...     | ...  | ... | 4   | 3   | 2   | 1.5 |
|                         |                         |                         | 6       | ...  | ... | 4   | 3   | 2   | 1.5 |
|                         |                         | 70                      | ...     | ...  | 6   | 4   | 3   | 2   | 1.5 |
| 80                      |                         | 75                      | ...     | ...  | 6   | 4   | 3   | 2   | 1.5 |
|                         |                         |                         | ...     | ...  | ... | 4   | 3   | 2   | 1.5 |
|                         |                         | 78                      | ...     | ...  | ... | ... | ... | 2   | ... |
| 90                      | 95                      | 82                      | ...     | ...  | 6   | 4   | 3   | 2   | 1.5 |
|                         |                         |                         | ...     | ...  | ... | ... | ... | 2   | ... |
|                         |                         | 85                      | ...     | ...  | 6   | 4   | 3   | 2   | ... |
| 100                     | 105                     |                         | ...     | ...  | 6   | 4   | 3   | 2   | ... |
|                         |                         |                         | ...     | ...  | 6   | 4   | 3   | 2   | ... |
|                         |                         |                         | ...     | ...  | 6   | 4   | 3   | 2   | ... |
| 110                     | 120                     |                         | ...     | ...  | 6   | 4   | 3   | 2   | ... |
|                         |                         |                         | ...     | ...  | 6   | 4   | 3   | 2   | ... |
|                         |                         |                         | ...     | 8    | 6   | 4   | 3   | 2   | ... |
| 125                     | 130                     |                         | ...     | 8    | 6   | 4   | 3   | 2   | ... |
|                         |                         |                         | ...     | ...  | 6   | 4   | 3   | 2   | ... |
|                         |                         | 135                     | ...     | 8    | 6   | 4   | 3   | 2   | ... |
| 140                     | 150                     |                         | ...     | ...  | 6   | 4   | 3   | 2   | ... |
|                         |                         |                         | ...     | 8    | 6   | 4   | 3   | 2   | ... |
|                         |                         | 155                     | ...     | ...  | 6   | 4   | 3   | ... | ... |
| 160                     | 170                     |                         | ...     | 8    | 6   | 4   | 3   | ... | ... |
|                         |                         |                         | ...     | ...  | 6   | 4   | 3   | ... | ... |
|                         |                         | 165                     | ...     | 8    | 6   | 4   | 3   | ... | ... |
| 180                     |                         | 175                     | ...     | ...  | 6   | 4   | 3   | ... | ... |
|                         |                         |                         | ...     | 8    | 6   | 4   | 3   | ... | ... |
|                         |                         |                         | ...     | ...  | 6   | 4   | 3   | ... | ... |

**Table 6 ISO 261 Diameter/Pitch Combinations  
From Which the Standards Were Selected (Cont'd)**

| Nominal Diameters       |                         |                         | Pitches |      |   |   |     |     |     |
|-------------------------|-------------------------|-------------------------|---------|------|---|---|-----|-----|-----|
| Col. 1<br>1st<br>Choice | Col. 2<br>2nd<br>Choice | Col. 3<br>3rd<br>Choice | Coarse  | Fine |   |   |     |     |     |
|                         |                         |                         |         | 8    | 6 | 4 | 3   | 2   | 1.5 |
| 200                     | 190                     | 185                     | ...     | ...  | 6 | 4 | 3   | ... | ... |
|                         |                         | 195                     | ...     | 8    | 6 | 4 | 3   | ... | ... |
|                         |                         | 205                     | ...     | ...  | 6 | 4 | 3   | ... | ... |
|                         |                         | 210                     | ...     | 8    | 6 | 4 | 3   | ... | ... |
|                         | 220                     | 215                     | ...     | ...  | 6 | 4 | 3   | ... | ... |
|                         |                         | 225                     | ...     | 8    | 6 | 4 | 3   | ... | ... |
|                         |                         | 230                     | ...     | ...  | 6 | 4 | 3   | ... | ... |
|                         |                         | 235                     | ...     | 8    | 6 | 4 | 3   | ... | ... |
|                         |                         | 240                     | ...     | ...  | 6 | 4 | 3   | ... | ... |
|                         |                         | 245                     | ...     | 8    | 6 | 4 | 3   | ... | ... |
| 250                     | 260                     | 255                     | ...     | ...  | 6 | 4 | ... | ... | ... |
|                         |                         | 265                     | ...     | 8    | 6 | 4 | ... | ... | ... |
|                         |                         | 270                     | ...     | ...  | 6 | 4 | ... | ... | ... |
|                         |                         | 275                     | ...     | 8    | 6 | 4 | ... | ... | ... |
|                         | 280                     | 285                     | ...     | ...  | 6 | 4 | ... | ... | ... |
|                         |                         | 290                     | ...     | 8    | 6 | 4 | ... | ... | ... |
|                         |                         | 295                     | ...     | ...  | 6 | 4 | ... | ... | ... |
|                         |                         | 300                     | ...     | 8    | 6 | 4 | ... | ... | ... |

GENERAL NOTE: All dimensions are in millimeters.

NOTES:

- (1) Only for spark plugs for engines.
- (2) Only for high strength structural steel fasteners.
- (3) Pitches shown in parentheses are to be avoided as far as possible.
- (4) Only for nuts for bearings.

diagram, the tolerance for the part (shaft) continues to be negative. Thus, the tolerance plus the fit define the lower deviation, *ei*. The tolerance for the mating part (hole) continues to be positive. Thus, the tolerance plus the fit define the upper deviation, *ES*. A schematic example of the metric tolerance system as applied to metric screw threads is shown in Fig. 4.

## 5.2 Tolerance Grade

(a) This is indicated by a number. The system provides for a series of tolerance grades for each of the four screw thread parameters ( $D_1$ ,  $d$ ,  $D_2$ ,  $d_2$ ). The tolerance grades for this Standard were selected from those given in ISO 965-1.

(b) The underlined tolerance grades are used with normal length of thread engagement.

| Characteristic                     | Tolerance Grade                     | Applicable Table |
|------------------------------------|-------------------------------------|------------------|
| Minor diameter of internal threads | 4, 5, <u>6</u> , 7, 8               | Table 9          |
| Major diameter of external threads | 4, <u>6</u> , 8                     | Table 10         |
| Pitch diameter of internal threads | 4, 5, <u>6</u> , 7, 8               | Table 12         |
| Pitch diameter of external threads | 3, <u>4</u> , 5, <u>6</u> , 7, 8, 9 | Table 11         |

### 5.3 Tolerance Position

(a) This is indicated by a letter. This position is the allowance (fundamental deviation). A capital letter is used for internal threads and a lowercase letter for external threads. The system provides a series of tolerance positions for internal and external threads. These tolerance positions are as follows with the numerical values given in the appropriate table.

(b) The underlined letters are used in this Standard.

|                  |                   |          |
|------------------|-------------------|----------|
| Internal Threads | G, <u>H</u>       | Table 13 |
| External Threads | e, f, g, <u>h</u> | Table 13 |

### 5.4 Allowance/Tolerance Formulas and Tables

(a) See section 6 for pitch and crest diameter allowance/tolerance formulas and tables.

(b) Functional diameter size includes the effects of all variations in pitch diameter, thread form, and profile. The variations in the individual thread characteristics such as flank angle, lead, taper, and roundness on a given thread, cause the measurements of the pitch diameter and functional diameter to vary from one another on most threads. The pitch diameter and functional diameter on a given thread are equal to one another only when the thread form is perfect. When required to inspect either the pitch diameter, the functional diameter, or both, for thread acceptance (see ASME B1.3), use the same limits of size for the appropriate thread size and class.

### 5.5 Selected Tolerance Classes

**5.5.1 External Thread Tolerance Classes.** Small allowance (fundamental deviation)

- (a) for normal tolerance — tolerance class 6g6g
- (b) for tighter tolerance — tolerance class 4g6g
- (c) for a no-allowance fit at maximum material, such as for a plated 6g6g — tolerance class 6h6h

**5.5.2 Internal Thread Tolerance Class.** No allowance (fundamental deviation). Tolerance class 6H6H. Internal threads with allowance are not standard practice.

### 5.6 Length of Thread Engagement

**5.6.1 Normal Length of Thread Engagement.** The pitch diameter tolerances specified herein are applicable to the limits of the normal length of thread engagement *LE* in Table 7. The limits were calculated by formulas given in para. 6.4.

**5.6.2 Short and Long Lengths of Thread Engagement When Gaged With Normal Length Contacts.** For short *LE* length of thread engagement, reduce the pitch diameter tolerance of the external thread by one tolerance grade number. For long *LE* length of thread engagement, increase the allowance (fundamental deviation) at the pitch diameter of the external thread. For internal

threads with long *LE* length of thread engagement, provide an allowance (fundamental deviation) corresponding to the next larger tolerance position. Thus, for the standard *H* position (no allowance), a tolerance position *G* would be provided. For assemblies with short or long lengths of engagement, the tolerance class adjustment may be applied to only one member. See Table 8.

### 5.7 Circular Runout

Circular runout is the full indicator movement (FIM) (see ASME Y14.5). Runout of the crest (minor diameter of internal thread or major diameter of external thread) relative to the pitch cylinder shall not be so great that the basic profile is transgressed.

**5.7.1 Internal Thread.** When measurement is specified, the runout of the minor diameter cylinder relative to the pitch cylinder on the internal thread shall not exceed the difference between the measured minor diameter and the basic minor diameter. An out-of-round pitch cylinder may reduce the available runout.

**5.7.2 External Thread.** When measurement is specified, the runout of the major diameter cylinder relative to the pitch cylinder on the external thread shall not exceed the difference between the measured major diameter and the basic major diameter. An out-of-round pitch cylinder may reduce the available runout.

### 5.8 Lead and Flank Angle Tolerances

See section 10.

### 5.9 Coated or Plated Threads

See section 8 for dimensional accommodation and limits for coated threads.

## 6 DESIGN FORMULAS AND TABULATED VALUES FOR ALLOWANCES AND TOLERANCES

### 6.1 General

This section provides the formulas and tabulated values for ISO allowances and tolerances in accordance with ISO 965-1. It is to be used for size limit calculation for non-standard threads, when required. See para. 9.2 for applications and limitations of formulas and tables.

### 6.2 Rounding Procedure for Tabulated Values

(a) The values for crest and pitch diameter tolerances (Tables 9, 10, 11, and 12), for length of engagement (Table 7), and for allowances/fundamental deviations (Table 13) have been calculated from formulas and then rounded off to the nearest values in the R40 series of preferred numbers in accordance with ISO 3 for the three decimal places required. If a fourth decimal place results, it is further rounded.

**Table 7 Length of Thread Engagement (ISO 965-1)**

| Basic Major Diameter,<br><i>d</i> bsc |                     |                    | Length of Thread Engagement |                  |                     |                |
|---------------------------------------|---------------------|--------------------|-----------------------------|------------------|---------------------|----------------|
|                                       |                     | Pitch,<br><i>P</i> | Short <i>LE</i>             | Normal <i>LE</i> |                     | Long <i>LE</i> |
| Over                                  | Up to and Including |                    | Up to and Including         | Over             | Up to and Including | Over           |
| 1.5                                   | 2.8                 | 0.2                | 0.5                         | 0.5              | 1.5                 | 1.5            |
|                                       |                     | 0.25               | 0.6                         | 0.6              | 1.9                 | 1.9            |
|                                       |                     | 0.35               | 0.8                         | 0.8              | 2.6                 | 2.6            |
|                                       |                     | 0.4                | 1                           | 1                | 3                   | 3              |
|                                       |                     | 0.45               | 1.3                         | 1.3              | 3.8                 | 3.8            |
| 2.8                                   | 5.6                 | 0.35               | 1                           | 1                | 3                   | 3              |
|                                       |                     | 0.5                | 1.5                         | 1.5              | 4.5                 | 4.5            |
|                                       |                     | 0.6                | 1.7                         | 1.7              | 5                   | 5              |
|                                       |                     | 0.7                | 2                           | 2                | 6                   | 6              |
|                                       |                     | 0.75               | 2.2                         | 2.2              | 6.7                 | 6.7            |
|                                       |                     | 0.8                | 2.5                         | 2.5              | 7.5                 | 7.5            |
| 5.6                                   | 11.2                | 0.75               | 2.4                         | 2.4              | 7.1                 | 7.1            |
|                                       |                     | 1                  | 3                           | 3                | 9                   | 9              |
|                                       |                     | 1.25               | 4                           | 4                | 12                  | 12             |
|                                       |                     | 1.5                | 5                           | 5                | 15                  | 15             |
| 11.2                                  | 22.4                | 1                  | 3.8                         | 3.8              | 11                  | 11             |
|                                       |                     | 1.25               | 4.5                         | 4.5              | 13                  | 13             |
|                                       |                     | 1.5                | 5.6                         | 5.6              | 16                  | 16             |
|                                       |                     | 1.75               | 6                           | 6                | 18                  | 18             |
|                                       |                     | 2                  | 8                           | 8                | 24                  | 24             |
|                                       |                     | 2.5                | 10                          | 10               | 30                  | 30             |
| 22.4                                  | 45                  | 1                  | 4                           | 4                | 12                  | 12             |
|                                       |                     | 1.5                | 6.3                         | 6.3              | 19                  | 19             |
|                                       |                     | 2                  | 8.5                         | 8.5              | 25                  | 25             |
|                                       |                     | 3                  | 12                          | 12               | 36                  | 36             |
|                                       |                     | 3.5                | 15                          | 15               | 45                  | 45             |
|                                       |                     | 4                  | 18                          | 18               | 53                  | 53             |
|                                       |                     | 4.5                | 21                          | 21               | 63                  | 63             |
| 45                                    | 90                  | 1.5                | 7.5                         | 7.5              | 22                  | 22             |
|                                       |                     | 2                  | 9.5                         | 9.5              | 28                  | 28             |
|                                       |                     | 3                  | 15                          | 15               | 45                  | 45             |
|                                       |                     | 4                  | 19                          | 19               | 56                  | 56             |
|                                       |                     | 5                  | 24                          | 24               | 71                  | 71             |
|                                       |                     | 5.5                | 28                          | 28               | 85                  | 85             |
|                                       |                     | 6                  | 32                          | 32               | 95                  | 95             |
| 90                                    | 180                 | 2                  | 12                          | 12               | 36                  | 36             |
|                                       |                     | 3                  | 18                          | 18               | 53                  | 53             |
|                                       |                     | 4                  | 24                          | 24               | 71                  | 71             |
|                                       |                     | 6                  | 36                          | 36               | 106                 | 106            |
|                                       |                     | 8                  | 45                          | 45               | 132                 | 132            |
| 180                                   | 355                 | 3                  | 20                          | 20               | 60                  | 60             |
|                                       |                     | 4                  | 26                          | 26               | 80                  | 80             |
|                                       |                     | 6                  | 40                          | 40               | 118                 | 118            |
|                                       |                     | 8                  | 50                          | 50               | 150                 | 150            |

GENERAL NOTE: All dimensions are in millimeters.

**Table 8 Examples of Tolerance Classes Required for Normal Gage Length Contacts With Various Thread Engagement Lengths**

| Normal <i>LE</i> | Short <i>LE</i> | Long <i>LE</i> |
|------------------|-----------------|----------------|
| 6g               | 5g6g            | 6e6g           |
| 4g6g             | 3g6g            | 4e6g           |
| 6h [Note (1)]    | 5h6h            | 6g6h           |
| 4h6h [Note (1)]  | 3h6h            | 4g6h           |
| 6H               | 5H              | 6G             |
| 4H6H             | 3H6H            | 4G6G           |

GENERAL NOTE: See para. 5.6.2.

NOTE:

(1) Applies to maximum material functional size (*GO* Thread gage) for plated 6g and 4g6g class threads, respectively.**Table 9 Minor Diameter Tolerances of Internal Thread,  $TD_1$  (ISO 965-1)**

| Pitch,<br><i>P</i> | Tolerance Grade |       |              |       |       |
|--------------------|-----------------|-------|--------------|-------|-------|
|                    | 4               | 5     | 6 [Note (1)] | 7     | 8     |
| 0.2                | 0.038           | ...   | ...          | ...   | ...   |
| 0.25               | 0.045           | 0.056 | ...          | ...   | ...   |
| 0.3                | 0.053           | 0.067 | 0.085        | ...   | ...   |
| 0.35               | 0.063           | 0.080 | 0.100        | ...   | ...   |
| 0.4                | 0.071           | 0.090 | 0.112        | ...   | ...   |
| 0.45               | 0.080           | 0.100 | 0.125        | ...   | ...   |
| 0.5                | 0.090           | 0.112 | 0.140        | 0.180 | ...   |
| 0.6                | 0.100           | 0.125 | 0.160        | 0.200 | ...   |
| 0.7                | 0.112           | 0.140 | 0.180        | 0.224 | ...   |
| 0.75               | 0.118           | 0.150 | 0.190        | 0.236 | ...   |
| 0.8                | 0.125           | 0.160 | 0.200        | 0.250 | 0.315 |
| 1                  | 0.150           | 0.190 | 0.236        | 0.300 | 0.375 |
| 1.25               | 0.170           | 0.212 | 0.265        | 0.335 | 0.425 |
| 1.5                | 0.190           | 0.236 | 0.300        | 0.375 | 0.475 |
| 1.75               | 0.212           | 0.265 | 0.335        | 0.425 | 0.530 |
| 2                  | 0.236           | 0.300 | 0.375        | 0.475 | 0.600 |
| 2.5                | 0.280           | 0.355 | 0.450        | 0.560 | 0.710 |
| 3                  | 0.315           | 0.400 | 0.500        | 0.630 | 0.800 |
| 3.5                | 0.355           | 0.450 | 0.560        | 0.710 | 0.900 |
| 4                  | 0.375           | 0.475 | 0.600        | 0.750 | 0.950 |
| 4.5                | 0.425           | 0.530 | 0.670        | 0.850 | 1.060 |
| 5                  | 0.450           | 0.560 | 0.710        | 0.900 | 1.120 |
| 5.5                | 0.475           | 0.600 | 0.750        | 0.950 | 1.180 |
| 6                  | 0.500           | 0.630 | 0.800        | 1.000 | 1.250 |
| 8                  | 0.630           | 0.800 | 1.000        | 1.250 | 1.600 |

GENERAL NOTE: All dimensions are in millimeters.

NOTE:

(1) Tabulated in this Standard for M Internal Threads.

**Table 10 Major Diameter Tolerances of External Thread,  $T_d$  (ISO 965-1)**

| Pitch,<br>$P$ | Tolerance Grade |              |       |
|---------------|-----------------|--------------|-------|
|               | 4               | 6 [Note (1)] | 8     |
| 0.2           | 0.036           | 0.056        | ...   |
| 0.25          | 0.042           | 0.067        | ...   |
| 0.3           | 0.048           | 0.075        | ...   |
| 0.35          | 0.053           | 0.085        | ...   |
| 0.4           | 0.060           | 0.095        | ...   |
| 0.45          | 0.063           | 0.100        | ...   |
| 0.5           | 0.067           | 0.106        | ...   |
| 0.6           | 0.080           | 0.125        | ...   |
| 0.7           | 0.090           | 0.140        | ...   |
| 0.75          | 0.090           | 0.140        | ...   |
| 0.8           | 0.095           | 0.150        | 0.236 |
| 1             | 0.112           | 0.180        | 0.280 |
| 1.25          | 0.132           | 0.212        | 0.335 |
| 1.5           | 0.150           | 0.236        | 0.375 |
| 1.75          | 0.170           | 0.265        | 0.425 |
| 2             | 0.180           | 0.280        | 0.450 |
| 2.5           | 0.212           | 0.335        | 0.530 |
| 3             | 0.236           | 0.375        | 0.600 |
| 3.5           | 0.265           | 0.425        | 0.670 |
| 4             | 0.300           | 0.475        | 0.750 |
| 4.5           | 0.315           | 0.500        | 0.800 |
| 5             | 0.335           | 0.530        | 0.850 |
| 5.5           | 0.355           | 0.560        | 0.900 |
| 6             | 0.375           | 0.600        | 0.950 |
| 8             | 0.450           | 0.710        | 1.180 |

GENERAL NOTE: All dimensions are in millimeters.

NOTE:

(1) Tabulated in this Standard for M External Threads.

(b) These rules of rounding have not always been used in order to produce a smooth progression. Same as ISO 965-1.

(c) The above procedures often result in a variation by one or more numerals in the last decimal place when comparing table and formula values.

**6.3 Allowances (Fundamental Deviations)**

The allowances (fundamental deviations) for internal and external threads have been calculated according to the following formulas and their rounded values given in Table 13. Allowance is the absolute value of fundamental deviation.

| Internal                    | External                              |
|-----------------------------|---------------------------------------|
| $EI_G = + (0.015 + 0.011P)$ | $es_e = - (0.05 + 0.011P)$ [Note (1)] |
| $EI_H = 0$                  | $es_f = - (0.03 + 0.011P)$            |
|                             | $es_g = - (0.015 + 0.011P)$           |
|                             | $es_h = 0$                            |

NOTE:

(1) Exceptions are values for threads with  $P \leq 0.45$  mm.**6.4 Length of Thread Engagement**

For the calculation of the limits of the normal length of thread engagement in Table 7, the following formulas have been used and their values rounded.

For each pitch,  $P$ , within a certain diameter range,  $d$  has been set equal to the smallest diameter within the table range.

$$\text{Normal } LE \text{ min.} = 2.24Pd^{0.2}$$

$$\text{Normal } LE \text{ max.} = 6.7Pd^{0.2}$$

**6.5 Crest Diameter Tolerances**

**6.5.1 Tolerances for Minor Diameter of Internal Thread,  $TD_1$ .** The  $TD_1$  tolerances for grade 6 are calculated according to the following formulas and rounded:

(a) Pitches 0.2 mm to 0.8 mm

$$TD_1(6) = 0.433P - 0.190P^{1.22}$$

(b) Pitches 1 mm and coarser

$$TD_1(6) = 0.230P^{0.7}$$

**6.5.1.1** The following rounded  $TD_1$  tolerance values for the other grades are obtained from the  $TD_1(6)$  values (in Table 9):

| Tolerance Grade | Tolerance               |
|-----------------|-------------------------|
| 4               | $TD_1(4) = 0.63TD_1(6)$ |
| 5               | $TD_1(5) = 0.8TD_1(6)$  |
| 6               | $TD_1(6)$               |
| 7               | $TD_1(7) = 1.25TD_1(6)$ |
| 8               | $TD_1(8) = 1.6TD_1(6)$  |

**6.5.2 Tolerances for Major Diameter of External Thread,  $T_d$ , Grade 6.** The  $T_d$  tolerances for grade 6 are calculated according to the following formula and rounded:

$$T_d(6) = 0.18 \sqrt[3]{P^2} - \frac{0.00315}{\sqrt{P}}$$

**6.5.2.1** The following rounded  $T_d$  tolerance values for the other grades are obtained from the  $T_d(6)$  values (see Table 10):

| Tolerance Grade | Tolerance             |
|-----------------|-----------------------|
| 4               | $T_d(4) = 0.63T_d(6)$ |
| 6               | $T_d(6)$              |
| 8               | $T_d(8) = 1.6T_d(6)$  |

**6.6 Pitch Diameter Tolerances**

**6.6.1 Tolerances for Pitch Diameter of External Thread,  $Td_2$ .**  $Td_2(6)$  values in Table 11 are calculated according to the following formula and rounded. ( $d$  is equal to the

**Table 11 Pitch Diameter Tolerance of External Thread,  $Td_2$  (ISO 965-1)**

| Basic Major Diameter, $d$ |                     | Pitch,<br>$P$ | Tolerance Grade |              |       |              |       |       |       |
|---------------------------|---------------------|---------------|-----------------|--------------|-------|--------------|-------|-------|-------|
| Over                      | Up to and Including |               | 3               | 4 [Note (1)] | 5     | 6 [Note (1)] | 7     | 8     | 9     |
| 1.5                       | 2.8                 | 0.2           | 0.025           | 0.032        | 0.040 | 0.050        | ...   | ...   | ...   |
|                           |                     | 0.25          | 0.028           | 0.036        | 0.045 | 0.056        | ...   | ...   | ...   |
|                           |                     | 0.35          | 0.032           | 0.040        | 0.050 | 0.063        | 0.080 | ...   | ...   |
|                           |                     | 0.4           | 0.034           | 0.042        | 0.053 | 0.067        | 0.085 | ...   | ...   |
|                           |                     | 0.45          | 0.036           | 0.045        | 0.056 | 0.071        | 0.090 | ...   | ...   |
| 2.8                       | 5.6                 | 0.35          | 0.034           | 0.042        | 0.053 | 0.067        | 0.085 | ...   | ...   |
|                           |                     | 0.5           | 0.038           | 0.048        | 0.060 | 0.075        | 0.095 | ...   | ...   |
|                           |                     | 0.6           | 0.042           | 0.053        | 0.067 | 0.085        | 0.106 | ...   | ...   |
|                           |                     | 0.7           | 0.045           | 0.056        | 0.071 | 0.090        | 0.112 | ...   | ...   |
|                           |                     | 0.75          | 0.045           | 0.056        | 0.071 | 0.090        | 0.112 | ...   | ...   |
|                           |                     | 0.8           | 0.048           | 0.060        | 0.075 | 0.095        | 0.118 | 0.150 | 0.190 |
| 5.6                       | 11.2                | 0.75          | 0.050           | 0.063        | 0.080 | 0.100        | 0.125 | ...   | ...   |
|                           |                     | 1             | 0.056           | 0.071        | 0.090 | 0.112        | 0.140 | 0.180 | 0.224 |
|                           |                     | 1.25          | 0.060           | 0.075        | 0.095 | 0.118        | 0.150 | 0.190 | 0.236 |
|                           |                     | 1.5           | 0.067           | 0.085        | 0.106 | 0.132        | 0.170 | 0.212 | 0.265 |
| 11.2                      | 22.4                | 1             | 0.060           | 0.075        | 0.095 | 0.118        | 0.150 | 0.190 | 0.236 |
|                           |                     | 1.25          | 0.067           | 0.085        | 0.106 | 0.132        | 0.170 | 0.212 | 0.265 |
|                           |                     | 1.5           | 0.071           | 0.090        | 0.112 | 0.140        | 0.180 | 0.224 | 0.280 |
|                           |                     | 1.75          | 0.075           | 0.095        | 0.118 | 0.150        | 0.190 | 0.236 | 0.300 |
|                           |                     | 2             | 0.080           | 0.100        | 0.125 | 0.160        | 0.200 | 0.250 | 0.315 |
|                           |                     | 2.5           | 0.085           | 0.106        | 0.132 | 0.170        | 0.212 | 0.265 | 0.335 |
| 22.4                      | 45                  | 1             | 0.063           | 0.080        | 0.100 | 0.125        | 0.160 | 0.200 | 0.250 |
|                           |                     | 1.5           | 0.075           | 0.095        | 0.118 | 0.150        | 0.190 | 0.236 | 0.300 |
|                           |                     | 2             | 0.085           | 0.106        | 0.132 | 0.170        | 0.212 | 0.265 | 0.335 |
|                           |                     | 3             | 0.100           | 0.125        | 0.160 | 0.200        | 0.250 | 0.315 | 0.400 |
|                           |                     | 3.5           | 0.106           | 0.132        | 0.170 | 0.212        | 0.265 | 0.335 | 0.425 |
|                           |                     | 4             | 0.112           | 0.140        | 0.180 | 0.224        | 0.280 | 0.355 | 0.450 |
|                           |                     | 4.5           | 0.118           | 0.150        | 0.190 | 0.236        | 0.300 | 0.375 | 0.475 |
| 45                        | 90                  | 1.5           | 0.080           | 0.100        | 0.125 | 0.160        | 0.200 | 0.250 | 0.315 |
|                           |                     | 2             | 0.090           | 0.112        | 0.140 | 0.180        | 0.224 | 0.280 | 0.355 |
|                           |                     | 3             | 0.106           | 0.132        | 0.170 | 0.212        | 0.265 | 0.335 | 0.425 |
|                           |                     | 4             | 0.118           | 0.150        | 0.190 | 0.236        | 0.300 | 0.375 | 0.475 |
|                           |                     | 5             | 0.125           | 0.160        | 0.200 | 0.250        | 0.315 | 0.400 | 0.500 |
|                           |                     | 5.5           | 0.132           | 0.170        | 0.212 | 0.265        | 0.335 | 0.425 | 0.530 |
|                           |                     | 6             | 0.140           | 0.180        | 0.224 | 0.280        | 0.355 | 0.450 | 0.560 |
| 90                        | 180                 | 2             | 0.095           | 0.118        | 0.150 | 0.190        | 0.236 | 0.300 | 0.375 |
|                           |                     | 3             | 0.112           | 0.140        | 0.180 | 0.224        | 0.280 | 0.355 | 0.450 |
|                           |                     | 4             | 0.125           | 0.160        | 0.200 | 0.250        | 0.315 | 0.400 | 0.500 |
|                           |                     | 6             | 0.150           | 0.190        | 0.236 | 0.300        | 0.375 | 0.475 | 0.600 |
|                           |                     | 8             | 0.170           | 0.212        | 0.265 | 0.335        | 0.425 | 0.530 | 0.670 |
| 180                       | 355                 | 3             | 0.125           | 0.160        | 0.200 | 0.250        | 0.315 | 0.400 | 0.500 |
|                           |                     | 4             | 0.140           | 0.180        | 0.224 | 0.280        | 0.355 | 0.450 | 0.560 |
|                           |                     | 6             | 0.160           | 0.200        | 0.250 | 0.315        | 0.400 | 0.500 | 0.630 |
|                           |                     | 8             | 0.180           | 0.224        | 0.280 | 0.355        | 0.450 | 0.560 | 0.710 |

GENERAL NOTE: All dimensions are in millimeters.

NOTE:

(1) Tabulated in this Standard for M Threads.

**Table 12 Pitch Diameter Tolerance of Internal Thread,  $TD_2$  (ISO 965-1)**

| Basic Major Diameter, $D$ |                     | Pitch,<br>$P$ | Tolerance Grade |       |              |       |       |
|---------------------------|---------------------|---------------|-----------------|-------|--------------|-------|-------|
| Over                      | Up to and Including |               | 4               | 5     | 6 [Note (1)] | 7     | 8     |
| 1.5                       | 2.8                 | 0.2           | 0.042           | ...   | ...          | ...   | ...   |
|                           |                     | 0.25          | 0.048           | 0.060 | ...          | ...   | ...   |
|                           |                     | 0.35          | 0.053           | 0.067 | 0.085        | ...   | ...   |
|                           |                     | 0.4           | 0.056           | 0.071 | 0.090        | ...   | ...   |
|                           |                     | 0.45          | 0.060           | 0.075 | 0.095        | ...   | ...   |
| 2.8                       | 5.6                 | 0.35          | 0.056           | 0.071 | 0.090        | ...   | ...   |
|                           |                     | 0.5           | 0.063           | 0.080 | 0.100        | 0.125 | ...   |
|                           |                     | 0.6           | 0.071           | 0.090 | 0.112        | 0.140 | ...   |
|                           |                     | 0.7           | 0.075           | 0.095 | 0.118        | 0.150 | ...   |
|                           |                     | 0.75          | 0.075           | 0.095 | 0.118        | 0.150 | ...   |
|                           |                     | 0.8           | 0.080           | 0.100 | 0.125        | 0.160 | 0.200 |
| 5.6                       | 11.2                | 0.75          | 0.085           | 0.106 | 0.132        | 0.170 | ...   |
|                           |                     | 1             | 0.095           | 0.118 | 0.150        | 0.190 | 0.236 |
|                           |                     | 1.25          | 0.100           | 0.125 | 0.160        | 0.200 | 0.250 |
|                           |                     | 1.5           | 0.112           | 0.140 | 0.180        | 0.224 | 0.280 |
| 11.2                      | 22.4                | 1             | 0.100           | 0.125 | 0.160        | 0.200 | 0.250 |
|                           |                     | 1.25          | 0.112           | 0.140 | 0.180        | 0.224 | 0.280 |
|                           |                     | 1.5           | 0.118           | 0.150 | 0.190        | 0.236 | 0.300 |
|                           |                     | 1.75          | 0.125           | 0.160 | 0.200        | 0.250 | 0.315 |
|                           |                     | 2             | 0.132           | 0.170 | 0.212        | 0.265 | 0.335 |
|                           |                     | 2.5           | 0.140           | 0.180 | 0.224        | 0.280 | 0.355 |
| 22.4                      | 45                  | 1             | 0.106           | 0.132 | 0.170        | 0.212 | ...   |
|                           |                     | 1.5           | 0.125           | 0.160 | 0.200        | 0.250 | 0.315 |
|                           |                     | 2             | 0.140           | 0.180 | 0.224        | 0.280 | 0.355 |
|                           |                     | 3             | 0.170           | 0.212 | 0.265        | 0.335 | 0.425 |
|                           |                     | 3.5           | 0.180           | 0.224 | 0.280        | 0.355 | 0.450 |
|                           |                     | 4             | 0.190           | 0.236 | 0.300        | 0.375 | 0.475 |
|                           |                     | 4.5           | 0.200           | 0.250 | 0.315        | 0.400 | 0.500 |
| 45                        | 90                  | 1.5           | 0.132           | 0.170 | 0.212        | 0.265 | 0.335 |
|                           |                     | 2             | 0.150           | 0.190 | 0.236        | 0.300 | 0.375 |
|                           |                     | 3             | 0.180           | 0.224 | 0.280        | 0.355 | 0.450 |
|                           |                     | 4             | 0.200           | 0.250 | 0.315        | 0.400 | 0.500 |
|                           |                     | 5             | 0.212           | 0.265 | 0.335        | 0.425 | 0.530 |
|                           |                     | 5.5           | 0.224           | 0.280 | 0.355        | 0.450 | 0.560 |
|                           |                     | 6             | 0.236           | 0.300 | 0.375        | 0.475 | 0.600 |
| 90                        | 180                 | 2             | 0.160           | 0.200 | 0.250        | 0.315 | 0.400 |
|                           |                     | 3             | 0.190           | 0.236 | 0.300        | 0.375 | 0.475 |
|                           |                     | 4             | 0.212           | 0.265 | 0.335        | 0.425 | 0.530 |
|                           |                     | 6             | 0.250           | 0.315 | 0.400        | 0.500 | 0.630 |
|                           |                     | 8             | 0.280           | 0.355 | 0.450        | 0.560 | 0.710 |
| 180                       | 355                 | 3             | 0.212           | 0.265 | 0.335        | 0.425 | 0.530 |
|                           |                     | 4             | 0.236           | 0.300 | 0.375        | 0.475 | 0.600 |
|                           |                     | 6             | 0.265           | 0.335 | 0.425        | 0.530 | 0.670 |
|                           |                     | 8             | 0.300           | 0.375 | 0.475        | 0.600 | 0.750 |

GENERAL NOTE: All dimensions are in millimeters.

NOTE:

(1) Tabulated in this Standard for M Threads.

**Table 13 Allowance (Fundamental Deviation) for Internal and External Threads (ISO 965-1)**

| Pitch,<br><i>P</i> | Allowance (Fundamental Deviation) [Note (1)]                      |                                   |                                                      |                         |                                   |                         |
|--------------------|-------------------------------------------------------------------|-----------------------------------|------------------------------------------------------|-------------------------|-----------------------------------|-------------------------|
|                    | Internal Thread,<br><i>D</i> <sub>2</sub> , <i>D</i> <sub>1</sub> |                                   | External Thread,<br><i>d</i> , <i>d</i> <sub>2</sub> |                         |                                   |                         |
|                    | <i>G</i> ,<br><i>El</i>                                           | <i>H</i> [Note (2)],<br><i>El</i> | <i>e</i> ,<br><i>es</i>                              | <i>f</i> ,<br><i>es</i> | <i>g</i> [Note (3)],<br><i>es</i> | <i>h</i> ,<br><i>es</i> |
| 0.2                | +0.017                                                            | 0                                 | ...                                                  | ...                     | -0.017                            | 0                       |
| 0.25               | +0.018                                                            | 0                                 | ...                                                  | ...                     | -0.018                            | 0                       |
| 0.3                | +0.018                                                            | 0                                 | ...                                                  | ...                     | -0.018                            | 0                       |
| 0.35               | +0.019                                                            | 0                                 | ...                                                  | -0.034                  | -0.019                            | 0                       |
| 0.4                | +0.019                                                            | 0                                 | ...                                                  | -0.034                  | -0.019                            | 0                       |
| 0.45               | +0.020                                                            | 0                                 | ...                                                  | -0.035                  | -0.020                            | 0                       |
| 0.5                | +0.020                                                            | 0                                 | -0.050                                               | -0.036                  | -0.020                            | 0                       |
| 0.6                | +0.021                                                            | 0                                 | -0.053                                               | -0.036                  | -0.021                            | 0                       |
| 0.7                | +0.022                                                            | 0                                 | -0.056                                               | -0.038                  | -0.022                            | 0                       |
| 0.75               | +0.022                                                            | 0                                 | -0.056                                               | -0.038                  | -0.022                            | 0                       |
| 0.8                | +0.024                                                            | 0                                 | -0.060                                               | -0.038                  | -0.024                            | 0                       |
| 1                  | +0.026                                                            | 0                                 | -0.060                                               | -0.040                  | -0.026                            | 0                       |
| 1.25               | +0.028                                                            | 0                                 | -0.063                                               | -0.042                  | -0.028                            | 0                       |
| 1.5                | +0.032                                                            | 0                                 | -0.067                                               | -0.045                  | -0.032                            | 0                       |
| 1.75               | +0.034                                                            | 0                                 | -0.071                                               | -0.048                  | -0.034                            | 0                       |
| 2                  | +0.038                                                            | 0                                 | -0.071                                               | -0.052                  | -0.038                            | 0                       |
| 2.5                | +0.042                                                            | 0                                 | -0.080                                               | -0.058                  | -0.042                            | 0                       |
| 3                  | +0.048                                                            | 0                                 | -0.085                                               | -0.063                  | -0.048                            | 0                       |
| 3.5                | +0.053                                                            | 0                                 | -0.090                                               | -0.070                  | -0.053                            | 0                       |
| 4                  | +0.060                                                            | 0                                 | -0.095                                               | -0.075                  | -0.060                            | 0                       |
| 4.5                | +0.063                                                            | 0                                 | -0.100                                               | -0.080                  | -0.063                            | 0                       |
| 5                  | +0.071                                                            | 0                                 | -0.106                                               | -0.085                  | -0.071                            | 0                       |
| 5.5                | +0.075                                                            | 0                                 | -0.112                                               | -0.090                  | -0.075                            | 0                       |
| 6                  | +0.080                                                            | 0                                 | -0.118                                               | -0.095                  | -0.080                            | 0                       |
| 8                  | +0.100                                                            | 0                                 | -0.140                                               | -0.118                  | -0.100                            | 0                       |

## NOTES:

- (1) Allowance is the absolute value of Fundamental Deviation.  
(2) Tabulated in this Standard for M Internal Threads.  
(3) Tabulated in this Standard for M External Threads.

geometrical mean value of the diameter range limits, i.e., the square root of the product of smallest and largest diameters.)

$$Td_2(6) = 0.09P^{0.4}d^{0.1}$$

**6.6.1.1** The following rounded  $Td_2$  tolerance values for the other grades are obtained from the  $Td_2(6)$  values (see Table 11). No  $Td_2$  values are given in Table 11 when values calculated according to the given formula exceed the  $Td$  values in the tolerance grades, which are combined in the tables for recommended tolerance classes.

Tolerance  
Grade

3  
4  
5  
6  
7  
8  
9

Tolerance

$Td_2(3) = 0.5Td_2(6)$   
 $Td_2(4) = 0.63Td_2(6)$   
 $Td_2(5) = 0.8Td_2(6)$   
 $Td_2(6)$   
 $Td_2(7) = 1.25Td_2(6)$   
 $Td_2(8) = 1.6Td_2(6)$   
 $Td_2(9) = 2Td_2(6)$

**6.6.2 Tolerances for Pitch Diameter of Internal Thread,  $TD_2$ .** The rounded  $TD_2$  tolerance values in Table 12 are calculated using formulas below and  $Td_2(6)$  values from

Table 11. No  $TD_2$  values are given in Table 12 when values calculated according to the given formula exceed  $0.25P$ .

| Tolerance Grade | Tolerance               |
|-----------------|-------------------------|
| 4               | $TD_2(4) = 0.85Td_2(6)$ |
| 5               | $TD_2(5) = 1.06Td_2(6)$ |
| 6               | $TD_2(6) = 1.32Td_2(6)$ |
| 7               | $TD_2(7) = 1.7Td_2(6)$  |
| 8               | $TD_2(8) = 2.12Td_2(6)$ |

## 7 DESIGNATION OF SCREW THREADS

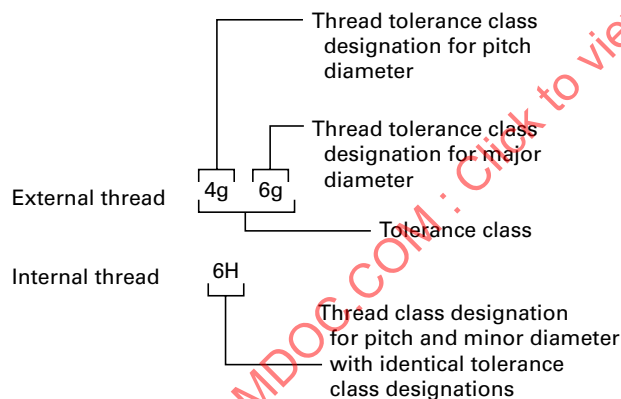
### 7.1 General

(a) The complete designation of a screw thread gives the thread symbol, the nominal size, the pitch, and the thread tolerance class.

(b) The tolerance class designation gives the class designation for the pitch diameter tolerance followed by a class designation for the crest diameter (major diameter for external thread and minor diameter for internal thread) tolerances.

(c) The class designation consists of a number indicating the tolerance grade followed by a letter indicating the tolerance position.

EXAMPLE:



### 7.2 Designation of Standard Screw Threads

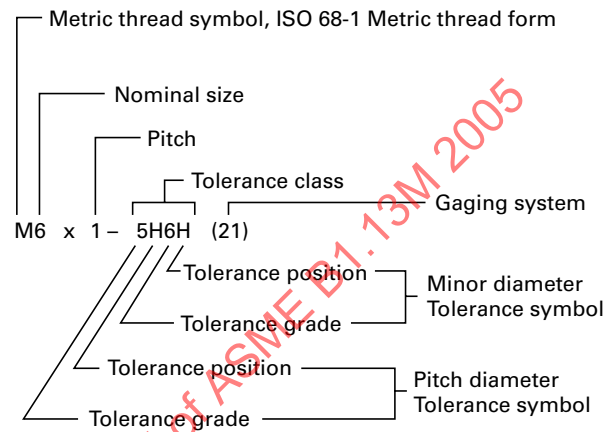
Metric screw threads are identified by the letter (M) for the thread form profile, followed by the nominal diameter size and the pitch expressed in millimeters, separated by the sign (×) and followed by the tolerance class separated by a dash (–) from the pitch.

The simplified international practice for designating coarse pitch M profile screw threads is to leave off the pitch. Thus a  $M14 \times 2$  thread is designated as just M14. To prevent misunderstanding, it is mandatory to use the value for pitch in all designations.

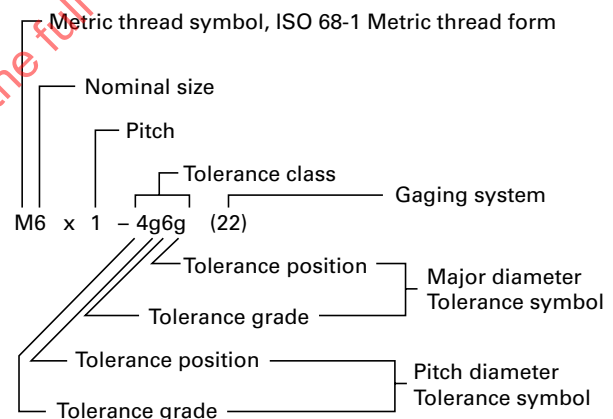
International practice permits a thread designation with tolerance class not specified for classes 6H and 6g. To prevent misunderstanding, it is mandatory to specify the tolerance class for all thread designations.

Thread acceptability gaging system requirements of ASME B1.3 may be added to the thread size designation as noted in examples or as specified in pertinent documentation, such as the drawing or procurement document.

#### (a) Internal Thread M Profile, Right Hand



#### (b) External Thread M Profile, Right Hand



Unless otherwise specified in the designation, the screw thread helix is right hand.

**7.2.1 Designation of Left-Hand Thread.** When left-hand thread is specified, the tolerance class designation is followed by a dash and LH.

EXAMPLE:

$M6 \times 1 - 5H6H - LH (23)$

**7.2.2 Designation of Identical Tolerance Classes.** If the two tolerance class designations for a thread are identical, it is not necessary to repeat the symbols.

EXAMPLE:

$M6 \times 1 - 6H (21)$

**7.2.3 Designations Using All Capital Letters.** When computer and teletype thread designations use all capital letters, the external or internal thread may need further identification. Thus the tolerance class identification is followed by the abbreviations EXT or INT in capital letters.

EXAMPLES:

M6 × 1 – 4G6G EXT  
M6 × 1 – 6H INT

### 7.3 Designation of Thread Fit

A fit between mating threads is indicated by the internal thread tolerance class followed by the external thread tolerance class separated by a slash.

EXAMPLES:

M6 × 1 – 6H/6g  
M6 × 1 – 6H/4g6g

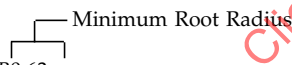
### 7.4 Designation of Rounded Root External Thread

**7.4.1 Modified ISO 68-1 Thread With Radius Root  $r$  min. = 0.125P.** For the mandatory condition-external fasteners of property class 8.8 and stronger (see para. 3.3.2), no special designation is required. Other parts requiring a 0.125P root radius must specify that radius as in para. 7.4.2.

**7.4.2 Designation of Special Rounded Root Thread.** When a special rounded root thread is required, its external thread designation is suffixed by the letter R and the minimum root radius value in millimeters.

EXAMPLE:

M42 × 4.5 – 6g – R0.63



### 7.5 Designation of Threads Having Modified Crests

Where the limits of size of the major diameter of an external thread or the minor diameter of an internal thread are modified, the thread designation is suffixed by the letters MOD followed by the modified diameter limits.

EXAMPLE: External thread M profile, major diameter reduced 0.075 mm.

M6 × 1 – 4h6h MOD  
MAJOR DIA 5.745 – 5.925 MOD

EXAMPLE: Internal thread M profile, minor diameter increased 0.075 mm.

M6 × 1 – 4H5H MOD  
MINOR DIA 5.101 – 5.291 MOD

### 7.6 Designation of Special Threads

Special diameter-pitch threads, developed in accordance with this Standard, shall be identified by the letters SPL following the tolerance class. Below the designation shall be specified the limits of size for major diameter, pitch diameter, and minor diameter.

EXAMPLE: External thread

M6.5 × 1 – 4h6h – SPL (22)  
MAJOR DIA 6.320 – 6.500  
PD 5.779 – 5.850  
MINOR DIA 5.163 – 5.386

EXAMPLE: Internal thread

M6.5 × 1 – 4H5H – SPL (23)  
MAJOR DIA 6.500 MIN.  
PD 5.850 – 5.945  
MINOR DIA 5.417 – 5.607

### 7.7 Designation of Multiple Start Threads

When a thread is required with a multiple start, it is designated by specifying sequentially M for metric thread, nominal diameter size, ×, L for lead, lead value, P for pitch, pitch value, parenthesis, number of starts, and the word “Starts,” close parenthesis, dash, tolerance class.

EXAMPLES:

M16 × L4P2 (2 STARTS) – 4h6h  
M14 × L6P2 (3 STARTS) – 6H

### 7.8 Designation of Coated or Plated Threads

**7.8.1 Designation of Coated or Plated M Threads.** Specify if the tolerance class is after coating or after plating. If no designation of after coating or after plating is specified, the tolerance class applies before coating or plating in accordance with ISO practice. After plating, the thread profile shall not transgress the maximum material limits for the tolerance position H/h.

EXAMPLES:

M6 × 1 – 6h AFTER COATING or AFTER PLATING  
M6 × 1 – 6g AFTER COATING or AFTER PLATING

**7.8.2** Where the tolerance position G/g is insufficient relief for the application to hold the threads within product limits, the coating or plating allowance may be specified as the maximum and minimum limits of size for threads before coating or plating. See section 8.

EXAMPLE: Allowance on external thread M profile based on 0.010 mm min. coating thickness

M6 × 1 – 4h6h – AFTER COATING

BEFORE COATING

MAJOR DIA 5.800 – 5.970  
PD 5.239 – 5.290  
MINOR DIA 4.887 MAX.

### 7.9 Designation of Threads With Adjusted Size Limits

If a standard thread requires adjustment of size limits of thread elements, so that standard allowances or tolerances do not apply, designation shall include the individual element sizes; each special size shall be identified as “SPL.”

EXAMPLE: External thread with allowance of 0.100 and pitch/major diameter tolerance grade of 4

M24 × 3 – SPL – EXT (22)  
 MAJOR DIA 23.664 – 23.900 SPL  
 PD 21.826 – 21.951 SPL  
 MINOR DIA 20.652 MAX. SPL

EXAMPLE: Internal thread with no allowance but with tolerance class 4G limits at minimum material.

M24 × 3 – SPL – INT (22)  
 MINOR DIA 20.752 – 21.115 SPL  
 PD 22.051 – 22.269 SPL  
 MAJOR DIA 24.000 MIN.

## 8 DIMENSIONAL ACCOMMODATION OF COATING OR PLATING FOR 60 deg THREADS

### 8.1 Introduction

It is not within the scope of this Standard to make recommendations for thickness of, or to specify limits for coatings. However, it will aid mechanical interchangeability if certain principles are followed wherever conditions permit. The following guides should be helpful in determining the amount and direction of the alterations to establish applicable limits of size before coating. Some commonly used and firmly established processes for heavy coatings, such as hot-dip galvanizing, do not fall within the scope of the section. Appendix E contains information on internal threads of tolerance class 6AX, which follow USA practice of overlapping to accommodate as-coated hot-dip galvanized external threads. Appendix F contains information on internal thread tolerance position *E*, which may be used where *G* does not provide sufficient allowance, but where *AX* would be excessive.

NOTE: The term *coating* refers to one or more applications of additive material to the threads, but not limited to, electroplated deposits, anodized deposits, dry film lubricants, dip-spin applied materials, and mechanically applied platings. It does not include soft or liquid lubricants that are readily displaced in assembly and gaging. Plating is therefore included as coating in the text.

### 8.2 Material Limits for Coated Threads

Unless otherwise specified, size limits for standard external thread tolerance classes 6g and 4g6g apply prior to coating. The external thread allowance may thus be used to accommodate the coating thickness on coated parts, provided that the maximum coating thickness is not more than  $\frac{1}{4}$  of the allowance. Thus, a 6g thread after coating is subject to acceptance using a basic size 6h GO thread gage and a 4g6g thread, a 4h6h or 6h GO thread gage. (Basic thread sizes, tolerance position *h*, are tabulated in Appendix D and size limits for 6h threads are included in Table 14.) Minimum material, LO or NOT-GO gages would be 6g and 4g6g, respectively. Where external thread has no allowance or allowance must be maintained after coating, and for standard internal threads, sufficient allowance must be provided prior to coating to ensure that finished product threads do not exceed the maximum material limits specified. For

thread classes with tolerance position *H* or *h*, coating allowances in accordance with Table 13 for positions *G* or *g* respectively, should be applied whenever possible. See paras. 8.4, 8.5, and 8.6.

### 8.3 Dimensional Effects of Coating

(a) On a cylindrical surface, the effect of coating is to change the diameter by twice the coating thickness — one coating thickness on each side of the cylinder. On a screw thread, this would apply to the major and minor diameters.

(b) Because the coating thickness is measured perpendicular to the coated surface, while the pitch diameter is measured perpendicular to the thread axis, the effect of a uniformly coated thread flank on the pitch diameter is a change 4 times the thickness of coating on the flank. (see Fig. 6). The diameters of external threads before coating will be smaller while the diameters of internal threads before coating will be larger than the coated diameters.

(c) Most coatings and platings do not apply uniformly on threads (see para. 8.7 and Fig. 7). Different coating materials and processes have different application characteristics. The threaded part's overall length and other configuration characteristics also affect the way coatings build up on the threads. Paragraphs 8.4, 8.5, and 8.6 provide general guidelines for calculating precoat thread size to allow for coating build-up while preventing interference in assembly. The exact precoat thread size for a given part with a given type of coating will frequently have to be developed by the producer experimentally.

### 8.4 External Thread With Allowance Available for Coating

**8.4.1 Maximum and Minimum Coating Thickness Specified.** The amount of the allowance on the pitch diameter is sufficient if 4 times the maximum coating thickness is equal to or less than the allowance tabulated in Table 13 or 14 or, if not in these tables, calculated per formula in para. 6.3.

**8.4.2 Only Nominal or Minimum Coating Thickness Specified.** If no coating thickness tolerance is given, it is recommended that a tolerance of plus 50% of the nominal or minimum thickness be assumed. Then, the amount of the allowance on the pitch diameter is sufficient if 6 times the specified coating thickness is equal to or less than the allowance tabulated in Table 13 or 14 or, if not in these tables, calculated per formula in para. 6.3.

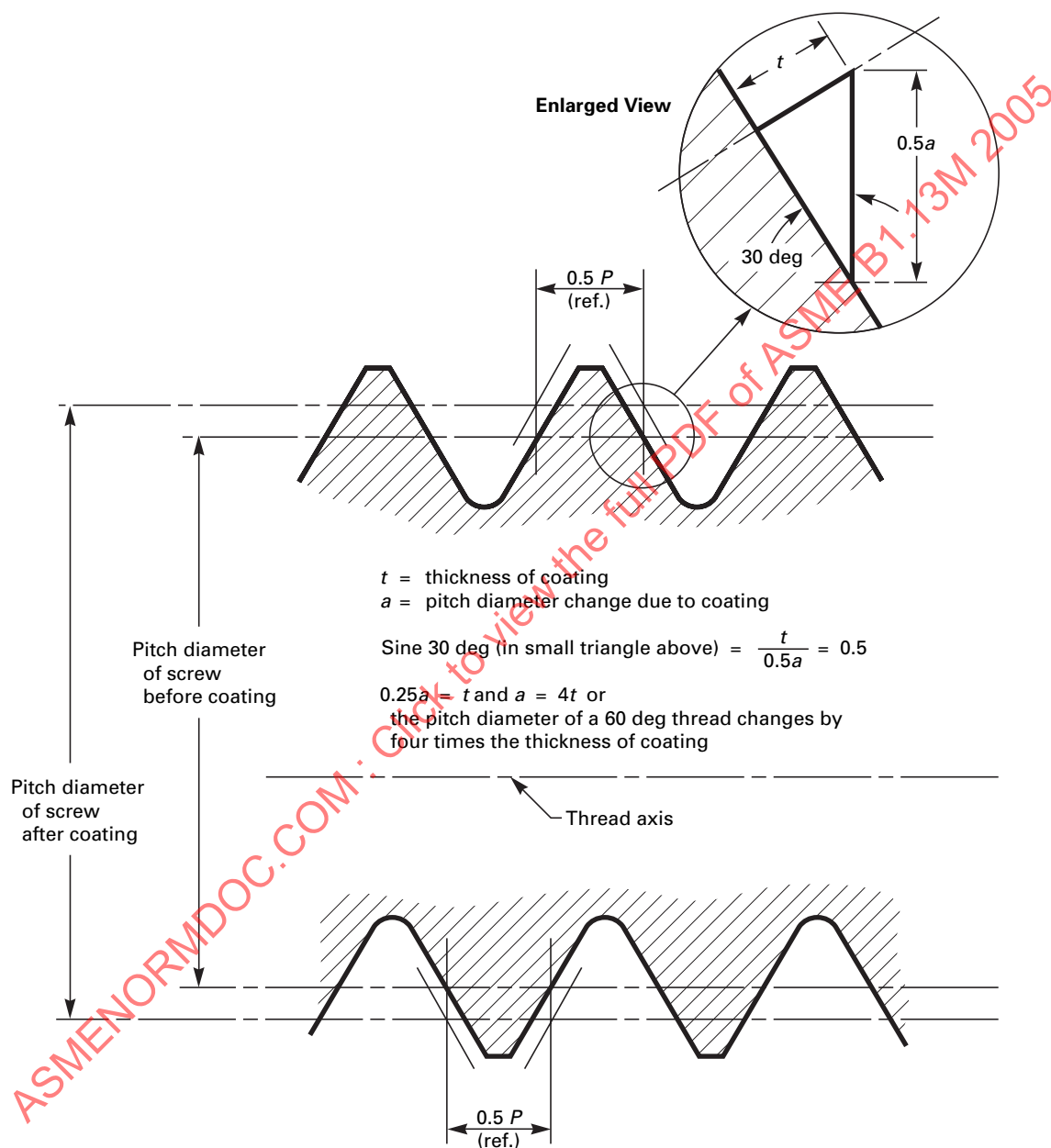
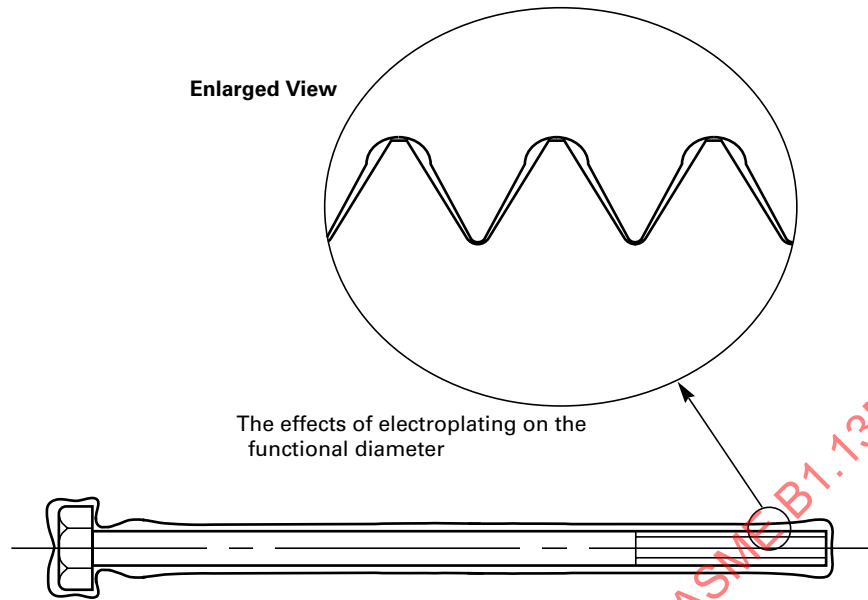


Fig. 6 Ratio of Pitch Diameter Change to Thickness of Coating on 60 deg Threads



GENERAL NOTE: Electrodeposited coating builds up more heavily at sharp corners, is greater at the the extreme ends and edges of a length, and is least in the center and recessed areas.

**Fig. 7 Effects of Electrodeposited Coating on 60 deg External Threads**

## 8.5 External Thread With No Allowance for Coating

**8.5.1 Maximum and Minimum Coating Thickness Specified.** To determine before coating product limits, decrease

- (a) maximum pitch diameter by 4 times maximum coating thickness
- (b) minimum pitch diameter by 4 times minimum coating thickness
- (c) maximum major diameter by 2 times maximum coating thickness
- (d) minimum major diameter by 2 times minimum coating thickness
- (e) maximum minor diameter by 2 times maximum coating thickness

EXAMPLE:

M10 × 1.5 – 6g After Coating  
Coating Thickness 0.005 – 0.008

To determine the before coating maximum material sizes, decrease the maximum pitch diameter of 8.994 by 0.032 ( $4 \times 0.008$ ) to 8.962, the maximum major diameter of 9.968 by 0.016 ( $2 \times 0.008$ ) to 9.952, and the maximum minor diameter of 8.344 by 0.016 ( $2 \times 0.008$ ) to 8.328. For the before coating minimum sizes, decrease the minimum pitch diameter of 8.862 by 0.020 ( $4 \times 0.005$ ) to 8.842 and the minimum major diameter of 9.732 by 0.010 ( $2 \times 0.005$ ) to 9.722. The before coating sizes should be included in the thread designation. (See para. 7.8.2.)

**8.5.2 Only Nominal or Minimum Coating Thickness Specified.** If no coating thickness tolerance is given, it

is recommended that a tolerance of plus 50% of the nominal or minimum thickness be assumed. Then, to determine before coating product limits, decrease

- (a) maximum pitch diameter by 6 times coating thickness
- (b) minimum pitch diameter by 4 times coating thickness
- (c) maximum major diameter by 3 times coating thickness
- (d) minimum major diameter by 2 times coating thickness
- (e) maximum minor diameter by 3 times coating thickness

EXAMPLE:

M14 × 2 – 4h6h Coating Thickness 0.008

Since allowance for tolerance position g is 0.038, the maximum thickness of coating that may be applied is equal to 0.038 divided by 6 or 0.0063. This is not sufficient for the required coating of 0.008 so additional adjustments must be made.

To determine the before coating maximum material sizes, decrease the maximum pitch diameter of 12.701 by 0.048 ( $6 \times 0.008$ ) to 12.653, the maximum major diameter of 14.000 by 0.024 ( $3 \times 0.008$ ) to 13.976, and the maximum minor diameter of 11.835 by 0.024 ( $3 \times 0.008$ ) to 11.811. For the before coating minimum sizes, decrease the minimum pitch diameter of 12.601 by 0.032 ( $4 \times 0.008$ ) to 12.569 and the minimum major diameter

of 13.720 by 0.016 ( $2 \times 0.008$ ) to 13.704. The before coating sizes should be included in the thread designation. (See para. 7.8.2.)

**8.5.3 Adjusted Size Limits.** It should be noted in the above examples that the before coating material limit tolerances are less than the tolerances after coating. This is because the coating tolerance consumes some of the product tolerance. In some instances there may be insufficient pitch diameter tolerance available in the before coating condition so that additional adjustments and controls will be necessary.

**8.5.4 Strength.** On small thread sizes (5 mm and smaller) there is a possibility that coating thickness adjustments will cause base material minimum material conditions that may significantly affect the strength of externally threaded parts. Limitations on coating thickness or part redesign may be necessary.

## 8.6 Internal Threads

**8.6.1 Maximum and Minimum Coating Thickness Specified.** Standard internal threads provide no allowance for coating thickness. Use the allowance provided by tolerance position G (see Table 13) if 4 times the maximum coating thickness specified is equal or less than this allowance. Otherwise, to determine before coating product limits, increase

- (a) minimum pitch diameter by 4 times maximum coating thickness
- (b) maximum pitch diameter by 4 times minimum coating thickness
- (c) minimum minor diameter by 2 times maximum coating thickness
- (d) maximum minor diameter by 2 times minimum coating thickness
- (e) minimum major diameter by 2 times maximum coating thickness

EXAMPLE:

M12  $\times$  1.75 – 6H Coating Thickness 0.006 – 0.010

Allowance provided by tolerance position G is 0.034. But 4 times the maximum coating thickness, the maximum diametral increase, is 0.040 ( $4 \times 0.010$ ). This is larger than the allowance provided by tolerance position G so additional adjustments must be made to the thread limits.

To determine the before coating minimum product sizes, increase the minimum pitch diameter of 10.863 by 0.040 ( $4 \times 0.010$ ) to 10.903, the minimum minor diameter of 10.106 by 0.020 ( $2 \times 0.010$ ) to 10.126, and the minimum major diameter of 12.000 by 0.020 ( $2 \times 0.010$ ) to 12.020. For the before coating maximum sizes, increase the maximum pitch diameter of 11.063 by 0.024 ( $4 \times 0.006$ ) to 11.087 and the maximum minor diameter of 10.441 by 0.012 ( $2 \times 0.006$ ) to 10.453. The before coating sizes should be included in the thread designation. (See para. 7.8.2.)

**8.6.2 Only Nominal or Minimum Coating Thickness Specified.** If no thickness tolerance is given, it is recommended that a tolerance of plus 50% of the nominal or minimum thickness be assumed. Since standard internal threads provide no allowance for coating thickness, use the allowance provided by tolerance position G (see Table 13) if 6 times the nominal or minimum coating thickness specified is equal or less than this allowance. Otherwise, to determine before coating product limits, increase

- (a) minimum pitch diameter by 6 times the minimum or nominal coating thickness
- (b) maximum pitch diameter by 4 times the minimum or nominal coating thickness
- (c) minimum minor diameter by 3 times the minimum or nominal coating thickness
- (d) maximum minor diameter by 2 times the minimum or nominal coating thickness
- (e) minimum major diameter by 3 times the minimum or nominal coating thickness

EXAMPLE:

M20  $\times$  2.5 – 6H Coating Thickness 0.010

Allowance provided by tolerance position G is 0.042. But 6 times the minimum or nominal coating thickness, the maximum diametral increase, is 0.060 ( $6 \times 0.010$ ). This is larger than the allowance provided by tolerance position G so additional adjustments must be made to the thread limits.

To determine the before coating minimum product sizes, increase the minimum pitch diameter of 18.376 by 0.060 ( $6 \times 0.010$ ) to 18.436, the minimum minor diameter of 17.294 by 0.030 ( $3 \times 0.010$ ) to 17.324, and the minimum major diameter of 20.000 by 0.030 ( $3 \times 0.010$ ) to 20.030. For the before coating maximum sizes, increase the maximum pitch diameter of 18.600 by 0.040 ( $4 \times 0.010$ ) to 18.640 and the maximum minor diameter of 17.744 by 0.020 ( $2 \times 0.010$ ) to 17.764. The before coating sizes should be included in the thread designation. (See para. 7.8.2.)

**8.6.3 Adjusted Size Limits.** It should be noted in the above examples that the before coating material limit tolerances are less than the tolerances after coating. This is because the coating tolerance consumes some of the product tolerance. In some instances there may be insufficient pitch diameter tolerance available in the before coating condition so that additional adjustments and controls will be necessary.

**8.6.4 Strength.** There is a possibility that coating thickness adjustments will cause base material minimum material conditions that may seriously affect strength of threaded parts. Limitations on coating thickness or part redesign may be necessary.

## 8.7 Electrodeposited Coatings

Electroplated coatings do not cover threads uniformly. Deposits build up more on thread crests than on thread

flanks and coating thickness is greater on the lead end of a thread than on threads in the center of a part. The guidelines for calculating precoating thread sizes for uniformly coated threads can be used as a starting place in determining the precoating thread sizes on a given part, but the exact sizes for any given part may have to be determined by trial and error experimentation. One of the effects of electrodeposited coatings not applying uniformly is that the functional diameter of an external thread will generally increase by a greater magnitude than the increase of the pitch diameter on a given part. Depending on an externally threaded part's configuration, an electrodeposited coating of 0.0025 mm on a thread flank will probably result in a growth of the pitch diameter of approximately 0.0100 mm or more, but the functional diameter may change by as much as 0.0150 mm or more. In the case of internally threaded parts, electrodeposited coatings cause the pitch diameter and functional diameter to decrease in size, with the pitch diameter decreasing less than the functional diameter on a given part.

Another effect of the nonuniform build-up of electrodeposited coatings is that the coating thickness on the lead end of a thread is commonly greater than the thickness on the threads in the center of the part. This results in the pitch diameter and the functional diameter of a thread to be considerably larger on the end of the part than their comparable measurements away from the end. The longer the part, in the case of external threads, or the thicker the part, in the case of internal threads, the greater these differences tend to be. The part producer and the plater cannot control this phenomenon. It is the nature of electrodeposited coatings on threaded parts. It is conceivable that a part's dimensions can measure within limits on the lead threads and be beyond their limits on the threads away from the lead threads.

## 8.8 Other Considerations

It is essential to adequately review all possibilities and consider limitations in the threading and coating production processes before finalizing the coating process and the allowance required to accommodate the coating. A no-allowance thread after coating shall not transgress the basic profile and is, therefore, subject to acceptance using a basic (tolerance position  $H/h$ ) size GO thread gage. Basic sizes for ISO series threads appear in Appendix D.

## 9 LIMITS OF SIZE

### 9.1 Standard Thread Series

(a) The limiting M profile for internal threads is shown in Fig. 8 with the associated dimensions in Table 15.

(b) The limiting M profiles for external threads are shown in Fig. 9 with the associated dimensions listed in Table 14.

(c) For information, basic dimensions of all ISO series metric screw threads, including the standard series, appear in Appendix D.

### 9.2 Determination of Size Limits

(a) Values listed in Tables 14 and 15 shall be used to determine limits of size.

(b) If required values are not listed in Tables 14 and 15, they shall be calculated using ISO data in Tables 7, 9, 10, 11, 12, and 13 and formulas in para. 9.3.

(c) If required data is not included in any of the tables listed above, calculate the missing data from formulas given in section 6 and in para. 9.3. Round in accordance with ASME B1.30, which includes rounding rules and examples.

(d) Examples in paras. 9.4.1 and 9.4.2, demonstrate the use of tabulated values of allowances and tolerances for calculating size limits for standard ISO 261 sizes (see Table 6). Examples in paras. 9.4.3 and 9.4.4, demonstrate the use of formulas for calculating values of allowances and tolerances for determining size limits for nonstandard thread sizes.

NOTE: If any tabulated values for allowance and tolerance are available, do not use formulas for calculation of these values. Calculate from formulas only when tabulated values do not exist.

### 9.3 Formulas for Calculating Limiting Dimensions for M Profile Screw Threads

#### 9.3.1 Internal Thread

(a) Minimum major diameter = basic major diameter +  $EI$  (Table 13)

(b) Minimum pitch diameter = basic major diameter -  $0.6495191P$  (Table 2) +  $EI$  for  $D_2$  (Table 13)

(c) Maximum pitch diameter = minimum pitch diameter +  $TD_2$  (Table 12)

(d) Maximum major diameter = maximum pitch diameter +  $0.7938566P$  (Table 2)

(e) Minimum minor diameter = minimum major diameter -  $1.0825318P$  (Table 2)

(f) Maximum minor diameter = minimum minor diameter +  $TD_1$  (Table 9)

#### 9.3.2 External Thread

(a) Maximum major diameter = basic major diameter -  $es$  (Table 13)

NOTE:  $es$  is absolute value.

(b) Minimum major diameter = maximum major diameter -  $Td$  (Table 10)

(c) Maximum pitch diameter = basic major diam. -  $0.6495191P$  (Table 2) -  $es$  for  $d_2$  (Table 13)

(d) Minimum pitch diameter = maximum pitch diameter -  $Td_2$  (Table 11)

Table 14 External Thread — Limiting Dimensions M Profile

| Basic Thread Designation | Tolerance Class | Allowances<br>[Note (1)] | Major Diameter,<br>$d$<br>[Note (2)] |       | Pitch Diameter, $d_2$ and<br>Functional Diameter<br>[Notes (2) and (3)] |       | Max. Minor<br>Diameter,<br>$d_1$<br>(Flat Form),<br>[Note (2)] | Min. Minor<br>Diameter<br>(Rounded<br>Form), $d_3$<br>[Note (4)]<br>(For Reference) |
|--------------------------|-----------------|--------------------------|--------------------------------------|-------|-------------------------------------------------------------------------|-------|----------------------------------------------------------------|-------------------------------------------------------------------------------------|
|                          |                 |                          | Max.                                 | Min.  | Max.                                                                    | Min.  |                                                                |                                                                                     |
| M1.6 × 0.35              | 6g              | 0.019                    | 1.581                                | 1.496 | 1.354                                                                   | 1.291 | 1.202                                                          | 1.075                                                                               |
| M1.6 × 0.35              | 6h              | 0.000                    | 1.600                                | 1.515 | 1.373                                                                   | 1.310 | 1.221                                                          | 1.094                                                                               |
| M1.6 × 0.35              | 4g6g            | 0.019                    | 1.581                                | 1.496 | 1.354                                                                   | 1.314 | 1.202                                                          | 1.098                                                                               |
| M2 × 0.4                 | 6g              | 0.019                    | 1.981                                | 1.886 | 1.721                                                                   | 1.654 | 1.548                                                          | 1.408                                                                               |
| M2 × 0.4                 | 6h              | 0.000                    | 2.000                                | 1.905 | 1.740                                                                   | 1.673 | 1.567                                                          | 1.427                                                                               |
| M2 × 0.4                 | 4g6g            | 0.019                    | 1.981                                | 1.886 | 1.721                                                                   | 1.679 | 1.548                                                          | 1.433                                                                               |
| M2.5 × 0.45              | 6g              | 0.020                    | 2.480                                | 2.380 | 2.188                                                                   | 2.117 | 1.993                                                          | 1.840                                                                               |
| M2.5 × 0.45              | 6h              | 0.000                    | 2.500                                | 2.400 | 2.208                                                                   | 2.137 | 2.013                                                          | 1.860                                                                               |
| M2.5 × 0.45              | 4g6g            | 0.020                    | 2.480                                | 2.380 | 2.188                                                                   | 2.143 | 1.993                                                          | 1.866                                                                               |
| M3 × 0.5                 | 6g              | 0.020                    | 2.980                                | 2.874 | 2.655                                                                   | 2.580 | 2.438                                                          | 2.272                                                                               |
| M3 × 0.5                 | 6h              | 0.000                    | 3.000                                | 2.894 | 2.675                                                                   | 2.600 | 2.458                                                          | 2.292                                                                               |
| M3 × 0.5                 | 4g6g            | 0.020                    | 2.980                                | 2.874 | 2.655                                                                   | 2.607 | 2.438                                                          | 2.299                                                                               |
| M3.5 × 0.6               | 6g              | 0.021                    | 3.479                                | 3.354 | 3.089                                                                   | 3.004 | 2.829                                                          | 2.634                                                                               |
| M3.5 × 0.6               | 6h              | 0.000                    | 3.500                                | 3.375 | 3.110                                                                   | 3.025 | 2.850                                                          | 2.655                                                                               |
| M3.5 × 0.6               | 4g6g            | 0.021                    | 3.479                                | 3.354 | 3.089                                                                   | 3.036 | 2.829                                                          | 2.666                                                                               |
| M4 × 0.7                 | 6g              | 0.022                    | 3.978                                | 3.838 | 3.523                                                                   | 3.433 | 3.220                                                          | 3.002                                                                               |
| M4 × 0.7                 | 6h              | 0.000                    | 4.000                                | 3.860 | 3.545                                                                   | 3.455 | 3.242                                                          | 3.024                                                                               |
| M4 × 0.7                 | 4g6g            | 0.022                    | 3.978                                | 3.838 | 3.523                                                                   | 3.467 | 3.220                                                          | 3.036                                                                               |
| M5 × 0.8                 | 6g              | 0.024                    | 4.976                                | 4.826 | 4.456                                                                   | 4.361 | 4.110                                                          | 3.868                                                                               |
| M5 × 0.8                 | 6h              | 0.000                    | 5.000                                | 4.850 | 4.480                                                                   | 4.385 | 4.134                                                          | 3.892                                                                               |
| M5 × 0.8                 | 4g6g            | 0.024                    | 4.976                                | 4.826 | 4.456                                                                   | 4.396 | 4.110                                                          | 3.903                                                                               |
| M6 × 1                   | 6g              | 0.026                    | 5.974                                | 5.794 | 5.324                                                                   | 5.212 | 4.891                                                          | 4.596                                                                               |
| M6 × 1                   | 6h              | 0.000                    | 6.000                                | 5.820 | 5.350                                                                   | 5.238 | 4.917                                                          | 4.622                                                                               |
| M6 × 1                   | 4g6g            | 0.026                    | 5.974                                | 5.794 | 5.324                                                                   | 5.253 | 4.891                                                          | 4.637                                                                               |
| M8 × 1.25                | 6g              | 0.028                    | 7.972                                | 7.760 | 7.160                                                                   | 7.042 | 6.619                                                          | 6.272                                                                               |
| M8 × 1.25                | 6h              | 0.000                    | 8.000                                | 7.788 | 7.188                                                                   | 7.070 | 6.647                                                          | 6.300                                                                               |
| M8 × 1.25                | 4g6g            | 0.028                    | 7.972                                | 7.760 | 7.160                                                                   | 7.085 | 6.619                                                          | 6.315                                                                               |
| M8 × 1                   | 6g              | 0.026                    | 7.974                                | 7.794 | 7.324                                                                   | 7.212 | 6.891                                                          | 6.596                                                                               |
| M8 × 1                   | 6h              | 0.000                    | 8.000                                | 7.820 | 7.350                                                                   | 7.238 | 6.917                                                          | 6.622                                                                               |
| M8 × 1                   | 4g6g            | 0.026                    | 7.974                                | 7.794 | 7.324                                                                   | 7.253 | 6.891                                                          | 6.637                                                                               |

Table 14 External Thread — Limiting Dimensions M Profile (Cont'd)

| Basic Thread Designation | Tolerance Class | Allowance, $e_s$<br>[Note (1)] | Major Diameter, $d$<br>[Note (2)] |        | Pitch Diameter, $d_2$ and Functional Diameter<br>[Notes (2) and (3)] |        |       | Max. Minor Diameter, $d_1$<br>(Flat Form), $d_1$<br>[Note (2)] | Min. Minor Diameter (Rounded Form), $d_3$<br>[Note (4)]<br>(For Reference) |
|--------------------------|-----------------|--------------------------------|-----------------------------------|--------|----------------------------------------------------------------------|--------|-------|----------------------------------------------------------------|----------------------------------------------------------------------------|
|                          |                 |                                | Max.                              | Min.   | Max.                                                                 | Min.   | Tol.  |                                                                |                                                                            |
| M10 × 1.5                | 6g              | 0.032                          | 9.968                             | 9.732  | 8.994                                                                | 8.862  | 0.132 | 8.344                                                          | 7.938                                                                      |
| M10 × 1.5                | 6h              | 0.000                          | 10.000                            | 9.764  | 9.026                                                                | 8.894  | 0.132 | 8.376                                                          | 7.970                                                                      |
| M10 × 1.5                | 4g6g            | 0.032                          | 9.968                             | 9.732  | 8.994                                                                | 8.909  | 0.085 | 8.344                                                          | 7.985                                                                      |
| M10 × 1.25               | 6g              | 0.028                          | 9.972                             | 9.760  | 9.160                                                                | 9.042  | 0.118 | 8.619                                                          | 8.272                                                                      |
| M10 × 1.25               | 6h              | 0.000                          | 10.000                            | 9.788  | 9.188                                                                | 9.070  | 0.118 | 8.647                                                          | 8.300                                                                      |
| M10 × 1.25               | 4g6g            | 0.028                          | 9.972                             | 9.760  | 9.160                                                                | 9.085  | 0.075 | 8.619                                                          | 8.315                                                                      |
| M10 × 1                  | 6g              | 0.026                          | 9.974                             | 9.794  | 9.324                                                                | 9.212  | 0.112 | 8.891                                                          | 8.596                                                                      |
| M10 × 1                  | 6h              | 0.000                          | 10.000                            | 9.820  | 9.350                                                                | 9.238  | 0.112 | 8.917                                                          | 8.622                                                                      |
| M10 × 1                  | 4g6g            | 0.026                          | 9.974                             | 9.794  | 9.324                                                                | 9.253  | 0.071 | 8.891                                                          | 8.637                                                                      |
| M10 × 0.75               | 6g              | 0.022                          | 9.978                             | 9.838  | 9.491                                                                | 9.391  | 0.100 | 9.166                                                          | 8.929                                                                      |
| M10 × 0.75               | 6h              | 0.000                          | 10.000                            | 9.860  | 9.513                                                                | 9.413  | 0.100 | 9.188                                                          | 8.951                                                                      |
| M10 × 0.75               | 4g6g            | 0.022                          | 9.978                             | 9.838  | 9.491                                                                | 9.428  | 0.063 | 9.166                                                          | 8.966                                                                      |
| M12 × 1.75               | 6g              | 0.034                          | 11.966                            | 11.701 | 10.829                                                               | 10.679 | 0.150 | 10.071                                                         | 9.601                                                                      |
| M12 × 1.75               | 6h              | 0.000                          | 12.000                            | 11.735 | 10.863                                                               | 10.713 | 0.150 | 10.105                                                         | 9.635                                                                      |
| M12 × 1.75               | 4g6g            | 0.034                          | 11.966                            | 11.701 | 10.829                                                               | 10.734 | 0.095 | 10.071                                                         | 9.656                                                                      |
| M12 × 1.5                | 6g              | 0.032                          | 11.968                            | 11.732 | 10.994                                                               | 10.854 | 0.140 | 10.344                                                         | 9.930                                                                      |
| M12 × 1.5                | 6h              | 0.000                          | 12.000                            | 11.764 | 11.026                                                               | 10.886 | 0.140 | 10.376                                                         | 9.962                                                                      |
| M12 × 1.5                | 4g6g            | 0.032                          | 11.968                            | 11.732 | 10.994                                                               | 10.904 | 0.090 | 10.344                                                         | 9.980                                                                      |
| M12 × 1.25               | 6g              | 0.028                          | 11.972                            | 11.760 | 11.160                                                               | 11.028 | 0.132 | 10.619                                                         | 10.258                                                                     |
| M12 × 1.25               | 6h              | 0.000                          | 12.000                            | 11.788 | 11.188                                                               | 11.056 | 0.132 | 10.647                                                         | 10.286                                                                     |
| M12 × 1.25               | 4g6g            | 0.028                          | 11.972                            | 11.760 | 11.160                                                               | 11.075 | 0.085 | 10.619                                                         | 10.305                                                                     |
| M12 × 1                  | 6g              | 0.026                          | 11.974                            | 11.794 | 11.324                                                               | 11.206 | 0.118 | 10.891                                                         | 10.590                                                                     |
| M12 × 1                  | 6h              | 0.000                          | 12.000                            | 11.820 | 11.350                                                               | 11.232 | 0.118 | 10.917                                                         | 10.616                                                                     |
| M12 × 1                  | 4g6g            | 0.026                          | 11.974                            | 11.794 | 11.324                                                               | 11.249 | 0.075 | 10.891                                                         | 10.633                                                                     |
| M14 × 2                  | 6g              | 0.038                          | 13.962                            | 13.682 | 12.663                                                               | 12.503 | 0.160 | 11.797                                                         | 11.271                                                                     |
| M14 × 2                  | 6h              | 0.000                          | 14.000                            | 13.720 | 12.701                                                               | 12.541 | 0.160 | 11.835                                                         | 11.309                                                                     |
| M14 × 2                  | 4g6g            | 0.038                          | 13.962                            | 13.682 | 12.663                                                               | 12.563 | 0.100 | 11.797                                                         | 11.331                                                                     |
| M14 × 1.5                | 6g              | 0.032                          | 13.968                            | 13.732 | 12.994                                                               | 12.854 | 0.140 | 12.344                                                         | 11.930                                                                     |
| M14 × 1.5                | 6h              | 0.000                          | 14.000                            | 13.764 | 13.026                                                               | 12.886 | 0.140 | 12.376                                                         | 11.962                                                                     |
| M14 × 1.5                | 4g6g            | 0.032                          | 13.968                            | 13.732 | 12.994                                                               | 12.904 | 0.090 | 12.344                                                         | 11.980                                                                     |
| M15 × 1                  | 6g              | 0.026                          | 14.974                            | 14.794 | 14.324                                                               | 14.206 | 0.118 | 13.891                                                         | 13.590                                                                     |
| M15 × 1                  | 6h              | 0.000                          | 15.000                            | 14.820 | 14.350                                                               | 14.232 | 0.118 | 13.917                                                         | 13.616                                                                     |
| M15 × 1                  | 4g6g            | 0.026                          | 14.974                            | 14.794 | 14.324                                                               | 14.249 | 0.075 | 13.891                                                         | 13.633                                                                     |

Table 14 External Thread — Limiting Dimensions M Profile (Cont'd)

| Basic Thread Designation | Tolerance Class | Allowance, $e_s$<br>[Note (1)] | Major Diameter, $d$<br>[Note (2)] |        | Pitch Diameter, $d_2$ and Functional Diameter<br>[Notes (2) and (3)] |        |       | Max. Minor Diameter, $d_1$<br>(Flat Form), [Note (2)] | Min. Minor Diameter (Rounded Form), $d_3$<br>[Note (4)]<br>(For Reference) |
|--------------------------|-----------------|--------------------------------|-----------------------------------|--------|----------------------------------------------------------------------|--------|-------|-------------------------------------------------------|----------------------------------------------------------------------------|
|                          |                 |                                | Max.                              | Min.   | Max.                                                                 | Min.   | Tol.  |                                                       |                                                                            |
| M16 × 2                  | 6g              | 0.038                          | 15.962                            | 15.682 | 14.663                                                               | 14.503 | 0.160 | 13.797                                                | 13.271                                                                     |
| M16 × 2                  | 6h              | 0.000                          | 16.000                            | 15.720 | 14.701                                                               | 14.541 | 0.160 | 13.835                                                | 13.309                                                                     |
| M16 × 2                  | 4g6g            | 0.038                          | 15.962                            | 15.682 | 14.663                                                               | 14.563 | 0.100 | 13.797                                                | 13.331                                                                     |
| M16 × 1.5                | 6g              | 0.032                          | 15.968                            | 15.732 | 14.994                                                               | 14.854 | 0.140 | 14.344                                                | 13.930                                                                     |
| M16 × 1.5                | 6h              | 0.000                          | 16.000                            | 15.764 | 15.026                                                               | 14.886 | 0.140 | 14.376                                                | 13.962                                                                     |
| M16 × 1.5                | 4g6g            | 0.032                          | 15.968                            | 15.732 | 14.994                                                               | 14.904 | 0.090 | 14.344                                                | 13.980                                                                     |
| M17 × 1                  | 6g              | 0.026                          | 16.974                            | 16.794 | 16.324                                                               | 16.206 | 0.118 | 15.891                                                | 15.590                                                                     |
| M17 × 1                  | 6h              | 0.000                          | 17.000                            | 16.820 | 16.350                                                               | 16.232 | 0.118 | 15.917                                                | 15.616                                                                     |
| M17 × 1                  | 4g6g            | 0.026                          | 16.974                            | 16.794 | 16.324                                                               | 16.249 | 0.075 | 15.891                                                | 15.633                                                                     |
| M18 × 1.5                | 6g              | 0.032                          | 17.968                            | 17.732 | 16.994                                                               | 16.854 | 0.140 | 16.344                                                | 15.930                                                                     |
| M18 × 1.5                | 6h              | 0.000                          | 18.000                            | 17.764 | 17.026                                                               | 16.886 | 0.140 | 16.376                                                | 15.962                                                                     |
| M18 × 1.5                | 4g6g            | 0.032                          | 17.968                            | 17.732 | 16.994                                                               | 16.904 | 0.090 | 16.344                                                | 15.980                                                                     |
| M20 × 2.5                | 6g              | 0.042                          | 19.958                            | 19.623 | 18.334                                                               | 18.164 | 0.170 | 17.251                                                | 16.624                                                                     |
| M20 × 2.5                | 6h              | 0.000                          | 20.000                            | 19.665 | 18.376                                                               | 18.206 | 0.170 | 17.293                                                | 16.666                                                                     |
| M20 × 2.5                | 4g6g            | 0.042                          | 19.958                            | 19.623 | 18.334                                                               | 18.228 | 0.106 | 17.251                                                | 16.688                                                                     |
| M20 × 1.5                | 6g              | 0.032                          | 19.968                            | 19.732 | 18.994                                                               | 18.854 | 0.140 | 18.344                                                | 17.930                                                                     |
| M20 × 1.5                | 6h              | 0.000                          | 20.000                            | 19.764 | 19.026                                                               | 18.886 | 0.140 | 18.376                                                | 17.962                                                                     |
| M20 × 1.5                | 4g6g            | 0.032                          | 19.968                            | 19.732 | 18.994                                                               | 18.904 | 0.090 | 18.344                                                | 17.980                                                                     |
| M20 × 1                  | 6g              | 0.026                          | 19.974                            | 19.794 | 19.324                                                               | 19.206 | 0.118 | 18.891                                                | 18.590                                                                     |
| M20 × 1                  | 6h              | 0.000                          | 20.000                            | 19.820 | 19.350                                                               | 19.232 | 0.118 | 18.917                                                | 18.616                                                                     |
| M20 × 1                  | 4g6g            | 0.026                          | 19.974                            | 19.794 | 19.324                                                               | 19.249 | 0.075 | 18.891                                                | 18.633                                                                     |
| M22 × 2.5                | 6g              | 0.042                          | 21.958                            | 21.623 | 20.334                                                               | 20.164 | 0.170 | 19.251                                                | 18.624                                                                     |
| M22 × 2.5                | 6h              | 0.000                          | 22.000                            | 21.665 | 20.376                                                               | 20.206 | 0.170 | 19.293                                                | 18.666                                                                     |
| M22 × 1.5                | 6g              | 0.032                          | 21.968                            | 21.732 | 20.994                                                               | 20.854 | 0.140 | 20.344                                                | 19.930                                                                     |
| M22 × 1.5                | 6h              | 0.000                          | 22.000                            | 21.764 | 21.026                                                               | 20.886 | 0.140 | 20.376                                                | 19.962                                                                     |
| M22 × 1.5                | 4g6g            | 0.032                          | 21.968                            | 21.732 | 20.994                                                               | 20.904 | 0.090 | 20.344                                                | 19.980                                                                     |
| M24 × 3                  | 6g              | 0.048                          | 23.952                            | 23.577 | 22.003                                                               | 21.803 | 0.200 | 20.704                                                | 19.955                                                                     |
| M24 × 3                  | 6h              | 0.000                          | 24.000                            | 23.625 | 22.051                                                               | 21.851 | 0.200 | 20.752                                                | 20.003                                                                     |
| M24 × 3                  | 4g6g            | 0.048                          | 23.952                            | 23.577 | 22.003                                                               | 21.878 | 0.125 | 20.704                                                | 20.030                                                                     |
| M24 × 2                  | 6g              | 0.038                          | 23.962                            | 23.682 | 22.663                                                               | 22.493 | 0.170 | 21.797                                                | 21.261                                                                     |
| M24 × 2                  | 6h              | 0.000                          | 24.000                            | 23.720 | 22.701                                                               | 22.531 | 0.170 | 21.835                                                | 21.299                                                                     |
| M24 × 2                  | 4g6g            | 0.038                          | 23.962                            | 23.682 | 22.663                                                               | 22.557 | 0.106 | 21.797                                                | 21.325                                                                     |

Table 14 External Thread — Limiting Dimensions M Profile (Cont'd)

| Basic Thread Designation | Tolerance Class | Allowance, $e_s$<br>[Note (1)] | Major Diameter, $d$<br>[Note (2)] |        | Pitch Diameter, $d_2$ and Functional Diameter<br>[Notes (2) and (3)] |        |       | Max. Minor Diameter<br>(Flat Form), $d_1$<br>[Note (2)] | Min. Minor Diameter<br>(Rounded Form), $d_3$<br>[Note (4)]<br>(For Reference) |
|--------------------------|-----------------|--------------------------------|-----------------------------------|--------|----------------------------------------------------------------------|--------|-------|---------------------------------------------------------|-------------------------------------------------------------------------------|
|                          |                 |                                | Max.                              | Min.   | Max.                                                                 | Min.   | Tol.  |                                                         |                                                                               |
| M25 × 1.5                | 6g              | 0.032                          | 24.968                            | 24.732 | 23.994                                                               | 23.844 | 0.150 | 23.344                                                  | 22.920                                                                        |
| M25 × 1.5                | 6h              | 0.000                          | 25.000                            | 24.764 | 24.026                                                               | 23.876 | 0.150 | 23.376                                                  | 22.952                                                                        |
| M25 × 1.5                | 4g6g            | 0.032                          | 24.968                            | 24.732 | 23.994                                                               | 23.899 | 0.095 | 23.344                                                  | 22.975                                                                        |
| M27 × 3                  | 6g              | 0.048                          | 26.952                            | 26.577 | 25.003                                                               | 24.803 | 0.200 | 23.704                                                  | 22.955                                                                        |
| M27 × 3                  | 6h              | 0.000                          | 27.000                            | 26.625 | 25.051                                                               | 24.851 | 0.200 | 23.752                                                  | 23.003                                                                        |
| M27 × 2                  | 6g              | 0.038                          | 26.962                            | 26.682 | 25.663                                                               | 25.493 | 0.170 | 24.797                                                  | 24.261                                                                        |
| M27 × 2                  | 6h              | 0.000                          | 27.000                            | 26.720 | 25.701                                                               | 25.531 | 0.170 | 24.835                                                  | 24.299                                                                        |
| M27 × 2                  | 4g6g            | 0.038                          | 26.962                            | 26.682 | 25.663                                                               | 25.557 | 0.106 | 24.797                                                  | 24.325                                                                        |
| M30 × 3.5                | 6g              | 0.053                          | 29.947                            | 29.522 | 27.674                                                               | 27.462 | 0.212 | 26.158                                                  | 25.306                                                                        |
| M30 × 3.5                | 6h              | 0.000                          | 30.000                            | 29.575 | 27.727                                                               | 27.515 | 0.212 | 26.211                                                  | 25.359                                                                        |
| M30 × 3.5                | 4g6g            | 0.053                          | 29.947                            | 29.522 | 27.674                                                               | 27.542 | 0.132 | 26.158                                                  | 25.386                                                                        |
| M30 × 2                  | 6g              | 0.038                          | 29.962                            | 29.682 | 28.663                                                               | 28.493 | 0.170 | 27.797                                                  | 27.261                                                                        |
| M30 × 2                  | 6h              | 0.000                          | 30.000                            | 29.720 | 28.701                                                               | 28.531 | 0.170 | 27.835                                                  | 27.299                                                                        |
| M30 × 2                  | 4g6g            | 0.038                          | 29.962                            | 29.682 | 28.663                                                               | 28.557 | 0.106 | 27.797                                                  | 27.325                                                                        |
| M30 × 1.5                | 6g              | 0.032                          | 29.968                            | 29.732 | 28.994                                                               | 28.844 | 0.150 | 28.344                                                  | 27.920                                                                        |
| M30 × 1.5                | 6h              | 0.000                          | 30.000                            | 29.764 | 29.026                                                               | 28.876 | 0.150 | 28.376                                                  | 27.952                                                                        |
| M30 × 1.5                | 4g6g            | 0.032                          | 29.968                            | 29.732 | 28.994                                                               | 28.899 | 0.095 | 28.344                                                  | 27.975                                                                        |
| M33 × 2                  | 6g              | 0.038                          | 32.962                            | 32.682 | 31.663                                                               | 31.493 | 0.170 | 30.797                                                  | 30.261                                                                        |
| M33 × 2                  | 6h              | 0.000                          | 33.000                            | 32.720 | 31.701                                                               | 31.531 | 0.170 | 30.835                                                  | 30.299                                                                        |
| M33 × 2                  | 4g6g            | 0.038                          | 32.962                            | 32.682 | 31.663                                                               | 31.557 | 0.106 | 30.797                                                  | 30.325                                                                        |
| M35 × 1.5                | 6g              | 0.032                          | 34.968                            | 34.732 | 33.994                                                               | 33.844 | 0.150 | 33.344                                                  | 32.920                                                                        |
| M35 × 1.5                | 6h              | 0.000                          | 35.000                            | 34.764 | 34.026                                                               | 33.876 | 0.150 | 33.376                                                  | 32.952                                                                        |
| M36 × 4                  | 6g              | 0.060                          | 35.940                            | 35.465 | 33.342                                                               | 33.118 | 0.224 | 31.610                                                  | 30.654                                                                        |
| M36 × 4                  | 6h              | 0.000                          | 36.000                            | 35.525 | 33.402                                                               | 33.178 | 0.224 | 31.670                                                  | 30.714                                                                        |
| M36 × 4                  | 4g6g            | 0.060                          | 35.940                            | 35.465 | 33.342                                                               | 33.202 | 0.140 | 31.610                                                  | 30.738                                                                        |
| M36 × 2                  | 6g              | 0.038                          | 35.962                            | 35.682 | 34.663                                                               | 34.493 | 0.170 | 33.797                                                  | 33.261                                                                        |
| M36 × 2                  | 6h              | 0.000                          | 36.000                            | 35.720 | 34.701                                                               | 34.531 | 0.170 | 33.835                                                  | 33.299                                                                        |
| M36 × 2                  | 4g6g            | 0.038                          | 35.962                            | 35.682 | 34.663                                                               | 34.557 | 0.106 | 33.797                                                  | 33.325                                                                        |
| M39 × 2                  | 6g              | 0.038                          | 38.962                            | 38.682 | 37.663                                                               | 37.493 | 0.170 | 36.797                                                  | 36.261                                                                        |
| M39 × 2                  | 6h              | 0.000                          | 39.000                            | 38.720 | 37.701                                                               | 37.531 | 0.170 | 36.835                                                  | 36.299                                                                        |
| M39 × 2                  | 4g6g            | 0.038                          | 38.962                            | 38.682 | 37.663                                                               | 37.557 | 0.106 | 36.797                                                  | 36.325                                                                        |
| M40 × 1.5                | 6g              | 0.032                          | 39.968                            | 39.732 | 38.994                                                               | 38.844 | 0.150 | 38.344                                                  | 37.920                                                                        |
| M40 × 1.5                | 6h              | 0.000                          | 40.000                            | 39.764 | 39.026                                                               | 38.876 | 0.150 | 38.376                                                  | 37.952                                                                        |

Table 14 External Thread — Limiting Dimensions M Profile (Cont'd)

| Basic Thread Designation | Tolerance Class | Allowances<br>[Note (1)] | Major Diameter,<br>$d$<br>[Note (2)] |        | Pitch Diameter, $d_2$ and<br>Functional Diameter<br>[Notes (2) and (3)] |        |       | Max. Minor<br>Diameter<br>(Flat Form), $d_1$<br>[Note (2)] | Min. Minor<br>Diameter<br>(Rounded<br>Form), $d_3$<br>[Note (4)]<br>(For Reference) |
|--------------------------|-----------------|--------------------------|--------------------------------------|--------|-------------------------------------------------------------------------|--------|-------|------------------------------------------------------------|-------------------------------------------------------------------------------------|
|                          |                 |                          | Max.                                 | Min.   | Max.                                                                    | Min.   | Tol.  |                                                            |                                                                                     |
| M40 × 1.5                | 4g6g            | 0.032                    | 39.968                               | 39.732 | 38.994                                                                  | 38.899 | 0.095 | 38.344                                                     | 37.975                                                                              |
| M42 × 4.5                | 6g              | 0.063                    | 41.937                               | 41.437 | 39.014                                                                  | 38.778 | 0.236 | 37.065                                                     | 36.006                                                                              |
| M42 × 4.5                | 6h              | 0.000                    | 42.000                               | 41.500 | 39.077                                                                  | 38.841 | 0.236 | 37.128                                                     | 36.069                                                                              |
| M42 × 4.5                | 4g6g            | 0.063                    | 41.937                               | 41.437 | 39.014                                                                  | 38.864 | 0.150 | 37.065                                                     | 36.092                                                                              |
| M42 × 2                  | 6g              | 0.038                    | 41.962                               | 41.682 | 40.663                                                                  | 40.493 | 0.170 | 39.797                                                     | 39.261                                                                              |
| M42 × 2                  | 6h              | 0.000                    | 42.000                               | 41.720 | 40.701                                                                  | 40.531 | 0.170 | 39.835                                                     | 39.299                                                                              |
| M42 × 2                  | 4g6g            | 0.038                    | 41.962                               | 41.682 | 40.663                                                                  | 40.557 | 0.106 | 39.797                                                     | 39.325                                                                              |
| M45 × 1.5                | 6g              | 0.032                    | 44.968                               | 44.732 | 43.994                                                                  | 43.844 | 0.150 | 43.344                                                     | 42.920                                                                              |
| M45 × 1.5                | 6h              | 0.000                    | 45.000                               | 44.764 | 44.026                                                                  | 43.876 | 0.150 | 43.376                                                     | 42.952                                                                              |
| M45 × 1.5                | 4g6g            | 0.032                    | 44.968                               | 44.732 | 43.994                                                                  | 43.899 | 0.095 | 43.344                                                     | 42.975                                                                              |
| M48 × 5                  | 6g              | 0.071                    | 47.929                               | 47.399 | 44.681                                                                  | 44.431 | 0.250 | 42.516                                                     | 41.351                                                                              |
| M48 × 5                  | 6h              | 0.000                    | 48.000                               | 47.470 | 44.752                                                                  | 44.502 | 0.250 | 42.587                                                     | 41.422                                                                              |
| M48 × 5                  | 4g6g            | 0.071                    | 47.929                               | 47.399 | 44.681                                                                  | 44.521 | 0.160 | 42.516                                                     | 41.441                                                                              |
| M48 × 2                  | 6g              | 0.038                    | 47.962                               | 47.682 | 46.663                                                                  | 46.483 | 0.180 | 45.797                                                     | 45.251                                                                              |
| M48 × 2                  | 6h              | 0.000                    | 48.000                               | 47.720 | 46.701                                                                  | 46.521 | 0.180 | 45.835                                                     | 45.289                                                                              |
| M48 × 2                  | 4g6g            | 0.038                    | 47.962                               | 47.682 | 46.663                                                                  | 46.551 | 0.112 | 45.797                                                     | 45.319                                                                              |
| M50 × 1.5                | 6g              | 0.032                    | 49.968                               | 49.732 | 48.994                                                                  | 48.834 | 0.160 | 48.344                                                     | 47.910                                                                              |
| M50 × 1.5                | 6h              | 0.000                    | 50.000                               | 49.764 | 49.026                                                                  | 48.866 | 0.160 | 48.376                                                     | 47.942                                                                              |
| M50 × 1.5                | 4g6g            | 0.032                    | 49.968                               | 49.732 | 48.994                                                                  | 48.894 | 0.100 | 48.344                                                     | 47.970                                                                              |
| M55 × 1.5                | 6g              | 0.032                    | 54.968                               | 54.732 | 53.994                                                                  | 53.834 | 0.160 | 53.344                                                     | 52.910                                                                              |
| M55 × 1.5                | 6h              | 0.000                    | 55.000                               | 54.764 | 54.026                                                                  | 53.866 | 0.160 | 53.376                                                     | 52.942                                                                              |
| M55 × 1.5                | 4g6g            | 0.032                    | 54.968                               | 54.732 | 53.994                                                                  | 53.894 | 0.100 | 53.344                                                     | 52.970                                                                              |
| M56 × 5.5                | 6g              | 0.075                    | 55.925                               | 55.365 | 52.353                                                                  | 52.088 | 0.265 | 49.971                                                     | 48.700                                                                              |
| M56 × 5.5                | 6h              | 0.000                    | 56.000                               | 55.440 | 52.428                                                                  | 52.163 | 0.265 | 50.046                                                     | 48.775                                                                              |
| M56 × 5.5                | 4g6g            | 0.075                    | 55.925                               | 55.365 | 52.353                                                                  | 52.183 | 0.170 | 49.971                                                     | 48.795                                                                              |
| M56 × 2                  | 6g              | 0.038                    | 55.962                               | 55.682 | 54.663                                                                  | 54.483 | 0.180 | 53.797                                                     | 53.251                                                                              |
| M56 × 2                  | 6h              | 0.000                    | 56.000                               | 55.720 | 54.701                                                                  | 54.521 | 0.180 | 53.835                                                     | 53.289                                                                              |
| M56 × 2                  | 4g6g            | 0.038                    | 55.962                               | 55.682 | 54.663                                                                  | 54.551 | 0.112 | 53.797                                                     | 53.319                                                                              |
| M60 × 1.5                | 6g              | 0.032                    | 59.968                               | 59.732 | 58.994                                                                  | 58.834 | 0.160 | 58.344                                                     | 57.910                                                                              |
| M60 × 1.5                | 6h              | 0.000                    | 60.000                               | 59.764 | 59.026                                                                  | 58.866 | 0.160 | 58.376                                                     | 57.942                                                                              |
| M60 × 1.5                | 4g6g            | 0.032                    | 59.968                               | 59.732 | 58.994                                                                  | 58.894 | 0.100 | 58.344                                                     | 57.970                                                                              |

Table 14 External Thread — Limiting Dimensions M Profile (Cont'd)

| Basic Thread Designation | Tolerance Class | Allowance, $e_s$<br>[Note (1)] | Major Diameter, $d$<br>[Note (2)] |        | Pitch Diameter, $d_2$ and Functional Diameter<br>[Notes (2) and (3)] |        |       | Max. Minor Diameter<br>(Flat Form), $d_1$<br>[Note (2)] | Min. Minor Diameter<br>(Rounded Form), $d_3$<br>[Note (4)]<br>(For Reference) |
|--------------------------|-----------------|--------------------------------|-----------------------------------|--------|----------------------------------------------------------------------|--------|-------|---------------------------------------------------------|-------------------------------------------------------------------------------|
|                          |                 |                                | Max.                              | Min.   | Max.                                                                 | Min.   | Tol.  |                                                         |                                                                               |
| M64 × 6                  | 6g              | 0.080                          | 63.920                            | 63.320 | 60.023                                                               | 59.743 | 0.280 | 57.425                                                  | 56.047                                                                        |
| M64 × 6                  | 6h              | 0.000                          | 64.000                            | 63.400 | 60.103                                                               | 59.823 | 0.280 | 57.505                                                  | 56.127                                                                        |
| M64 × 6                  | 4g6g            | 0.080                          | 63.920                            | 63.320 | 60.023                                                               | 59.843 | 0.180 | 57.425                                                  | 56.147                                                                        |
| M64 × 2                  | 6g              | 0.038                          | 63.962                            | 63.682 | 62.663                                                               | 62.483 | 0.180 | 61.797                                                  | 61.251                                                                        |
| M64 × 2                  | 6h              | 0.000                          | 64.000                            | 63.720 | 62.701                                                               | 62.521 | 0.180 | 61.835                                                  | 61.289                                                                        |
| M64 × 2                  | 4g6g            | 0.038                          | 63.962                            | 63.682 | 62.663                                                               | 62.551 | 0.112 | 61.797                                                  | 61.319                                                                        |
| M65 × 1.5                | 6g              | 0.032                          | 64.968                            | 64.732 | 63.994                                                               | 63.834 | 0.160 | 63.344                                                  | 62.910                                                                        |
| M65 × 1.5                | 6h              | 0.000                          | 65.000                            | 64.764 | 64.026                                                               | 63.866 | 0.160 | 63.376                                                  | 62.942                                                                        |
| M65 × 1.5                | 4g6g            | 0.032                          | 64.968                            | 64.732 | 63.994                                                               | 63.894 | 0.100 | 63.344                                                  | 62.970                                                                        |
| M70 × 1.5                | 6g              | 0.032                          | 69.968                            | 69.732 | 68.994                                                               | 68.834 | 0.160 | 68.344                                                  | 67.910                                                                        |
| M70 × 1.5                | 6h              | 0.000                          | 70.000                            | 69.764 | 69.026                                                               | 68.866 | 0.160 | 68.376                                                  | 67.942                                                                        |
| M70 × 1.5                | 4g6g            | 0.032                          | 69.968                            | 69.732 | 68.994                                                               | 68.894 | 0.100 | 68.344                                                  | 67.970                                                                        |
| M72 × 6                  | 6g              | 0.080                          | 71.920                            | 71.320 | 68.023                                                               | 67.743 | 0.280 | 65.425                                                  | 64.047                                                                        |
| M72 × 6                  | 6h              | 0.000                          | 72.000                            | 71.400 | 68.103                                                               | 67.823 | 0.280 | 65.505                                                  | 64.127                                                                        |
| M72 × 6                  | 4g6g            | 0.080                          | 71.920                            | 71.320 | 68.023                                                               | 67.843 | 0.180 | 65.425                                                  | 64.147                                                                        |
| M72 × 2                  | 6g              | 0.038                          | 71.962                            | 71.682 | 70.663                                                               | 70.483 | 0.180 | 69.797                                                  | 69.251                                                                        |
| M72 × 2                  | 6h              | 0.000                          | 72.000                            | 71.720 | 70.701                                                               | 70.521 | 0.180 | 69.835                                                  | 69.289                                                                        |
| M72 × 2                  | 4g6g            | 0.038                          | 71.962                            | 71.682 | 70.663                                                               | 70.551 | 0.112 | 69.797                                                  | 69.319                                                                        |
| M75 × 1.5                | 6g              | 0.032                          | 74.968                            | 74.732 | 73.994                                                               | 73.834 | 0.160 | 73.344                                                  | 72.910                                                                        |
| M75 × 1.5                | 6h              | 0.000                          | 75.000                            | 74.764 | 74.026                                                               | 73.866 | 0.160 | 73.376                                                  | 72.942                                                                        |
| M75 × 1.5                | 4g6g            | 0.032                          | 74.968                            | 74.732 | 73.994                                                               | 73.894 | 0.100 | 73.344                                                  | 72.970                                                                        |
| M80 × 6                  | 6g              | 0.080                          | 79.920                            | 79.320 | 76.023                                                               | 75.743 | 0.280 | 73.425                                                  | 72.047                                                                        |
| M80 × 6                  | 6h              | 0.000                          | 80.000                            | 79.400 | 76.103                                                               | 75.823 | 0.280 | 73.505                                                  | 72.127                                                                        |
| M80 × 6                  | 4g6g            | 0.080                          | 79.920                            | 79.320 | 76.023                                                               | 75.843 | 0.180 | 73.425                                                  | 72.147                                                                        |
| M80 × 2                  | 6g              | 0.038                          | 79.962                            | 79.682 | 78.663                                                               | 78.483 | 0.180 | 77.797                                                  | 77.251                                                                        |
| M80 × 2                  | 6h              | 0.000                          | 80.000                            | 79.720 | 78.701                                                               | 78.521 | 0.180 | 77.835                                                  | 77.289                                                                        |
| M80 × 2                  | 4g6g            | 0.038                          | 79.962                            | 79.682 | 78.663                                                               | 78.551 | 0.112 | 77.797                                                  | 77.319                                                                        |
| M80 × 1.5                | 6g              | 0.032                          | 79.968                            | 79.732 | 78.994                                                               | 78.834 | 0.160 | 78.344                                                  | 77.910                                                                        |
| M80 × 1.5                | 6h              | 0.000                          | 80.000                            | 79.764 | 79.026                                                               | 78.866 | 0.160 | 78.376                                                  | 77.942                                                                        |
| M80 × 1.5                | 4g6g            | 0.032                          | 79.968                            | 79.732 | 78.994                                                               | 78.894 | 0.100 | 78.344                                                  | 77.970                                                                        |
| M85 × 2                  | 6g              | 0.038                          | 84.962                            | 84.682 | 83.663                                                               | 83.483 | 0.180 | 82.797                                                  | 82.251                                                                        |
| M85 × 2                  | 6h              | 0.000                          | 85.000                            | 84.720 | 83.701                                                               | 83.521 | 0.180 | 82.835                                                  | 82.289                                                                        |

Table 14 External Thread — Limiting Dimensions M Profile (Cont'd)

| Basic Thread Designation | Tolerance Class | Allowances<br>[Note (1)] | Major Diameter,<br>$d$<br>[Note (2)] |         | Pitch Diameter, $d_2$ and<br>Functional Diameter<br>[Notes (2) and (3)] |         | Max. Minor<br>Diameter<br>(Flat Form), $d_1$<br>[Note (2)] | Min. Minor<br>Diameter<br>(Rounded<br>Form), $d_3$<br>[Note (4)]<br>(For Reference) |
|--------------------------|-----------------|--------------------------|--------------------------------------|---------|-------------------------------------------------------------------------|---------|------------------------------------------------------------|-------------------------------------------------------------------------------------|
|                          |                 |                          | Max.                                 | Min.    | Max.                                                                    | Min.    |                                                            |                                                                                     |
| M85 × 2                  | 4g6g            | 0.038                    | 84.962                               | 84.682  | 83.663                                                                  | 83.551  | 82.797                                                     | 82.319                                                                              |
| M90 × 6                  | 6g              | 0.080                    | 89.920                               | 89.320  | 86.023                                                                  | 85.743  | 83.425                                                     | 82.047                                                                              |
| M90 × 6                  | 6h              | 0.000                    | 90.000                               | 89.400  | 86.103                                                                  | 85.823  | 83.505                                                     | 82.127                                                                              |
| M90 × 6                  | 4g6g            | 0.080                    | 89.920                               | 89.320  | 86.023                                                                  | 85.843  | 83.425                                                     | 82.147                                                                              |
| M90 × 2                  | 6g              | 0.038                    | 89.962                               | 89.682  | 88.663                                                                  | 88.483  | 87.797                                                     | 87.251                                                                              |
| M90 × 2                  | 6h              | 0.000                    | 90.000                               | 89.720  | 88.701                                                                  | 88.521  | 87.835                                                     | 87.289                                                                              |
| M90 × 2                  | 4g6g            | 0.038                    | 89.962                               | 89.682  | 88.663                                                                  | 88.551  | 87.797                                                     | 87.319                                                                              |
| M95 × 2                  | 6g              | 0.038                    | 94.962                               | 94.682  | 93.663                                                                  | 93.473  | 92.797                                                     | 92.241                                                                              |
| M95 × 2                  | 6h              | 0.000                    | 95.000                               | 94.720  | 93.701                                                                  | 93.511  | 92.835                                                     | 92.279                                                                              |
| M95 × 2                  | 4g6g            | 0.038                    | 94.962                               | 94.682  | 93.663                                                                  | 93.545  | 92.797                                                     | 92.313                                                                              |
| M100 × 6                 | 6g              | 0.080                    | 99.920                               | 99.320  | 96.023                                                                  | 95.723  | 93.425                                                     | 92.027                                                                              |
| M100 × 6                 | 6h              | 0.000                    | 100.000                              | 99.400  | 96.103                                                                  | 95.803  | 93.505                                                     | 92.107                                                                              |
| M100 × 6                 | 4g6g            | 0.080                    | 99.920                               | 99.320  | 96.023                                                                  | 95.833  | 93.425                                                     | 92.137                                                                              |
| M100 × 2                 | 6g              | 0.038                    | 99.962                               | 99.682  | 98.663                                                                  | 98.473  | 97.797                                                     | 97.241                                                                              |
| M100 × 2                 | 6h              | 0.000                    | 100.000                              | 99.720  | 98.701                                                                  | 98.511  | 97.835                                                     | 97.279                                                                              |
| M100 × 2                 | 4g6g            | 0.038                    | 99.962                               | 99.682  | 98.663                                                                  | 98.545  | 97.797                                                     | 97.313                                                                              |
| M105 × 2                 | 6g              | 0.038                    | 104.962                              | 104.682 | 103.663                                                                 | 103.473 | 102.797                                                    | 102.241                                                                             |
| M105 × 2                 | 6h              | 0.000                    | 105.000                              | 104.720 | 103.701                                                                 | 103.511 | 102.835                                                    | 102.279                                                                             |
| M105 × 2                 | 4g6g            | 0.038                    | 104.962                              | 104.682 | 103.663                                                                 | 103.545 | 102.797                                                    | 102.313                                                                             |
| M110 × 2                 | 6g              | 0.038                    | 109.962                              | 109.682 | 108.663                                                                 | 108.473 | 107.797                                                    | 107.241                                                                             |
| M110 × 2                 | 6h              | 0.000                    | 110.000                              | 109.720 | 108.701                                                                 | 108.511 | 107.835                                                    | 107.279                                                                             |
| M110 × 2                 | 4g6g            | 0.038                    | 109.962                              | 109.682 | 108.663                                                                 | 108.545 | 107.797                                                    | 107.313                                                                             |
| M120 × 2                 | 6g              | 0.038                    | 119.962                              | 119.682 | 118.663                                                                 | 118.473 | 117.797                                                    | 117.241                                                                             |
| M120 × 2                 | 6h              | 0.000                    | 120.000                              | 119.720 | 118.701                                                                 | 118.511 | 117.835                                                    | 117.279                                                                             |
| M120 × 2                 | 4g6g            | 0.038                    | 119.962                              | 119.682 | 118.663                                                                 | 118.545 | 117.797                                                    | 117.313                                                                             |
| M130 × 2                 | 6g              | 0.038                    | 129.962                              | 129.682 | 128.663                                                                 | 128.473 | 127.797                                                    | 127.241                                                                             |
| M130 × 2                 | 6h              | 0.000                    | 130.000                              | 129.720 | 128.701                                                                 | 128.511 | 127.835                                                    | 127.279                                                                             |
| M130 × 2                 | 4g6g            | 0.038                    | 129.962                              | 129.682 | 128.663                                                                 | 128.545 | 127.797                                                    | 127.313                                                                             |
| M140 × 2                 | 6g              | 0.038                    | 139.962                              | 139.682 | 138.663                                                                 | 138.473 | 137.797                                                    | 137.241                                                                             |
| M140 × 2                 | 6h              | 0.000                    | 140.000                              | 139.720 | 138.701                                                                 | 138.511 | 137.835                                                    | 137.279                                                                             |
| M140 × 2                 | 4g6g            | 0.038                    | 139.962                              | 139.682 | 138.663                                                                 | 138.545 | 137.797                                                    | 137.313                                                                             |

Table 14 External Thread — Limiting Dimensions M Profile (Cont'd)

| Basic Thread Designation | Tolerance Class | Allowance, $e_s$ | Major Diameter, $d$ |         | Pitch Diameter, $d_2$ and Functional Diameter [Notes (2) and (3)] |         | Max Minor Diameter (Flat Form) $d_1$ [Note (2)] | Min. Minor Diameter (Rounded Form), $d_3$ [Note (4)] (For Reference) |
|--------------------------|-----------------|------------------|---------------------|---------|-------------------------------------------------------------------|---------|-------------------------------------------------|----------------------------------------------------------------------|
|                          |                 |                  | Max.                | Min.    | Max.                                                              | Min.    |                                                 |                                                                      |
| M150 × 2                 | 6g              | 0.038            | 149.962             | 149.682 | 148.663                                                           | 148.473 | 147.797                                         | 147.241                                                              |
| M150 × 2                 | 6h              | 0.000            | 150.000             | 149.720 | 148.701                                                           | 148.511 | 147.835                                         | 147.279                                                              |
| M150 × 2                 | 4g6g            | 0.038            | 149.962             | 149.682 | 148.663                                                           | 148.545 | 147.797                                         | 147.313                                                              |
| M160 × 3                 | 6g              | 0.048            | 159.952             | 159.577 | 158.003                                                           | 157.779 | 156.704                                         | 155.931                                                              |
| M160 × 3                 | 6h              | 0.000            | 160.000             | 159.625 | 158.051                                                           | 157.827 | 156.752                                         | 155.979                                                              |
| M160 × 3                 | 4g6g            | 0.048            | 159.952             | 159.577 | 158.003                                                           | 157.863 | 156.704                                         | 156.015                                                              |
| M170 × 3                 | 6g              | 0.048            | 169.952             | 169.577 | 168.003                                                           | 167.779 | 166.704                                         | 165.931                                                              |
| M170 × 3                 | 6h              | 0.000            | 170.000             | 169.625 | 168.051                                                           | 167.827 | 166.752                                         | 165.979                                                              |
| M170 × 3                 | 4g6g            | 0.048            | 169.952             | 169.577 | 168.003                                                           | 167.863 | 166.704                                         | 166.015                                                              |
| M180 × 3                 | 6g              | 0.048            | 179.952             | 179.577 | 178.003                                                           | 177.779 | 176.704                                         | 175.931                                                              |
| M180 × 3                 | 6h              | 0.000            | 180.000             | 179.625 | 178.051                                                           | 177.827 | 176.752                                         | 175.979                                                              |
| M180 × 3                 | 4g6g            | 0.048            | 179.952             | 179.577 | 178.003                                                           | 177.863 | 176.704                                         | 176.015                                                              |
| M190 × 3                 | 6g              | 0.048            | 189.952             | 189.577 | 188.003                                                           | 187.753 | 186.704                                         | 185.905                                                              |
| M190 × 3                 | 6h              | 0.000            | 190.000             | 189.625 | 188.051                                                           | 187.801 | 186.752                                         | 185.953                                                              |
| M190 × 3                 | 4g6g            | 0.048            | 189.952             | 189.577 | 188.003                                                           | 187.843 | 186.704                                         | 185.995                                                              |
| M200 × 3                 | 6g              | 0.048            | 199.952             | 199.577 | 198.003                                                           | 197.753 | 196.704                                         | 195.905                                                              |
| M200 × 3                 | 6h              | 0.000            | 200.000             | 199.625 | 198.051                                                           | 197.801 | 196.752                                         | 195.953                                                              |
| M200 × 3                 | 4g6g            | 0.048            | 199.952             | 199.577 | 198.003                                                           | 197.843 | 196.704                                         | 195.995                                                              |

GENERAL NOTE: All dimensions are in millimeters.

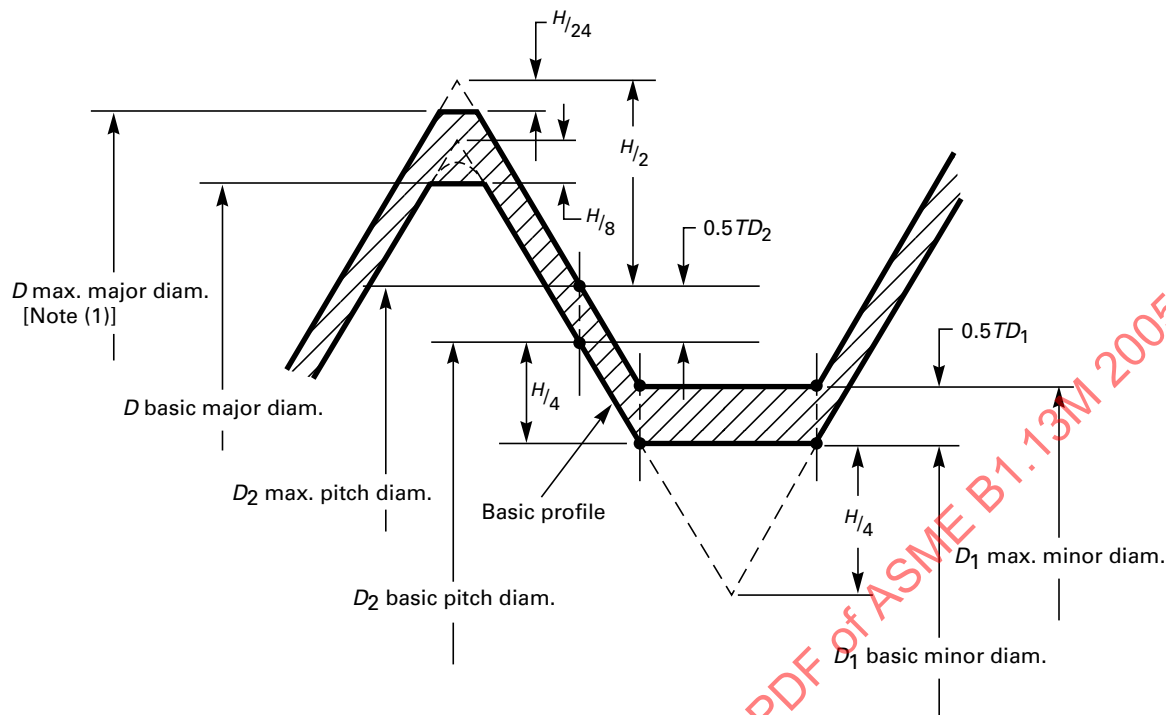
NOTES:

(1)  $e_s$  is absolute value.

(2) For coated threads with tolerance classes 6g or 4g6g, see para. 8.2.

(3) See para. 5.4(b).

(4) Dimension used in the design of tools, etc. In dimensioning external threads it is not normally specified. Generally, minor diameter acceptance is based on maximum material condition gaging.



GENERAL NOTE: Section-lined portions identify tolerance zone.

NOTE:

- (1) Dimension is used in the design of tools, etc. In dimensioning internal threads it is not normally specified. Generally major diameter acceptance is based upon a maximum material condition gaging.

**Fig. 8 Internal Thread — Limiting M Profile, Tolerance Position H**

(e) Maximum flat form minor diameter = maximum pitch diameter  $- 0.4330127P$  (Table 2)

(f) Maximum rounded form minor diameter =

$$\text{max. pitch diam.} - \left\{ 0.5H + 2r \min \left\{ 1 - \cos \left[ 60 \text{ deg} \right. \right. \right. \\ \left. \left. \left. - \arccos \left( 1 - \frac{Td_2}{4r \min.} \right) \right] \right\} \right\}$$

(for  $0.125P$  min. root radius)

(g) Minimum rounded form minor diameter = minimum pitch diameter  $- 0.6160254P$  (Table 2)

$r \min. = 0.125P$  (Table 3)

#### 9.4 Examples of Calculations of Size Limits

Tables 16A through 16D show examples that are based upon the practices for calculating and rounding screw thread dimensions as specified in ASME B1.30. Dimensions are expressed in millimeters.

**9.4.1 External Screw Thread, Standard Size.** The example in Table 16A shows how tabulated values for allowances and tolerances (in accordance with ISO 965-1) are used for the calculation of size limits in ASME B1.13M tables for standard external thread sizes

listed in ISO 261. See para. 9.4.3 for an example with a size not listed in ISO 261.

#### 9.4.2 Internal Metric Screw Thread, Standard Size.

The example in Table 16B shows how tabulated values for allowances and tolerances (in accordance with ISO 965-1) are used for the calculation of size limits in ASME B1.13M tables for standard internal thread sizes listed in ISO 261. See para. 9.4.4 for an example with a size not listed in ISO 261.

#### 9.4.3 Metric External Screw Thread, Non-Standard Size.

The example in Table 16C shows how size limit calculations are made by use of formulas for sizes not listed in ISO 261. For an example of how tabulated values for allowances and tolerances (in accordance with ISO 965-1) are used for the calculation of size limits in ASME B1.13M tables for standard external thread sizes listed in ISO 261, see para. 9.4.1.

#### 9.4.4 Internal Metric Screw Thread, Non-Standard Size.

The example in Table 16D shows how size limit calculations are made by use of formulas for sizes not listed in ISO 261. For an example of how tabulated values for allowances and tolerances (in accordance with ISO 965-1) are used for the calculation of size limits in

**Table 15 Internal Thread — Limiting Dimensions M Profile**

| Basic Thread Designation | Tolerance Class | Minor Diam., $D_1$ |        | Pitch Diam., $D_2$ and Functional Diam. [Note (1)] |        |       | Major Diam., $D$ |                                 |
|--------------------------|-----------------|--------------------|--------|----------------------------------------------------|--------|-------|------------------|---------------------------------|
|                          |                 | Min.               | Max.   | Min.                                               | Max.   | Tol.  | Min.             | Max. [Note (2)] (For Reference) |
| M1.6 × 0.35              | 6H              | 1.221              | 1.321  | 1.373                                              | 1.458  | 0.085 | 1.600            | 1.736                           |
| M2 × 0.4                 | 6H              | 1.567              | 1.679  | 1.740                                              | 1.830  | 0.090 | 2.000            | 2.148                           |
| M2.5 × 0.45              | 6H              | 2.013              | 2.138  | 2.208                                              | 2.303  | 0.095 | 2.500            | 2.660                           |
| M3 × 0.5                 | 6H              | 2.459              | 2.599  | 2.675                                              | 2.775  | 0.100 | 3.000            | 3.172                           |
| M3.5 × 0.6               | 6H              | 2.850              | 3.010  | 3.110                                              | 3.222  | 0.112 | 3.500            | 3.698                           |
| M4 × 0.7                 | 6H              | 3.242              | 3.422  | 3.545                                              | 3.663  | 0.118 | 4.000            | 4.219                           |
| M5 × 0.8                 | 6H              | 4.134              | 4.334  | 4.480                                              | 4.605  | 0.125 | 5.000            | 5.240                           |
| M6 × 1                   | 6H              | 4.917              | 5.153  | 5.350                                              | 5.500  | 0.150 | 6.000            | 6.294                           |
| M8 × 1.25                | 6H              | 6.647              | 6.912  | 7.188                                              | 7.348  | 0.160 | 8.000            | 8.340                           |
| M8 × 1                   | 6H              | 6.917              | 7.153  | 7.350                                              | 7.500  | 0.150 | 8.000            | 8.294                           |
| M10 × 1.5                | 6H              | 8.376              | 8.676  | 9.026                                              | 9.206  | 0.180 | 10.000           | 10.397                          |
| M10 × 1.25               | 6H              | 8.647              | 8.912  | 9.188                                              | 9.348  | 0.160 | 10.000           | 10.340                          |
| M10 × 1                  | 6H              | 8.917              | 9.153  | 9.350                                              | 9.500  | 0.150 | 10.000           | 10.294                          |
| M10 × 0.75               | 6H              | 9.188              | 9.378  | 9.513                                              | 9.645  | 0.132 | 10.000           | 10.240                          |
| M12 × 1.75               | 6H              | 10.106             | 10.441 | 10.863                                             | 11.063 | 0.200 | 12.000           | 12.452                          |
| M12 × 1.5                | 6H              | 10.376             | 10.676 | 11.026                                             | 11.216 | 0.190 | 12.000           | 12.407                          |
| M12 × 1.25               | 6H              | 10.647             | 10.912 | 11.188                                             | 11.368 | 0.180 | 12.000           | 12.360                          |
| M12 × 1                  | 6H              | 10.917             | 11.153 | 11.350                                             | 11.510 | 0.160 | 12.000           | 12.304                          |
| M14 × 2                  | 6H              | 11.835             | 12.210 | 12.701                                             | 12.913 | 0.212 | 14.000           | 14.501                          |
| M14 × 1.5                | 6H              | 12.376             | 12.676 | 13.026                                             | 13.216 | 0.190 | 14.000           | 14.407                          |
| M15 × 1                  | 6H              | 13.917             | 14.153 | 14.350                                             | 14.510 | 0.160 | 15.000           | 15.304                          |
| M16 × 2                  | 6H              | 13.835             | 14.210 | 14.701                                             | 14.913 | 0.212 | 16.000           | 16.501                          |
| M16 × 1.5                | 6H              | 14.376             | 14.676 | 15.026                                             | 15.216 | 0.190 | 16.000           | 16.407                          |
| M17 × 1                  | 6H              | 15.917             | 16.153 | 16.350                                             | 16.510 | 0.160 | 17.000           | 17.304                          |
| M18 × 1.5                | 6H              | 16.376             | 16.676 | 17.026                                             | 17.216 | 0.190 | 18.000           | 18.407                          |
| M20 × 2.5                | 6H              | 17.294             | 17.744 | 18.376                                             | 18.600 | 0.224 | 20.000           | 20.585                          |
| M20 × 1.5                | 6H              | 18.376             | 18.676 | 19.026                                             | 19.216 | 0.190 | 20.000           | 20.407                          |
| M20 × 1                  | 6H              | 18.917             | 19.153 | 19.350                                             | 19.510 | 0.160 | 20.000           | 20.304                          |
| M22 × 2.5                | 6H              | 19.294             | 19.744 | 20.376                                             | 20.600 | 0.224 | 22.000           | 22.585                          |
| M22 × 1.5                | 6H              | 20.376             | 20.676 | 21.026                                             | 21.216 | 0.190 | 22.000           | 22.407                          |
| M24 × 3                  | 6H              | 20.752             | 21.252 | 22.051                                             | 22.316 | 0.265 | 24.000           | 24.698                          |
| M24 × 2                  | 6H              | 21.835             | 22.210 | 22.701                                             | 22.925 | 0.224 | 24.000           | 24.513                          |
| M25 × 1.5                | 6H              | 23.376             | 23.676 | 24.026                                             | 24.226 | 0.200 | 25.000           | 25.417                          |
| M27 × 3                  | 6H              | 23.752             | 24.252 | 25.051                                             | 25.316 | 0.265 | 27.000           | 27.698                          |
| M27 × 2                  | 6H              | 24.835             | 25.210 | 25.701                                             | 25.925 | 0.224 | 27.000           | 27.513                          |
| M30 × 3.5                | 6H              | 26.211             | 26.771 | 27.727                                             | 28.007 | 0.280 | 30.000           | 30.786                          |
| M30 × 2                  | 6H              | 27.835             | 28.210 | 28.701                                             | 28.925 | 0.224 | 30.000           | 30.513                          |
| M30 × 1.5                | 6H              | 28.376             | 28.676 | 29.026                                             | 29.226 | 0.200 | 30.000           | 30.417                          |
| M33 × 2                  | 6H              | 30.835             | 31.210 | 31.701                                             | 31.925 | 0.224 | 33.000           | 33.513                          |
| M35 × 1.5                | 6H              | 33.376             | 33.676 | 34.026                                             | 34.226 | 0.200 | 35.000           | 35.417                          |
| M36 × 4                  | 6H              | 31.670             | 32.270 | 33.402                                             | 33.702 | 0.300 | 36.000           | 36.877                          |
| M36 × 2                  | 6H              | 33.835             | 34.210 | 34.701                                             | 34.925 | 0.224 | 36.000           | 36.513                          |
| M39 × 2                  | 6H              | 36.835             | 37.210 | 37.701                                             | 37.925 | 0.224 | 39.000           | 39.513                          |
| M40 × 1.5                | 6H              | 38.376             | 38.676 | 39.026                                             | 39.226 | 0.200 | 40.000           | 40.417                          |
| M42 × 4.5                | 6H              | 37.129             | 37.799 | 39.077                                             | 39.392 | 0.315 | 42.000           | 42.964                          |

**Table 15 Internal Thread — Limiting Dimensions M Profile (Cont'd)**

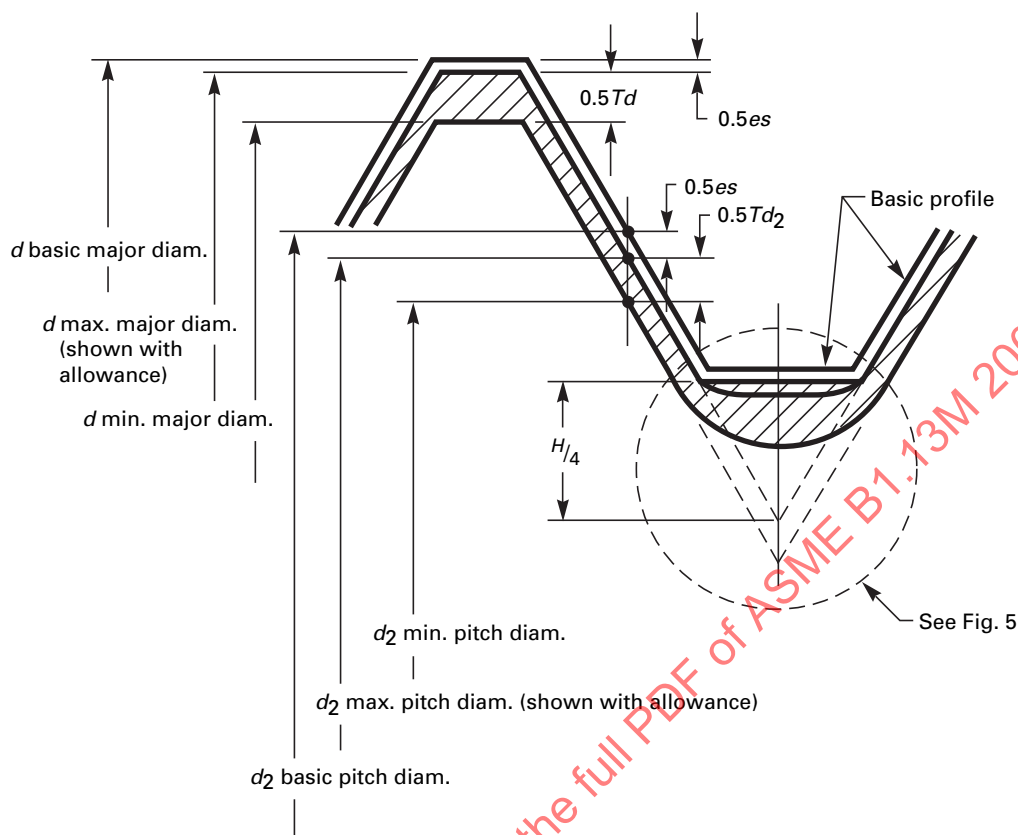
| Basic Thread Designation | Tolerance Class | Minor Diam., $D_1$ |         | Pitch Diam., $D_2$ and Functional Diam. [Note (1)] |         |       | Major Diam., $D$ |                                 |
|--------------------------|-----------------|--------------------|---------|----------------------------------------------------|---------|-------|------------------|---------------------------------|
|                          |                 | Min.               | Max.    | Min.                                               | Max.    | Tol.  | Min.             | Max. [Note (2)] (For Reference) |
| M42 × 2                  | 6H              | 39.835             | 40.210  | 40.701                                             | 40.925  | 0.224 | 42.000           | 42.513                          |
| M45 × 1.5                | 6H              | 43.376             | 43.676  | 44.026                                             | 44.226  | 0.200 | 45.000           | 45.417                          |
| M48 × 5                  | 6H              | 42.587             | 43.297  | 44.752                                             | 45.087  | 0.335 | 48.000           | 49.056                          |
| M48 × 2                  | 6H              | 45.835             | 46.210  | 46.701                                             | 46.937  | 0.236 | 48.000           | 48.525                          |
| M50 × 1.5                | 6H              | 48.376             | 48.676  | 49.026                                             | 49.238  | 0.212 | 50.000           | 50.429                          |
| M55 × 1.5                | 6H              | 53.376             | 53.676  | 54.026                                             | 54.238  | 0.212 | 55.000           | 55.429                          |
| M56 × 5.5                | 6H              | 50.046             | 50.796  | 52.428                                             | 52.783  | 0.355 | 56.000           | 57.149                          |
| M56 × 2                  | 6H              | 53.835             | 54.210  | 54.701                                             | 54.937  | 0.236 | 56.000           | 56.525                          |
| M60 × 1.5                | 6H              | 58.376             | 58.676  | 59.026                                             | 59.238  | 0.212 | 60.000           | 60.429                          |
| M64 × 6                  | 6H              | 57.505             | 58.305  | 60.103                                             | 60.478  | 0.375 | 64.000           | 65.241                          |
| M64 × 2                  | 6H              | 61.835             | 62.210  | 62.701                                             | 62.937  | 0.236 | 64.000           | 64.525                          |
| M65 × 1.5                | 6H              | 63.376             | 63.676  | 64.026                                             | 64.238  | 0.212 | 65.000           | 65.429                          |
| M70 × 1.5                | 6H              | 68.376             | 68.676  | 69.026                                             | 69.238  | 0.212 | 70.000           | 70.429                          |
| M72 × 6                  | 6H              | 65.505             | 66.305  | 68.103                                             | 68.478  | 0.375 | 72.000           | 73.241                          |
| M72 × 2                  | 6H              | 69.835             | 70.210  | 70.701                                             | 70.937  | 0.236 | 72.000           | 72.525                          |
| M75 × 1.5                | 6H              | 73.376             | 73.676  | 74.026                                             | 74.238  | 0.212 | 75.000           | 75.429                          |
| M80 × 6                  | 6H              | 73.505             | 74.305  | 76.103                                             | 76.478  | 0.375 | 80.000           | 81.241                          |
| M80 × 2                  | 6H              | 77.835             | 78.210  | 78.701                                             | 78.937  | 0.236 | 80.000           | 80.525                          |
| M80 × 1.5                | 6H              | 78.376             | 78.676  | 79.026                                             | 79.238  | 0.212 | 80.000           | 80.429                          |
| M85 × 2                  | 6H              | 82.835             | 83.210  | 83.701                                             | 83.937  | 0.236 | 85.000           | 85.525                          |
| M90 × 6                  | 6H              | 83.505             | 84.305  | 86.103                                             | 86.478  | 0.375 | 90.000           | 91.241                          |
| M90 × 2                  | 6H              | 87.835             | 88.210  | 88.701                                             | 88.937  | 0.236 | 90.000           | 90.525                          |
| M95 × 2                  | 6H              | 92.835             | 93.210  | 93.701                                             | 93.951  | 0.250 | 95.000           | 95.539                          |
| M100 × 6                 | 6H              | 93.505             | 94.305  | 96.103                                             | 96.503  | 0.400 | 100.000          | 101.266                         |
| M100 × 2                 | 6H              | 97.835             | 98.210  | 98.701                                             | 98.951  | 0.250 | 100.000          | 100.539                         |
| M105 × 2                 | 6H              | 102.835            | 103.210 | 103.701                                            | 103.951 | 0.250 | 105.000          | 105.539                         |
| M110 × 2                 | 6H              | 107.835            | 108.210 | 108.701                                            | 108.951 | 0.250 | 110.000          | 110.539                         |
| M120 × 2                 | 6H              | 117.835            | 118.210 | 118.701                                            | 118.951 | 0.250 | 120.000          | 120.539                         |
| M130 × 2                 | 6H              | 127.835            | 128.210 | 128.701                                            | 128.951 | 0.250 | 130.000          | 130.539                         |
| M140 × 2                 | 6H              | 137.835            | 138.210 | 138.701                                            | 138.951 | 0.250 | 140.000          | 140.539                         |
| M150 × 2                 | 6H              | 147.835            | 148.210 | 148.701                                            | 148.951 | 0.250 | 150.000          | 150.539                         |
| M160 × 3                 | 6H              | 156.752            | 157.252 | 158.051                                            | 158.351 | 0.300 | 160.000          | 160.733                         |
| M170 × 3                 | 6H              | 166.752            | 167.252 | 168.051                                            | 168.351 | 0.300 | 170.000          | 170.733                         |
| M180 × 3                 | 6H              | 176.752            | 177.252 | 178.051                                            | 178.351 | 0.300 | 180.000          | 180.733                         |
| M190 × 3                 | 6H              | 186.752            | 187.252 | 188.051                                            | 188.386 | 0.335 | 190.000          | 190.768                         |
| M200 × 3                 | 6H              | 196.752            | 197.252 | 198.051                                            | 198.386 | 0.335 | 200.000          | 200.768                         |

GENERAL NOTE: All dimensions are in millimeters.

NOTES:

(1) See para. 5.4(b).

(2) Dimension is used in the design of tools, etc. In dimensioning internal threads it is not normally specified. Generally, major diameter acceptance is based on maximum material condition gaging.



## GENERAL NOTES:

- (a) Section-lined portions identify tolerance zone and unshaded portions identify allowance (fundamental deviation).  
 (b) Tolerance position  $g$  is shown. For position  $h$ , allowance  $es$  is zero.

**Fig. 9 External Thread — Limiting M Thread Profile**

ASME B1.13M tables for standard internal thread sizes listed in ISO 261, see para. 9.4.2.

## 10 LEAD AND FLANK ANGLE TOLERANCES

### 10.1 Lead and Flank Angle Acceptance

Acceptance of lead and flank angles of product screw threads shall be in accordance with paras. 10.1.1 through 10.1.6. These factors also contribute to visual identification of gross defects in thread profile.

**10.1.1** When Thread Gaging System 21 of ASME B1.3 is specified, product thread lead (including helix) and flank angle variations are not considered.

**10.1.2** When Thread Gaging System 22 of ASME B1.3 is specified, with the pitch diameter or thread groove diameter inspection required, the product thread lead (including helix) and flank angles shall be considered acceptable when the minimum material characteristic (pitch diameter or thread groove diameter in Tables 1 and 2, Cols. C and D of ASME B1.3) and the

maximum material characteristic (GO in Tables 1 and 2, Col. A of ASME B1.3) are accepted by the gages specified for System 22, over the standard GO thread gage length.

When Thread Gaging System 22 is specified with NOT-GO (LO) functional diameter combined with control of lead and flank option, agreements must be reached between the purchaser and the supplier on lead and flank angle limits and method of evaluation.

**10.1.3** When Thread Gaging System 23 of ASME B1.3 is specified, product thread lead and flank angles shall be acceptable if within the allowable variations as specified in Tables 17 and 18. Also, the minimum material characteristic (pitch diameter or thread groove diameter in Tables 1 and 2, Cols. C and D of ASME B1.3) and the maximum material characteristic (GO in Tables 1 and 2, Col. A of ASME B1.3) must be accepted by the gages specified for System 23, over the standard GO thread gage length.

Allowable variations in lead and flank angles are maximum values. Maximum variation in these and pitch

diameter tolerance cannot be taken simultaneously. See paras. 10.1.5 and 10.1.6.

**10.1.4** When individual inspections of lead (including helix) and flank angle variations are required, in addition to Thread Gaging System 21 or 22 of ASME B1.3, the allowable variations for these characteristics shall be specified.

**10.1.5** For sizes not included in Tables 17 and 18, the allowable lead variation is equal to 0.57735 times one-half the pitch diameter tolerance. This is the lead variation that causes a change in functional diameter equal to one-half the pitch diameter tolerance. The allowable flank half-angle variation in minutes of arc is equal to 125 divided by the square root of pitch for pitch

diameter tolerance grade 6 and 80 divided by the square root of pitch for pitch diameter tolerance grade 4. For other standard tolerance grades, multiply allowable angle variations for tolerance grade 6 by the multipliers in para. 6.6.1.1. Round calculated angle variations to the nearest 5 min.

**10.1.6** For requirements of paras. 10.1.4 and 10.1.5, lead variation values tabulated or calculated are the maximum variations from specified lead between any two points not farther apart than the length of the standard GO thread gage. (See ASME B47.1.) Flank angle variation values are maximum variations from the basic 30 deg angle between thread flanks and perpendiculars to the thread axis.

ASMENORMDOC.COM : Click to view the full PDF of ASME B1.13M-2005

Table 16A Example of External Screw Thread, Standard Size

| Thread Size = M12 x 1.75–4g6g                                                                                                                                                                   |                                                                                                                                                       |                                                                                                                                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Characteristic Description                                                                                                                                                                      | Example of Size Calculation                                                                                                                           | Additional Information                                                                                                                                                                                                                                                |
| (1) Maximum external major diameter ( $d_{max.}$ )<br>= Basic major diameter ( $db_{sc}$ ) – allowance ( $es$ )                                                                                 | $d_{max.} = db_{sc} -  es $ ; $ es $ is absolute value<br>$db_{sc} = 12.000$<br>$ es  = 0.034$<br>$d_{max.} = 12.000 - 0.034 = 11.966$                | ...<br>From thread size.<br>From Allowance in Table 13.<br>Final value is rounded to three decimal places so no further rounding is necessary.                                                                                                                        |
| (2) Minimum external major diameter ( $d_{min.}$ )<br>= Maximum external major diameter ( $d_{max.}$ ) – major diameter tolerance ( $T_d$ )                                                     | $d_{min.} = d_{max.} - T_d$<br>$d_{max.} = 11.966$<br>$T_d = 0.265$<br>$d_{min.} = 11.966 - 0.265 = 11.701$                                           | ...<br>[See Table 16A, (1).]<br>From Major Diameter Tolerance in Table 10.<br>Final value is rounded to three decimal places so no further rounding is necessary.                                                                                                     |
| (3) Maximum external pitch diameter ( $d_{2max.}$ )<br>= Basic major diameter ( $db_{sc}$ ) – allowance ( $es$ ) – 0.6495191P<br>or maximum external major diameter ( $d_{max.}$ ) – 0.6495191P | $d_{2max.} = d_{max.} - 0.6495191P$<br>$d_{max.} = 11.966$<br>$0.6495191P = (0.6495191)(1.75)$<br>$0.6495191P = 1.1366584$<br>$0.6495191P = 1.136666$ | ...<br>[See Table 16A, (1).]<br>...<br>This figure is rounded to five decimal places which is two places beyond the three decimal place final value of $d_{2max.}$ .<br>This value may also be found in Thread Data in Table 2.                                       |
| (4) Minimum external pitch diameter ( $d_{2min.}$ )<br>= Maximum external pitch diameter ( $d_{2max.}$ ) – external pitch diameter tolerance ( $T_{d_2}$ )                                      | $d_{2min.} = d_{2max.} - T_{d_2}$<br>$d_{2max.} = 10.829$<br>$T_{d_2} = 0.095$<br>$d_{2min.} = 10.829 - 0.095 = 10.734$                               | ...<br>This figure is rounded to three decimal places to obtain the final value of $d_{2max.}$ .<br>...<br>[See Table 16A, (3).]<br>From Pitch Diameter Tolerance in Table 11.<br>Final value is rounded to three decimal places so no further rounding is necessary. |

**Table 16A Example of External Screw Thread, Standard Size (Cont'd)**

| Thread Size = M12 x 1.75–4g6g                                                                                                                    |                                                                                                                         |                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Characteristic Description                                                                                                                       | Example of Size Calculation                                                                                             | Additional Information                                                                                                                                                                                                       |
| (5) Maximum external minor diameter ( $d_1$ max.) (flat form)<br>= Maximum external pitch diameter ( $d_2$ max.) – 0.4330127P                    | $d_1$ max. = $d_2$ max. – 0.4330127P<br>$d_2$ max. = 10.829<br>0.4330127P = (0.4330127)(1.75)<br>0.4330127P = 0.7577722 | ...<br>[See Table 16A, (3).]<br>...<br>This figure is rounded to five decimal places which is two places beyond the three decimal place final value of $d_1$ max.<br>This value may also be found in Thread Data in Table 2. |
|                                                                                                                                                  | 0.4330127P = 0.75777                                                                                                    |                                                                                                                                                                                                                              |
|                                                                                                                                                  | $d_1$ max. = 10.829 – 0.75777<br>$d_1$ max. = 10.07123                                                                  | ...<br>This figure is rounded to three decimal places to obtain the final value of $d_1$ max.                                                                                                                                |
|                                                                                                                                                  | $d_1$ max. = 10.071, when rounded                                                                                       | ...                                                                                                                                                                                                                          |
| (6) For Reference:<br>Minimum external minor diameter ( $d_3$ min.) (round form)<br>= Minimum external pitch diameter ( $d_2$ min.) – 0.6160254P | $d_3$ min. = $d_2$ min. – 0.6160254P<br>$d_2$ min. = 10.734<br>0.6160254P = (0.6160254)(1.75)<br>0.6160254P = 1.078045  | ...<br>[See Table 16A, (4).]<br>...<br>This figure is rounded to five decimal places which is two places beyond the three decimal place final value of $d_3$ min.<br>This value may also be found in Thread Data in Table 2. |
|                                                                                                                                                  | 0.6160254P = 1.07804                                                                                                    | This figure is rounded to three decimal places to obtain the final value of $d_3$ min.                                                                                                                                       |
|                                                                                                                                                  | $d_3$ min. = 10.734 – 1.07804 = 9.65596                                                                                 |                                                                                                                                                                                                                              |
|                                                                                                                                                  | $d_3$ min. = 9.656, when rounded                                                                                        | ...                                                                                                                                                                                                                          |

GENERAL NOTE: All dimensions are expressed in millimeters.

**Table 16B Example of Internal Metric Screw Thread, Standard Size**

| Thread Size = M12 x 1.75–6H                                                                                                                                                                              |  | Example of Size Calculation                                                                                                                                                                                                                           | Additional Information                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Characteristic Description                                                                                                                                                                               |  |                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                   |
| (1) Minimum internal major diameter ( $D_{1min.}$ )<br>= Basic internal major diameter ( $Db_{sc}$ ) + allowance ( $EI$ )                                                                                |  | $D_{min.} = Db_{sc} +  EI $ ; $ EI $ is absolute value<br>$Db_{sc} = db_{sc} = 12.000$<br>$ EI  = 0$<br>$D_{min.} = 12.000 + 0.000 = 12.000$                                                                                                          | ...<br>From thread size.<br>From Allowance in Table 13.<br>Final value is rounded to three decimal places so no further rounding is necessary.                                                                                                                                                                                                    |
| (2) Minimum internal pitch diameter ( $D_{2min.}$ )<br>= Basic internal major diameter ( $Db_{sc}$ ) – 0.6495191P + allowance ( $EI$ )<br>or minimum internal major diameter ( $D_{min.}$ ) – 0.6495191P |  | $D_{2min.} = D_{min.} - 0.6495191P$<br>$D_{min.} = 12.000$<br>$0.6495191P = 0.6495191(1.75)$<br>$0.6495191P = 1.1366584$<br>$0.6495191P = 1.13666$<br>$D_{2min.} = 12.000 - 1.13666$<br>$D_{2min.} = 10.86334$<br>$D_{2min.} = 10.863$ , when rounded | ...<br>[See Table 16B, (1).]<br>...<br>This figure is rounded to five decimal places which is two places beyond the three decimal place final value of $D_{2min.}$ .<br>This value may also be found in Thread Data in Table 2.<br>...<br>This figure is rounded to obtain the final value of minimum pitch diameter.                             |
| (3) Maximum internal pitch diameter ( $D_{2max.}$ )<br>= Minimum internal pitch diameter ( $D_{2min.}$ ) + internal pitch diameter tolerance ( $TD_2$ )                                                  |  | $D_{2max.} = D_{2min.} + TD_2$<br>$D_{2min.} = 10.863$<br>$TD_2(6) = 0.200$<br>$D_{2max.} = 10.863 + 0.200 = 11.063$                                                                                                                                  | ...<br>[See Table 16B, (2).]<br>From Pitch Diameter Tolerance in Table 12.<br>Final value is rounded to three decimal places so no further rounding is necessary.                                                                                                                                                                                 |
| (4) Minimum internal minor diameter ( $D_1min.$ )<br>= Minimum internal major diameter ( $D_{min.}$ ) – 1.0825318P                                                                                       |  | $D_1min. = D_{min.} - 1.0825318P$<br>$D_{min.} = 12.000$<br>$1.0825318P = (1.0825318)(1.75)$<br>$1.0825318P = 1.8944306$<br>$1.0825318P = 1.89443$<br>$D_1min. = 12.000 - 1.89443$<br>$D_1min. = 10.10557$<br>$D_1min. = 10.106$ , when rounded       | ...<br>[See Table 16B, (1).]<br>...<br>This figure is rounded to five decimal places which is two places beyond the three decimal place final value $D_{1min.}$ .<br>This value may also be found in Thread Data in Table 2.<br>...<br>This figure is rounded to three decimal places to obtain the final value of minimum pitch diameter.<br>... |

**Table 16B Example of Internal Metric Screw Thread, Standard Size (Cont'd)**

| Thread Size = M12 x 1.75-6H                                                                                                                   |                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Characteristic Description                                                                                                                    | Example of Size Calculation                                                                                                                                                                                                                             | Additional Information                                                                                                                                                                                                                                                                                                                   |
| (5) Maximum internal minor diameter ( $D_1$ max.)<br>= Minimum internal diameter ( $D_1$ min.) + internal minor diameter tolerance ( $TD_1$ ) | $D_1$ max. = $D_1$ min. + $TD_1$<br>$D_1$ min. = 10.106<br>$TD_1$ (6) = 0.335<br><br>$D_1$ max. = 10.106 + 0.335 = 10.441                                                                                                                               | ...<br>[See Table 16B, (4).]<br>From Minor Diameter Tolerance in Table 9.<br><br>Final value is rounded to three decimal places so no further rounding is necessary.                                                                                                                                                                     |
| (6) For Reference:<br>Maximum internal major diameter ( $D$ max.)<br>= Maximum internal pitch diameter ( $D_2$ max.) + 0.7938566P             | $D$ max. = $D_2$ max. + 0.7938566P<br>$D_2$ max. = 11.063<br>$0.7938566P = (0.7938566) 1.75$<br>$0.7938566P = 1.3892490$<br><br>$0.7938566P = 1.38925$<br><br>$D$ max. = 11.063 + 1.38925<br>$D$ max. = 12.45225<br><br>$D$ max. = 12.452, when rounded | ...<br>[See Table 16B, (3).]<br>...<br>This figure is rounded to five decimal places which is two places beyond the three decimal place final value of $D$ max.<br>This value may also be found in Thread Data in Table 2.<br>...<br>This figure is rounded to three decimal places to obtain the final value of maximum major diameter. |

GENERAL NOTE: All dimensions are expressed in millimeters.

Table 16C Example of External Metric Screw Thread, Non-Standard Size

| Thread Size = M13 x 0.9–4g6g                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Characteristic Description                                                                                                                                                                        | Example of Size Calculation                                                                                                                                                                                                                                                                                                                        | Additional Information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| (1) Maximum external major diameter ( $d_{max.}$ )<br>= Basic major diameter ( $db_{sc}$ ) + allowance ( $es$ )                                                                                   | $d_{max.} = db_{sc} -  es $ ; $ es $ is absolute value<br>$db_{sc} = 13.000$<br>$ es_g  = 0.015 + 0.011P$<br>$ es_g  = 0.015 + 0.011(0.9)$<br>$ es_g  = 0.0249$<br>$ es_g  = 0.025$ , when rounded<br>$d_{max.} = 13.000 - 0.025 = 12.975$                                                                                                         | <p>... This is the final value of the basic major diameter and is therefore expressed with three decimal places.</p> <p><math>es</math> for tolerance position <math>g</math> is not tabulated for <math>P = 0.9</math> so it must be calculated.</p> <p>... This figure is rounded to three decimal places to obtain the final absolute value of allowance for tolerance position <math>g</math>.</p> <p>... Final value is rounded to three decimal places so no further rounding is necessary.</p> |
| (2) Minimum external major diameter ( $d_{min.}$ )<br>= Maximum external major diameter ( $d_{max.}$ ) – tolerance ( $Td$ )                                                                       | $d_{min.} = d_{max.} - Td$<br>$d_{max.} = 12.975$<br>$Td(6) = 0.18 \sqrt[3]{P^2} - \frac{0.00315}{\sqrt{P}}$<br>$Td(6) = 0.18 \sqrt[3]{0.9^2} - \frac{0.00315}{\sqrt{0.9}}$<br>$Td(6) = 0.18 \sqrt[3]{0.81000} - \frac{0.00315}{0.94868}$<br>$Td(6) = 0.18(0.93217) - \frac{0.00315}{0.94868}$<br>$Td(6) = 0.16779 - 0.00332$<br>$Td(6) = 0.16447$ | <p>... [See Table 16C, (1).]</p> <p><math>Td</math> for tolerance grade 6 is not tabulated for <math>P = 0.9</math> so it must be calculated.</p> <p>... This figure is rounded to three decimal places to obtain the final value of major diameter tolerance for tolerance grade 6.</p> <p>... Final value is rounded to three decimal places so no further rounding is necessary.</p>                                                                                                               |
| (3) Maximum external pitch diameter ( $d_{2max.}$ )<br>= [Basic major diameter ( $db_{sc}$ ) – allowance ( $es$ )] – 0.6495191P<br>or maximum external major diameter ( $d_{max.}$ ) – 0.6495191P | $d_{2max.} = d_{max.} - 0.6495191P$<br>$d_{max.} = 12.975$<br>$0.6495191P = 0.6495191(0.9)$<br>$0.6495191P = 0.5845672$<br>$0.6495191P = 0.58457$<br>$d_{2max.} = 12.975 - 0.58457$<br>$d_{2max.} = 12.39043$<br>$d_{2max.} = 12.390$ , when rounded                                                                                               | <p>... [See Table 16C, (1).]</p> <p>This figure is rounded to five decimal places to obtain the final value.</p> <p>... This figure is rounded to obtain the final value of <math>d_{2max.}</math></p> <p>...</p>                                                                                                                                                                                                                                                                                     |

Table 16C Example of External Metric Screw Thread, Non-Standard Size (Cont'd)

| Thread Size = M13 x 0.9–4g6g                                                                                                                            |                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Characteristic Description                                                                                                                              | Example of Size Calculation                                                                                                                                                                                                                                                                                                    | Additional Information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| (4) Minimum external pitch diameter ( $d_{2min.}$ )<br>= Maximum external pitch diameter ( $d_{2max.}$ ) – external pitch diameter tolerance ( $Td_2$ ) | $d_{2min.} = d_{2max.} - Td_2$<br>$d_{2max.} = 12.390$<br>$Td_2 (4) = 0.63Td_2 (6)$<br>$Td_2 (4) = 0.63 [0.09P^{0.4}d^{0.1}]$<br>$Td_2 (4) = 0.63 [0.09 (0.9)^{0.4}(13)^{0.1}]$<br>$Td_2 (4) = 0.63 [0.09 (0.95873) (1.29239)]$<br>$Td_2 (4) = 0.63 [(0.09)(1.23905)]$<br>$Td_2 (4) = (0.63)(0.11151)$<br>$Td_2 (4) = 0.07025$ | <p>...<br/>[See Table 16C, (3).]<br/><math>Td_2</math> for tolerance grade 4 is not tabulated for <math>P=0.9</math> so it must be calculated.<br/>...<br/>...<br/>...<br/>...<br/>...<br/>This figure is rounded to three decimal places to obtain the final value of pitch diameter tolerance for tolerance grade 4.<br/>...<br/>Final value is rounded to three decimal places so no further rounding is necessary.<br/>...<br/>[See Table 16C, (3).]<br/>...<br/>This figure is rounded to five decimal places, which is two decimal places beyond the three decimal place value of <math>d_{1max.}</math><br/>...<br/>...<br/>This figure is rounded to three decimal places to obtain the final value of maximum minor diameter<br/>...<br/>...</p> |
| (5) Maximum external minor diameter ( $d_{1max.}$ ) (flat form)<br>= Maximum external pitch diameter ( $d_{2max.}$ ) – 0.4330127P                       | $d_{1max.} = d_{2max.} - 0.4330127P$<br>$d_{2max.} = 12.390$<br>$0.4330127P = 0.4330127 (0.9)$<br>$0.4330127P = 0.3897114$<br>$0.4330127P = 0.38971$<br>$d_{1max.} = 12.390 - 0.38971$<br>$d_{1max.} = 12.00029$<br>$d_{1max.} = 12.000$<br>$d_{1max.} = 12.000$ , when rounded                                                | <p>...<br/>[See Table 16C, (3).]<br/>...<br/>This figure is rounded to five decimal places, which is two decimal places beyond the three decimal place value of <math>d_{1max.}</math><br/>...<br/>...<br/>This figure is rounded to three decimal places to obtain the final value of maximum minor diameter<br/>...<br/>...</p>                                                                                                                                                                                                                                                                                                                                                                                                                         |
| (6) For Reference:<br>Minimum external minor diameter ( $d_{3min.}$ )(round form)<br>= Minimum external pitch diameter ( $d_{2min.}$ ) – 0.6160254P     | $d_{3min.} = d_{2min.} - 0.6160254P$<br>$d_{2min.} = 12.320$<br>$0.6160254P = 0.6160254 (0.9)$<br>$0.6160254P = 0.5544229$<br>$0.6160254P = 0.55442$<br>$d_{3min.} = 12.320 - 0.55442$<br>$d_{3min.} = 11.76558$<br>$d_{3min.} = 11.766$ , when rounded                                                                        | <p>...<br/>[See Table 16C, (4).]<br/>...<br/>This figure is rounded to five decimal places, which is two decimal places beyond the three decimal place final value of <math>d_{3min.}</math><br/>...<br/>...<br/>This figure is rounded to obtain the final value of minimum minor diameter.<br/>...<br/>...</p>                                                                                                                                                                                                                                                                                                                                                                                                                                          |

GENERAL NOTE: All dimensions are expressed in millimeters.

Table 16D Example of Internal Metric Screw Thread, Non-Standard Size

| Thread Size = M13 x 0.9–6H                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Characteristic Description                                                                                                                                                                                 | Example of Size Calculation                                                                                                                                                                                                                                                                                                                  | Additional Information                                                                                                                                                                                                                                                                                                                                                               |
| (1) Minimum internal major diameter ( $D_{min.}$ )<br>= Basic internal major diameter ( $D_{bsc}$ ) + allowance ( $EI$ )                                                                                   | $D_{min.} = D_{bsc} +  EI $ ; $ EI $ is absolute value<br>$D_{bsc} = d_{bsc} = 13.000$<br>$EI_H = 0$<br><br>$D_{min.} = 13.000 + 0.000 = 13.000$                                                                                                                                                                                             | ...<br>[See Table 16C, (1)]<br>From Allowance for tolerance position $H$ in Table 13.<br>Final value is rounded to three decimal places so no further rounding is necessary.                                                                                                                                                                                                         |
| (2) Minimum internal pitch diameter ( $D_{2min.}$ )<br>= Basic internal major diameter ( $D_{min.}$ ) – 0.6495191P<br>+ allowance ( $EI$ ); or minimum internal major diameter ( $D_{min.}$ ) – 0.6495191P | $D_{2min.} = D_{min.} - 0.6495191P$<br>$D_{min.} = 13.000$<br>$0.6495191P = 0.6495191 (0.9)$<br>$0.6495191P = 0.5845672$<br><br>$0.6495191P = 0.58457$<br>$D_{2min.} = 13.000 - 0.58457$<br>$D_{2min.} = 12.41543$<br><br>$D_{2min.} = 12.415$ , when rounded                                                                                | ...<br>[See Table 16D, (1).]<br>...<br>This figure is rounded to five decimal places, which is two places beyond the three decimal place final value of $D_{2min.}$ .<br>...<br>...<br>This figure is rounded to obtain the final value of minimum pitch diameter.                                                                                                                   |
| (3) Maximum internal pitch diameter ( $D_{2max.}$ )<br>= Minimum internal pitch diameter ( $D_{2min.}$ ) + internal pitch diameter tolerance ( $TD_2$ )                                                    | $D_{2max.} = D_{2min.} + TD_2$<br>$D_{2min.} = 12.415$<br>$TD_2 (6) = 1.22TD_2 (6)$<br><br>$TD_2 (6) = 1.32 [0.09P^{0.4}d^{0.1}]$<br>$TD_2 (6) = 1.32 [0.09 (0.9)^{0.4}(13)^{0.1}]$<br>$TD_2 (6) = 1.32 [0.09 (0.95873)(1.29239)]$<br>$TD_2 (6) = 0.14720$<br><br>$TD_2 (6) = 0.147$ , when rounded<br>$D_{2max.} = 12.415 + 0.147 = 12.562$ | ...<br>[See Table 16D, (2).]<br>$TD_2$ (or $TD_2$ ) for tolerance grade 6 is not tabulated for $P = 0.9$ so it must be calculated.<br>...<br>...<br>...<br>This figure is rounded to three decimal places to obtain the final value of pitch diameter tolerance for tolerance grade 6.<br>...<br>Final value is rounded to three decimal places so no further rounding is necessary. |
| (4) Minimum internal minor diameter ( $D_1min.$ )<br>= Minimum internal major diameter ( $D_{min.}$ ) – 1.0825318P                                                                                         | $D_1min. = D_{min.} - 1.0825318P$<br>$D_{min.} = 13.000$<br>$1.0825318P = 1.0825318 (0.9)$<br>$1.0825318P = 0.9742786$<br><br>$1.0825318P = 0.97428$<br>$D_1min. = 13.000 - 0.97428$<br>$D_1min. = 12.02572$<br><br>$D_1min. = 12.026$ , when rounded                                                                                        | ...<br>[See Table 16D, (1).]<br>...<br>This figure is rounded to five decimal places, which is two places beyond the three decimal place final value of $D_1min.$ .<br>...<br>...<br>This figure is rounded to three decimal places to obtain the final value of minimum pitch diameter.<br>...                                                                                      |

Table 16D Example of Internal Metric Screw Thread, Non-Standard Size (Cont'd)

| Thread Size = M13 x 0.9-6H                                                                                                        |                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Characteristic Description                                                                                                        | Example of Size Calculation                                                                                                                                                                                 | Additional Information                                                                                                                                                                                                                                                                                                                               |
| (5) Maximum internal minor diameter ( $D_1$ max.)<br>= Minimum internal minor diameter ( $D_1$ min.) + tolerance ( $TD_1$ )       | $D_1$ max. = $D_1$ min. + $TD_1$<br>$D_1$ min. = 12.026<br>$TD_1$ (6) = 0.218                                                                                                                               | ...<br>[See Table 16D, (4).]<br>$P = 0.9$ is not tabulated nor is there any ISO formula applicable to this pitch. Therefore, a tolerance midway between the tabulated values for $P = 0.8$ and $P = 1.0$ has been selected. This value is $TD_1$ (6) = 0.218.<br>Final value is rounded to three decimal places so no further rounding is necessary. |
| (6) For Reference:<br>Maximum internal major diameter ( $D$ max.)<br>= Maximum internal pitch diameter ( $D_2$ max.) + 0.7938566P | $D$ max. = $D_2$ max. + 0.7938566P<br>$D_2$ max. = 12.562<br>$0.7938566P = 0.7938566$ (0.9)<br>$0.7938566P = 0.7144709$<br><br>$0.7938566P = 0.71447$<br>$D$ max. = 12.562 + 0.71447<br>$D$ max. = 13.27647 | ...<br>[See Table 16D, (3).]<br>...<br>This figure is rounded to five decimal places, which is two places beyond the three decimal place value of $D$ max.<br>...<br>...<br>This figure is rounded to three decimal places to obtain the final value of maximum major diameter.                                                                      |
|                                                                                                                                   | $D$ max. = 13.276, when rounded                                                                                                                                                                             | ...                                                                                                                                                                                                                                                                                                                                                  |

GENERAL NOTE: All dimensions are expressed in millimeters.

**Table 17 Allowable Variations in Lead and Equivalent Change in Functional Diameter**

(See paras. 10.1.3 through 10.1.6 for applicability.)

| Basic Thread Designation | External Threads |                                       |                                              | Internal Threads |                                       |                                              |
|--------------------------|------------------|---------------------------------------|----------------------------------------------|------------------|---------------------------------------|----------------------------------------------|
|                          | Tolerance Class  | Allowable Variation in Lead ( $\pm$ ) | Equivalent Change in Functional Diameter (+) | Tolerance Class  | Allowable Variation in Lead ( $\pm$ ) | Equivalent Change in Functional Diameter (-) |
| M1.6 $\times$ 0.35       | 6g               | 0.018                                 | 0.032                                        | 6H               | 0.025                                 | 0.042                                        |
|                          | 4g6g             | 0.012                                 | 0.020                                        | ...              | ...                                   | ...                                          |
| M2 $\times$ 0.4          | 6g               | 0.019                                 | 0.034                                        | 6H               | 0.026                                 | 0.045                                        |
|                          | 4g6g             | 0.012                                 | 0.021                                        | ...              | ...                                   | ...                                          |
| M2.5 $\times$ 0.45       | 6g               | 0.020                                 | 0.036                                        | 6H               | 0.027                                 | 0.048                                        |
|                          | 4g6g             | 0.013                                 | 0.022                                        | ...              | ...                                   | ...                                          |
| M3 $\times$ 0.5          | 6g               | 0.022                                 | 0.038                                        | 6H               | 0.029                                 | 0.050                                        |
|                          | 4g6g             | 0.014                                 | 0.024                                        | ...              | ...                                   | ...                                          |
| M3.5 $\times$ 0.6        | 6g               | 0.025                                 | 0.042                                        | 6H               | 0.032                                 | 0.056                                        |
|                          | 4g6g             | 0.015                                 | 0.026                                        | ...              | ...                                   | ...                                          |
| M4 $\times$ 0.7          | 6g               | 0.026                                 | 0.045                                        | 6H               | 0.034                                 | 0.059                                        |
|                          | 4g6g             | 0.016                                 | 0.028                                        | ...              | ...                                   | ...                                          |
| M5 $\times$ 0.8          | 6g               | 0.027                                 | 0.048                                        | 6H               | 0.036                                 | 0.062                                        |
|                          | 4g6g             | 0.017                                 | 0.030                                        | ...              | ...                                   | ...                                          |
| M6 $\times$ 1            | 6g               | 0.032                                 | 0.056                                        | 6H               | 0.043                                 | 0.075                                        |
|                          | 4g6g             | 0.020                                 | 0.036                                        | ...              | ...                                   | ...                                          |
| M8 $\times$ 1.25         | 6g               | 0.034                                 | 0.059                                        | 6H               | 0.046                                 | 0.080                                        |
|                          | 4g6g             | 0.022                                 | 0.038                                        | ...              | ...                                   | ...                                          |
| M8 $\times$ 1            | 6g               | 0.032                                 | 0.056                                        | 6H               | 0.043                                 | 0.075                                        |
|                          | 4g6g             | 0.020                                 | 0.036                                        | ...              | ...                                   | ...                                          |
| M10 $\times$ 1.5         | 6g               | 0.038                                 | 0.066                                        | 6H               | 0.052                                 | 0.090                                        |
|                          | 4g6g             | 0.025                                 | 0.042                                        | ...              | ...                                   | ...                                          |
| M10 $\times$ 1.25        | 6g               | 0.034                                 | 0.059                                        | 6H               | 0.046                                 | 0.080                                        |
|                          | 4g6g             | 0.022                                 | 0.038                                        | ...              | ...                                   | ...                                          |
| M10 $\times$ 1           | 6g               | 0.032                                 | 0.056                                        | 6H               | 0.043                                 | 0.075                                        |
|                          | 4g6g             | 0.020                                 | 0.036                                        | ...              | ...                                   | ...                                          |
| M10 $\times$ 0.75        | 6g               | 0.029                                 | 0.050                                        | 6H               | 0.038                                 | 0.066                                        |
|                          | 4g6g             | 0.019                                 | 0.032                                        | ...              | ...                                   | ...                                          |
| M12 $\times$ 1.75        | 6g               | 0.043                                 | 0.075                                        | 6H               | 0.058                                 | 0.100                                        |
|                          | 4g6g             | 0.027                                 | 0.048                                        | ...              | ...                                   | ...                                          |
| M12 $\times$ 1.5         | 6g               | 0.040                                 | 0.070                                        | 6H               | 0.055                                 | 0.095                                        |
|                          | 4g6g             | 0.026                                 | 0.045                                        | ...              | ...                                   | ...                                          |
| M12 $\times$ 1.25        | 6g               | 0.038                                 | 0.066                                        | 6H               | 0.052                                 | 0.090                                        |
|                          | 4g6g             | 0.025                                 | 0.042                                        | ...              | ...                                   | ...                                          |
| M12 $\times$ 1           | 6g               | 0.034                                 | 0.059                                        | 6H               | 0.055                                 | 0.080                                        |
|                          | 4g6g             | 0.022                                 | 0.038                                        | ...              | ...                                   | ...                                          |
| M14 $\times$ 2           | 6g               | 0.046                                 | 0.080                                        | 6H               | 0.061                                 | 0.106                                        |
|                          | 4g6g             | 0.029                                 | 0.050                                        | ...              | ...                                   | ...                                          |
| M14 $\times$ 1.5         | 6g               | 0.040                                 | 0.070                                        | 6H               | 0.055                                 | 0.095                                        |
|                          | 4g6g             | 0.026                                 | 0.045                                        | ...              | ...                                   | ...                                          |
| M15 $\times$ 1           | 6g               | 0.034                                 | 0.059                                        | 6H               | 0.055                                 | 0.080                                        |
|                          | 4g6g             | 0.022                                 | 0.038                                        | ...              | ...                                   | ...                                          |
| M16 $\times$ 2           | 6g               | 0.046                                 | 0.080                                        | 6H               | 0.061                                 | 0.106                                        |
|                          | 4g6g             | 0.029                                 | 0.050                                        | ...              | ...                                   | ...                                          |
| M16 $\times$ 1.5         | 6g               | 0.040                                 | 0.070                                        | 6H               | 0.055                                 | 0.095                                        |
|                          | 4g6g             | 0.026                                 | 0.045                                        | ...              | ...                                   | ...                                          |
| M17 $\times$ 1           | 6g               | 0.034                                 | 0.059                                        | 6H               | 0.046                                 | 0.080                                        |
|                          | 4g6g             | 0.022                                 | 0.038                                        | ...              | ...                                   | ...                                          |

**Table 17 Allowable Variations in Lead and Equivalent Change in Functional Diameter (Cont'd)**

(See paras. 10.1.3 through 10.1.6 for applicability.)

| Basic Thread Designation | External Threads |                                 |                                              | Internal Threads |                                 |                                              |
|--------------------------|------------------|---------------------------------|----------------------------------------------|------------------|---------------------------------|----------------------------------------------|
|                          | Tolerance Class  | Allowable Variation in Lead (±) | Equivalent Change in Functional Diameter (+) | Tolerance Class  | Allowable Variation in Lead (±) | Equivalent Change in Functional Diameter (–) |
| M18 × 1.5                | 6g               | 0.040                           | 0.070                                        | 6H               | 0.055                           | 0.095                                        |
|                          | 4g6g             | 0.026                           | 0.045                                        | ...              | ...                             | ...                                          |
| M20 × 2.5                | 6g               | 0.049                           | 0.085                                        | 6H               | 0.065                           | 0.112                                        |
|                          | 4g6g             | 0.031                           | 0.053                                        | ...              | ...                             | ...                                          |
| M20 × 1.5                | 6g               | 0.040                           | 0.070                                        | 6H               | 0.055                           | 0.095                                        |
|                          | 4g6g             | 0.026                           | 0.045                                        | ...              | ...                             | ...                                          |
| M20 × 1                  | 6g               | 0.034                           | 0.059                                        | 6H               | 0.046                           | 0.080                                        |
|                          | 4g6g             | 0.022                           | 0.038                                        | ...              | ...                             | ...                                          |
| M22 × 2.5                | 6g               | 0.049                           | 0.085                                        | 6H               | 0.065                           | 0.112                                        |
| M22 × 1.5                | 6g               | 0.040                           | 0.070                                        | 6H               | 0.055                           | 0.095                                        |
|                          | 4g6g             | 0.026                           | 0.045                                        | ...              | ...                             | ...                                          |
| M24 × 3                  | 6g               | 0.058                           | 0.100                                        | 6H               | 0.076                           | 0.132                                        |
|                          | 4g6g             | 0.036                           | 0.062                                        | ...              | ...                             | ...                                          |
| M24 × 2                  | 6g               | 0.049                           | 0.085                                        | 6H               | 0.065                           | 0.112                                        |
|                          | 4g6g             | 0.031                           | 0.053                                        | ...              | ...                             | ...                                          |
| M25 × 1.5                | 6g               | 0.043                           | 0.075                                        | 6H               | 0.058                           | 0.100                                        |
|                          | 4g6g             | 0.025                           | 0.042                                        | ...              | ...                             | ...                                          |
| M27 × 3                  | 6g               | 0.058                           | 0.100                                        | 6H               | 0.076                           | 0.132                                        |
| M27 × 2                  | 6g               | 0.049                           | 0.085                                        | 6H               | 0.065                           | 0.112                                        |
|                          | 4g6g             | 0.031                           | 0.053                                        | ...              | ...                             | ...                                          |
| M30 × 3.5                | 6g               | 0.061                           | 0.106                                        | 6H               | 0.081                           | 0.140                                        |
|                          | 4g6g             | 0.038                           | 0.066                                        | ...              | ...                             | ...                                          |
| M30 × 2                  | 6g               | 0.049                           | 0.085                                        | 6H               | 0.065                           | 0.112                                        |
|                          | 4g6g             | 0.031                           | 0.053                                        | ...              | ...                             | ...                                          |
| M30 × 1.5                | 6g               | 0.043                           | 0.075                                        | 6H               | 0.058                           | 0.100                                        |
|                          | 4g6g             | 0.025                           | 0.042                                        | ...              | ...                             | ...                                          |
| M33 × 2                  | 6g               | 0.049                           | 0.085                                        | 6H               | 0.065                           | 0.112                                        |
|                          | 4g6g             | 0.031                           | 0.053                                        | ...              | ...                             | ...                                          |
| M35 × 1.5                | 6g               | 0.043                           | 0.075                                        | 6H               | 0.058                           | 0.100                                        |
| M36 × 4                  | 6g               | 0.065                           | 0.112                                        | 6H               | 0.087                           | 0.150                                        |
|                          | 4g6g             | 0.040                           | 0.070                                        | ...              | ...                             | ...                                          |
| M36 × 2                  | 6g               | 0.049                           | 0.085                                        | 6H               | 0.065                           | 0.112                                        |
|                          | 4g6g             | 0.031                           | 0.053                                        | ...              | ...                             | ...                                          |
| M39 × 2                  | 6g               | 0.049                           | 0.085                                        | 6H               | 0.065                           | 0.112                                        |
|                          | 4g6g             | 0.031                           | 0.053                                        | ...              | ...                             | ...                                          |
| M40 × 1.5                | 6g               | 0.043                           | 0.075                                        | 6H               | 0.058                           | 0.100                                        |
|                          | 4g6g             | 0.025                           | 0.042                                        | ...              | ...                             | ...                                          |
| M42 × 4.5                | 6g               | 0.068                           | 0.118                                        | 6H               | 0.091                           | 0.158                                        |
|                          | 4g6g             | 0.043                           | 0.075                                        | ...              | ...                             | ...                                          |
| M42 × 2                  | 6g               | 0.049                           | 0.085                                        | 6H               | 0.065                           | 0.112                                        |
|                          | 4g6g             | 0.031                           | 0.053                                        | ...              | ...                             | ...                                          |
| M45 × 1.5                | 6g               | 0.043                           | 0.075                                        | 6H               | 0.058                           | 0.100                                        |
|                          | 4g6g             | 0.025                           | 0.042                                        | ...              | ...                             | ...                                          |
| M48 × 5                  | 6g               | 0.072                           | 0.125                                        | 6H               | 0.097                           | 0.168                                        |
|                          | 4g6g             | 0.046                           | 0.080                                        | ...              | ...                             | ...                                          |
| M48 × 2                  | 6g               | 0.052                           | 0.090                                        | 6H               | 0.068                           | 0.118                                        |
|                          | 4g6g             | 0.032                           | 0.056                                        | ...              | ...                             | ...                                          |
| M50 × 1.5                | 6g               | 0.046                           | 0.080                                        | 6H               | 0.061                           | 0.106                                        |
|                          | 4g6g             | 0.029                           | 0.050                                        | ...              | ...                             | ...                                          |

**Table 17 Allowable Variations in Lead and Equivalent Change in Functional Diameter (Cont'd)**

(See paras. 10.1.3 through 10.1.6 for applicability.)

| Basic Thread Designation | External Threads |                                 |                                              | Internal Threads |                                 |                                              |
|--------------------------|------------------|---------------------------------|----------------------------------------------|------------------|---------------------------------|----------------------------------------------|
|                          | Tolerance Class  | Allowable Variation in Lead (±) | Equivalent Change in Functional Diameter (+) | Tolerance Class  | Allowable Variation in Lead (±) | Equivalent Change in Functional Diameter (–) |
| M55 × 1.5                | 6g               | 0.046                           | 0.080                                        | 6H               | 0.061                           | 0.106                                        |
|                          | 4g6g             | 0.029                           | 0.050                                        | ...              | ...                             | ...                                          |
| M56 × 5.5                | 6g               | 0.076                           | 0.132                                        | 6H               | 0.102                           | 0.178                                        |
|                          | 4g6g             | 0.049                           | 0.085                                        | ...              | ...                             | ...                                          |
| M56 × 2                  | 6g               | 0.052                           | 0.090                                        | 6H               | 0.068                           | 0.118                                        |
|                          | 4g6g             | 0.032                           | 0.056                                        | ...              | ...                             | ...                                          |
| M60 × 1.5                | 6g               | 0.046                           | 0.080                                        | 6H               | 0.061                           | 0.106                                        |
|                          | 4g6g             | 0.029                           | 0.050                                        | ...              | ...                             | ...                                          |
| M64 × 6                  | 6g               | 0.081                           | 0.140                                        | 6H               | 0.108                           | 0.188                                        |
|                          | 4g6g             | 0.052                           | 0.090                                        | ...              | ...                             | ...                                          |
| M64 × 2                  | 6g               | 0.052                           | 0.090                                        | 6H               | 0.068                           | 0.118                                        |
|                          | 4g6g             | 0.032                           | 0.056                                        | ...              | ...                             | ...                                          |
| M65 × 1.5                | 6g               | 0.046                           | 0.080                                        | 6H               | 0.061                           | 0.106                                        |
|                          | 4g6g             | 0.029                           | 0.050                                        | ...              | ...                             | ...                                          |
| M70 × 1.5                | 6g               | 0.046                           | 0.080                                        | 6H               | 0.061                           | 0.106                                        |
|                          | 4g6g             | 0.029                           | 0.050                                        | ...              | ...                             | ...                                          |
| M72 × 6                  | 6g               | 0.081                           | 0.140                                        | 6H               | 0.108                           | 0.188                                        |
|                          | 4g6g             | 0.052                           | 0.090                                        | ...              | ...                             | ...                                          |
| M72 × 2                  | 6g               | 0.052                           | 0.090                                        | 6H               | 0.068                           | 0.118                                        |
|                          | 4g6g             | 0.032                           | 0.056                                        | ...              | ...                             | ...                                          |
| M75 × 1.5                | 6g               | 0.046                           | 0.080                                        | 6H               | 0.061                           | 0.106                                        |
|                          | 4g6g             | 0.029                           | 0.050                                        | ...              | ...                             | ...                                          |
| M80 × 6                  | 6g               | 0.081                           | 0.140                                        | 6H               | 0.108                           | 0.188                                        |
|                          | 4g6g             | 0.052                           | 0.090                                        | ...              | ...                             | ...                                          |
| M80 × 2                  | 6g               | 0.052                           | 0.090                                        | 6H               | 0.068                           | 0.118                                        |
|                          | 4g6g             | 0.032                           | 0.056                                        | ...              | ...                             | ...                                          |
| M80 × 1.5                | 6g               | 0.046                           | 0.080                                        | 6H               | 0.061                           | 0.106                                        |
|                          | 4g6g             | 0.029                           | 0.050                                        | ...              | ...                             | ...                                          |
| M85 × 2                  | 6g               | 0.052                           | 0.090                                        | 6H               | 0.068                           | 0.118                                        |
|                          | 4g6g             | 0.032                           | 0.056                                        | ...              | ...                             | ...                                          |
| M90 × 6                  | 6g               | 0.081                           | 0.140                                        | 6H               | 0.108                           | 0.188                                        |
|                          | 4g6g             | 0.052                           | 0.090                                        | ...              | ...                             | ...                                          |
| M90 × 2                  | 6g               | 0.052                           | 0.090                                        | 6H               | 0.068                           | 0.118                                        |
|                          | 4g6g             | 0.032                           | 0.056                                        | ...              | ...                             | ...                                          |
| M95 × 2                  | 6g               | 0.055                           | 0.095                                        | 6H               | 0.072                           | 0.125                                        |
|                          | 4g6g             | 0.034                           | 0.059                                        | ...              | ...                             | ...                                          |
| M100 × 6                 | 6g               | 0.087                           | 0.150                                        | 6H               | 0.115                           | 0.200                                        |
|                          | 4g6g             | 0.055                           | 0.095                                        | ...              | ...                             | ...                                          |
| M100 × 2                 | 6g               | 0.055                           | 0.095                                        | 6H               | 0.072                           | 0.125                                        |
|                          | 4g6g             | 0.034                           | 0.059                                        | ...              | ...                             | ...                                          |
| M105 × 2                 | 6g               | 0.055                           | 0.095                                        | 6H               | 0.072                           | 0.125                                        |
|                          | 4g6g             | 0.034                           | 0.059                                        | ...              | ...                             | ...                                          |
| M110 × 2                 | 6g               | 0.055                           | 0.095                                        | 6H               | 0.072                           | 0.125                                        |
|                          | 4g6g             | 0.034                           | 0.059                                        | ...              | ...                             | ...                                          |
| M120 × 2                 | 6g               | 0.055                           | 0.095                                        | 6H               | 0.072                           | 0.125                                        |
|                          | 4g6g             | 0.034                           | 0.059                                        | ...              | ...                             | ...                                          |
| M130 × 2                 | 6g               | 0.055                           | 0.095                                        | 6H               | 0.072                           | 0.125                                        |
|                          | 4g6g             | 0.034                           | 0.059                                        | ...              | ...                             | ...                                          |

**Table 17 Allowable Variations in Lead and Equivalent Change in Functional Diameter (Cont'd)**

(See paras. 10.1.3 through 10.1.6 for applicability.)

| Basic Thread Designation | External Threads |                                 |                                              | Internal Threads |                                 |                                              |
|--------------------------|------------------|---------------------------------|----------------------------------------------|------------------|---------------------------------|----------------------------------------------|
|                          | Tolerance Class  | Allowable Variation in Lead (±) | Equivalent Change in Functional Diameter (+) | Tolerance Class  | Allowable Variation in Lead (±) | Equivalent Change in Functional Diameter (–) |
| M140 × 2                 | 6g               | 0.055                           | 0.095                                        | 6H               | 0.072                           | 0.125                                        |
|                          | 4g6g             | 0.034                           | 0.059                                        | ...              | ...                             | ...                                          |
| M150 × 2                 | 6g               | 0.055                           | 0.095                                        | 6H               | 0.072                           | 0.125                                        |
|                          | 4g6g             | 0.034                           | 0.059                                        | ...              | ...                             | ...                                          |
| M160 × 3                 | 6g               | 0.065                           | 0.112                                        | 6H               | 0.087                           | 0.150                                        |
|                          | 4g6g             | 0.040                           | 0.070                                        | ...              | ...                             | ...                                          |
| M170 × 3                 | 6g               | 0.065                           | 0.112                                        | 6H               | 0.087                           | 0.150                                        |
|                          | 4g6g             | 0.040                           | 0.070                                        | ...              | ...                             | ...                                          |
| M180 × 3                 | 6g               | 0.065                           | 0.112                                        | 6H               | 0.087                           | 0.150                                        |
|                          | 4g6g             | 0.040                           | 0.070                                        | ...              | ...                             | ...                                          |
| M190 × 3                 | 6g               | 0.072                           | 0.125                                        | 6H               | 0.097                           | 0.168                                        |
|                          | 4g6g             | 0.046                           | 0.080                                        | ...              | ...                             | ...                                          |
| M200 × 3                 | 6g               | 0.072                           | 0.125                                        | 6H               | 0.097                           | 0.168                                        |
|                          | 4g6g             | 0.046                           | 0.080                                        | ...              | ...                             | ...                                          |

GENERAL NOTE: All dimensions are in millimeters.

**Table 18 Allowable Variations in 30 deg Basic Half-Angle of Screw Threads**

| External and Internal Threads     |                          |      |                          |      |
|-----------------------------------|--------------------------|------|--------------------------|------|
| Allowable Variation in Half-Angle |                          |      |                          |      |
| Pitch                             | Pitch Diam. Tol. Grade 6 |      | Pitch Diam. Tol. Grade 4 |      |
|                                   | ± deg                    | Min. | ± deg                    | Min. |
| 0.35                              | 3                        | 30   | 2                        | 15   |
| 0.4                               | 3                        | 20   | 2                        | 05   |
| 0.45                              | 3                        | 05   | 2                        | 00   |
| 0.5                               | 2                        | 55   | 1                        | 55   |
| 0.6                               | 2                        | 40   | 1                        | 45   |
| 0.7                               | 2                        | 30   | 1                        | 35   |
| 0.75                              | 2                        | 25   | 1                        | 30   |
| 0.8                               | 2                        | 20   | 1                        | 30   |
| 1                                 | 2                        | 05   | 1                        | 20   |
| 1.25                              | 1                        | 50   | 1                        | 10   |
| 1.5                               | 1                        | 40   | 1                        | 05   |
| 1.75                              | 1                        | 35   | 1                        | 00   |
| 2                                 | 1                        | 30   | 0                        | 55   |
| 2.5                               | 1                        | 20   | 0                        | 50   |
| 3                                 | 1                        | 10   | 0                        | 45   |
| 3.5                               | 1                        | 05   | 0                        | 45   |
| 4                                 | 1                        | 05   | 0                        | 40   |
| 4.5                               | 1                        | 00   | 0                        | 40   |
| 5                                 | 0                        | 55   | 0                        | 35   |
| 5.5                               | 0                        | 55   | 0                        | 35   |
| 6                                 | 0                        | 50   | 0                        | 35   |
| 8                                 | 0                        | 45   | 0                        | 30   |

GENERAL NOTE: See paras. 10.1.3 through 10.1.6 for applicability.

## **NONMANDATORY APPENDIX A STANDARD RULES FOR ROUNDING**

See ASME B1.30 for rounding rules and examples.

ASMENORMDOC.COM : Click to view the full PDF of ASME B1.13M 2005

## NONMANDATORY APPENDIX B THREAD STRENGTH DESIGN FORMULAS

### B-1 THREAD TENSILE STRESS AREA

The following tensile stress area formula is used for the purpose of product acceptance computations per ISO 898-1. This formula is based upon the area at a section midway between the basic pitch diameter and the basic rounded form minor diameter with radius of  $0.144P$ .

Tensile stress Area,  $\text{mm}^2$

$$A_s = 0.7854 (d_{\text{bsc}} - 0.9382P)^2$$

### B-2 THREAD SHEAR AREA

The following formulas for thread shear areas are geometric minimum values. Shear (Thread Stripping) strength of screw threads under load are dependent, in addition, on mating component relative material strengths, nut geometry, and coefficient of friction between thread bearing surfaces. Effective shear areas are therefore somewhat less than the geometric values.

Thread Geometric Shear Areas:

$$AS_n = \frac{3.1416}{P} LE d \text{ min.}$$

$$\left[ \frac{P}{2} + 0.57735 (d \text{ min.} - D_2 \text{ max.}) \right]$$

$$AS_s = \frac{3.1416}{P} LE D_1 \text{ max.}$$

$$\left[ \frac{P}{2} + 0.57735 (d_2 \text{ min.} - D_1 \text{ max.}) \right]$$

where

$AS_n$  = minimum thread shear area for internal threads,  $\text{mm}^2$

$AS_s$  = minimum thread shear area for external threads,  $\text{mm}^2$

$LE$  = length of engagement

### B-3 LENGTH OF THREAD ENGAGEMENT

In general the length of engagement of mating threads is selected to utilize full tensile strength of a bolt prior to shearing of nut threads. Other applications may require internal thread shear prior to failure of the externally threaded part. For noncritical design, the following formulas are often used for approximation:

Tensile strength of externally threaded part, kN

$$= \frac{S_t A_s}{1000}$$

Shear strength of threads, kN

$$= S_t (AS_n \text{ or } AS_s) / 2000$$

where

$S_t$  = Ultimate tensile strength of material, MPa

An internationally accepted study on the subject has been published in the 1977 Transactions of the Society of Automotive Engineers as Paper number 770420, *Analysis and Design of Threaded Assemblies* by E. M. Alexander.

## **NONMANDATORY APPENDIX C LIMITING DIMENSIONS M PROFILE SCREW THREADS — INCH TRANSLATION**

This Appendix (see Tables C-1 and C-2) presents an inch translation of limiting dimensions for M profile screw threads appearing in Tables 14 and 15. Data appearing here are for reference only. Dimensions have been calculated by dividing millimeter values in Tables 14 and 15, respectively, by 25.400 and rounding to 5 decimal places in accordance with ASME B1.30.

ASMENORMDOC.COM : Click to view the full PDF of ASME B1.13M 2005

Table C-1 Inch Translation for External Thread — Limiting Dimensions M Profile

| Basic Thread Designation | Tolerance Class | Allowances<br>[Note (1)] | Major Diameter, $d$<br>[Note (2)] |         | Pitch Diameter, $d_2$ and Functional Diameter<br>[Notes (2), (3), and (4)] |         | Max. Minor Diameter<br>$d_1$ [Note (2)] | Min. Minor Diam.,<br>(Rounded Form), $d_3$<br>[Note (5)]<br>(For Reference) | Nominal Pitch, $P$ |
|--------------------------|-----------------|--------------------------|-----------------------------------|---------|----------------------------------------------------------------------------|---------|-----------------------------------------|-----------------------------------------------------------------------------|--------------------|
|                          |                 |                          | Max.                              | Min.    | Max.                                                                       | Min.    |                                         |                                                                             |                    |
| M1.6 × 0.35              | 6g              | 0.00075                  | 0.06224                           | 0.05890 | 0.05331                                                                    | 0.05083 | 0.04732                                 | 0.04232                                                                     | 0.01378            |
| M1.6 × 0.35              | 6h              | 0.00000                  | 0.06299                           | 0.05965 | 0.05406                                                                    | 0.05157 | 0.04807                                 | 0.04307                                                                     | 0.01378            |
| M1.6 × 0.35              | 4g6g            | 0.00075                  | 0.06224                           | 0.05890 | 0.05331                                                                    | 0.05173 | 0.04732                                 | 0.04323                                                                     | 0.01378            |
| M2 × 0.4                 | 6g              | 0.00075                  | 0.07799                           | 0.07425 | 0.06776                                                                    | 0.06512 | 0.06094                                 | 0.05543                                                                     | 0.01575            |
| M2 × 0.4                 | 6h              | 0.00000                  | 0.07874                           | 0.07500 | 0.06850                                                                    | 0.06587 | 0.06169                                 | 0.05618                                                                     | 0.01575            |
| M2 × 0.4                 | 4g6g            | 0.00075                  | 0.07799                           | 0.07425 | 0.06776                                                                    | 0.06610 | 0.06094                                 | 0.05642                                                                     | 0.01575            |
| M2.5 × 0.45              | 6g              | 0.00079                  | 0.09764                           | 0.09370 | 0.08614                                                                    | 0.08335 | 0.07846                                 | 0.07244                                                                     | 0.01772            |
| M2.5 × 0.45              | 6h              | 0.00000                  | 0.09843                           | 0.09449 | 0.08693                                                                    | 0.08413 | 0.07925                                 | 0.07323                                                                     | 0.01772            |
| M2.5 × 0.45              | 4g6g            | 0.00079                  | 0.09764                           | 0.09370 | 0.08614                                                                    | 0.08437 | 0.07846                                 | 0.07346                                                                     | 0.01772            |
| M3 × 0.5                 | 6g              | 0.00079                  | 0.11732                           | 0.11315 | 0.10453                                                                    | 0.10157 | 0.09598                                 | 0.08945                                                                     | 0.01969            |
| M3 × 0.5                 | 6h              | 0.00000                  | 0.11811                           | 0.11394 | 0.10531                                                                    | 0.10236 | 0.09677                                 | 0.09024                                                                     | 0.01969            |
| M3 × 0.5                 | 4g6g            | 0.00079                  | 0.11732                           | 0.11315 | 0.10453                                                                    | 0.10264 | 0.09598                                 | 0.09051                                                                     | 0.01969            |
| M3.5 × 0.6               | 6g              | 0.00083                  | 0.13697                           | 0.13205 | 0.12161                                                                    | 0.11827 | 0.11138                                 | 0.10370                                                                     | 0.02362            |
| M3.5 × 0.6               | 6h              | 0.00000                  | 0.13780                           | 0.13287 | 0.12244                                                                    | 0.11909 | 0.11220                                 | 0.10453                                                                     | 0.02362            |
| M3.5 × 0.6               | 4g6g            | 0.00083                  | 0.13697                           | 0.13205 | 0.12161                                                                    | 0.11953 | 0.11138                                 | 0.10496                                                                     | 0.02362            |
| M4 × 0.7                 | 6g              | 0.00087                  | 0.15661                           | 0.15110 | 0.13870                                                                    | 0.13516 | 0.12677                                 | 0.11819                                                                     | 0.02756            |
| M4 × 0.7                 | 6h              | 0.00000                  | 0.15748                           | 0.15197 | 0.13957                                                                    | 0.13602 | 0.12764                                 | 0.11906                                                                     | 0.02756            |
| M4 × 0.7                 | 4g6g            | 0.00087                  | 0.15661                           | 0.15110 | 0.13870                                                                    | 0.13650 | 0.12677                                 | 0.11953                                                                     | 0.02756            |
| M5 × 0.8                 | 6g              | 0.00094                  | 0.19591                           | 0.19000 | 0.17543                                                                    | 0.17169 | 0.16181                                 | 0.15228                                                                     | 0.03150            |
| M5 × 0.8                 | 6h              | 0.00000                  | 0.19685                           | 0.19094 | 0.17638                                                                    | 0.17264 | 0.16276                                 | 0.15323                                                                     | 0.03150            |
| M5 × 0.8                 | 4g6g            | 0.00094                  | 0.19591                           | 0.19000 | 0.17543                                                                    | 0.17307 | 0.16181                                 | 0.15366                                                                     | 0.03150            |
| M6 × 1                   | 6g              | 0.00102                  | 0.23520                           | 0.22811 | 0.20961                                                                    | 0.20520 | 0.19256                                 | 0.18094                                                                     | 0.03937            |
| M6 × 1                   | 6h              | 0.00000                  | 0.23622                           | 0.22913 | 0.21063                                                                    | 0.20622 | 0.19358                                 | 0.18197                                                                     | 0.03937            |
| M6 × 1                   | 4g6g            | 0.00102                  | 0.23520                           | 0.22811 | 0.20961                                                                    | 0.20681 | 0.19256                                 | 0.18256                                                                     | 0.03937            |
| M8 × 1.25                | 6g              | 0.00110                  | 0.31386                           | 0.30551 | 0.28189                                                                    | 0.27724 | 0.26059                                 | 0.24693                                                                     | 0.04921            |
| M8 × 1.25                | 6h              | 0.00000                  | 0.31496                           | 0.30661 | 0.28299                                                                    | 0.27835 | 0.26169                                 | 0.24803                                                                     | 0.04921            |
| M8 × 1.25                | 4g6g            | 0.00110                  | 0.31386                           | 0.30551 | 0.28189                                                                    | 0.27894 | 0.26059                                 | 0.24862                                                                     | 0.04921            |
| M8 × 1                   | 6g              | 0.00102                  | 0.31394                           | 0.30685 | 0.28835                                                                    | 0.28394 | 0.27130                                 | 0.25969                                                                     | 0.03937            |
| M8 × 1                   | 6h              | 0.00000                  | 0.31496                           | 0.30787 | 0.28937                                                                    | 0.28496 | 0.27232                                 | 0.26071                                                                     | 0.03937            |
| M8 × 1                   | 4g6g            | 0.00102                  | 0.31394                           | 0.30685 | 0.28835                                                                    | 0.28555 | 0.27130                                 | 0.26130                                                                     | 0.03937            |
| M10 × 1.5                | 6g              | 0.00126                  | 0.39244                           | 0.38315 | 0.35409                                                                    | 0.34890 | 0.32850                                 | 0.31252                                                                     | 0.05906            |
| M10 × 1.5                | 6h              | 0.00000                  | 0.39370                           | 0.38441 | 0.35535                                                                    | 0.35016 | 0.32976                                 | 0.31378                                                                     | 0.05906            |

Table C-1 Inch Translation for External Thread — Limiting Dimensions M Profile (Cont'd)

| Basic Thread Designation | Tolerance Class | Allowances<br>[Note (1)] | Major Diameter, $d$<br>[Note (2)] |         | Pitch Diameter, $d_2$ and Functional Diameter<br>[Notes (2), (3), and (4)] |         |         | Max. Minor Diameter<br>(Flat Form), $d_1$ [Note (2)] | Min. Minor Diam.<br>(Rounded Form), $d_3$<br>[Note (5)]<br>(For Reference) | Nominal Pitch, $P$ |
|--------------------------|-----------------|--------------------------|-----------------------------------|---------|----------------------------------------------------------------------------|---------|---------|------------------------------------------------------|----------------------------------------------------------------------------|--------------------|
|                          |                 |                          | Max.                              | Min.    | Max.                                                                       | Min.    | Tol.    |                                                      |                                                                            |                    |
| M10 × 1.5                | 4g6g            | 0.00126                  | 0.39244                           | 0.38315 | 0.35409                                                                    | 0.35075 | 0.00334 | 0.32850                                              | 0.31437                                                                    | 0.05906            |
| M10 × 1.25               | 6g              | 0.00110                  | 0.39260                           | 0.38425 | 0.36063                                                                    | 0.35598 | 0.00465 | 0.33933                                              | 0.32567                                                                    | 0.04921            |
| M10 × 1.25               | 6h              | 0.00000                  | 0.39370                           | 0.38535 | 0.36173                                                                    | 0.35709 | 0.00465 | 0.34043                                              | 0.32677                                                                    | 0.04921            |
| M10 × 1.25               | 4g6g            | 0.00110                  | 0.39260                           | 0.38425 | 0.36063                                                                    | 0.35768 | 0.00295 | 0.33933                                              | 0.32736                                                                    | 0.04921            |
| M10 × 1                  | 6g              | 0.00102                  | 0.39268                           | 0.38559 | 0.36709                                                                    | 0.36268 | 0.00441 | 0.35004                                              | 0.33843                                                                    | 0.03937            |
| M10 × 1                  | 6h              | 0.00000                  | 0.39370                           | 0.38661 | 0.36811                                                                    | 0.36370 | 0.00441 | 0.35106                                              | 0.33945                                                                    | 0.03937            |
| M10 × 1                  | 4g6g            | 0.00102                  | 0.39268                           | 0.38559 | 0.36709                                                                    | 0.36429 | 0.00280 | 0.35004                                              | 0.34004                                                                    | 0.03937            |
| M10 × 0.75               | 6g              | 0.00087                  | 0.39283                           | 0.38732 | 0.37366                                                                    | 0.36972 | 0.00394 | 0.36087                                              | 0.35154                                                                    | 0.02953            |
| M10 × 0.75               | 6h              | 0.00000                  | 0.39370                           | 0.38819 | 0.37453                                                                    | 0.37059 | 0.00394 | 0.36173                                              | 0.35240                                                                    | 0.02953            |
| M10 × 0.75               | 4g6g            | 0.00087                  | 0.39283                           | 0.38732 | 0.37366                                                                    | 0.37118 | 0.00248 | 0.36087                                              | 0.35299                                                                    | 0.02953            |
| M12 × 1.75               | 6g              | 0.00134                  | 0.47110                           | 0.46067 | 0.42634                                                                    | 0.42023 | 0.00591 | 0.39650                                              | 0.37799                                                                    | 0.06890            |
| M12 × 1.75               | 6h              | 0.00000                  | 0.47244                           | 0.46201 | 0.42768                                                                    | 0.42177 | 0.00591 | 0.39783                                              | 0.37933                                                                    | 0.06890            |
| M12 × 1.75               | 4g6g            | 0.00134                  | 0.47110                           | 0.46067 | 0.42634                                                                    | 0.42260 | 0.00374 | 0.39650                                              | 0.38016                                                                    | 0.06890            |
| M12 × 1.5                | 6g              | 0.00126                  | 0.47118                           | 0.46189 | 0.43283                                                                    | 0.42732 | 0.00551 | 0.40724                                              | 0.39094                                                                    | 0.05906            |
| M12 × 1.5                | 6h              | 0.00000                  | 0.47244                           | 0.46315 | 0.43409                                                                    | 0.42858 | 0.00551 | 0.40850                                              | 0.39220                                                                    | 0.05906            |
| M12 × 1.5                | 4g6g            | 0.00126                  | 0.47118                           | 0.46189 | 0.43283                                                                    | 0.42929 | 0.00354 | 0.40724                                              | 0.39291                                                                    | 0.05906            |
| M12 × 1.25               | 6g              | 0.00110                  | 0.47134                           | 0.46299 | 0.43937                                                                    | 0.43417 | 0.00520 | 0.41807                                              | 0.40386                                                                    | 0.04921            |
| M12 × 1.25               | 6h              | 0.00000                  | 0.47244                           | 0.46409 | 0.44047                                                                    | 0.43528 | 0.00520 | 0.41917                                              | 0.40496                                                                    | 0.04921            |
| M12 × 1.25               | 4g6g            | 0.00110                  | 0.47134                           | 0.46299 | 0.43937                                                                    | 0.43602 | 0.00335 | 0.41807                                              | 0.40571                                                                    | 0.04921            |
| M12 × 1                  | 6g              | 0.00102                  | 0.47142                           | 0.46433 | 0.44583                                                                    | 0.44118 | 0.00465 | 0.42878                                              | 0.41693                                                                    | 0.03937            |
| M12 × 1                  | 6h              | 0.00000                  | 0.47244                           | 0.46535 | 0.44685                                                                    | 0.44220 | 0.00465 | 0.42980                                              | 0.41795                                                                    | 0.03937            |
| M12 × 1                  | 4g6g            | 0.00102                  | 0.47142                           | 0.46433 | 0.44583                                                                    | 0.44287 | 0.00296 | 0.42878                                              | 0.41862                                                                    | 0.03937            |
| M14 × 2                  | 6g              | 0.00150                  | 0.54969                           | 0.53866 | 0.49854                                                                    | 0.49224 | 0.00630 | 0.46445                                              | 0.44374                                                                    | 0.07874            |
| M14 × 2                  | 6h              | 0.00000                  | 0.55118                           | 0.54016 | 0.50004                                                                    | 0.49374 | 0.00630 | 0.46594                                              | 0.44524                                                                    | 0.07874            |
| M14 × 2                  | 4g6g            | 0.00150                  | 0.54969                           | 0.53866 | 0.49854                                                                    | 0.49461 | 0.00393 | 0.46445                                              | 0.44610                                                                    | 0.07874            |
| M14 × 1.5                | 6g              | 0.00126                  | 0.54992                           | 0.54063 | 0.51157                                                                    | 0.50606 | 0.00551 | 0.48598                                              | 0.46969                                                                    | 0.05906            |
| M14 × 1.5                | 6h              | 0.00000                  | 0.55118                           | 0.54189 | 0.51283                                                                    | 0.50732 | 0.00551 | 0.48724                                              | 0.47094                                                                    | 0.05906            |
| M14 × 1.5                | 4g6g            | 0.00126                  | 0.54992                           | 0.54063 | 0.51157                                                                    | 0.50803 | 0.00354 | 0.48598                                              | 0.47165                                                                    | 0.05906            |
| M15 × 1                  | 6g              | 0.00102                  | 0.58953                           | 0.58244 | 0.56394                                                                    | 0.55929 | 0.00465 | 0.54689                                              | 0.53504                                                                    | 0.03937            |
| M15 × 1                  | 6h              | 0.00000                  | 0.59055                           | 0.58346 | 0.56496                                                                    | 0.56031 | 0.00465 | 0.54791                                              | 0.53606                                                                    | 0.03937            |
| M15 × 1                  | 4g6g            | 0.00102                  | 0.58953                           | 0.58244 | 0.56394                                                                    | 0.56098 | 0.00296 | 0.54689                                              | 0.53673                                                                    | 0.03937            |
| M16 × 2                  | 6g              | 0.00150                  | 0.62843                           | 0.61740 | 0.57728                                                                    | 0.57098 | 0.00630 | 0.54319                                              | 0.52248                                                                    | 0.07874            |
| M16 × 2                  | 6h              | 0.00000                  | 0.62992                           | 0.61890 | 0.57878                                                                    | 0.57248 | 0.00630 | 0.54469                                              | 0.52398                                                                    | 0.07874            |
| M16 × 2                  | 4g6g            | 0.00150                  | 0.62843                           | 0.61740 | 0.57728                                                                    | 0.57335 | 0.00393 | 0.54319                                              | 0.52484                                                                    | 0.07874            |

Table C-1 Inch Translation for External Thread — Limiting Dimensions M Profile (Cont'd)

| Basic Thread Designation | Tolerance Class | Allowance, $e_s$<br>[Note (1)] | Major Diameter, $d$<br>[Note (2)] |         | Pitch Diameter, $d_2$ and Functional Diameter<br>[Notes (2), (3), and (4)] |         | Max. Minor Diameter (Flat Form), $d_1$<br>[Note (2)] | Min. Minor Diam. (Rounded Form), $d_3$<br>[Note (5)]<br>(For Reference) | Nominal Pitch, $P$ |
|--------------------------|-----------------|--------------------------------|-----------------------------------|---------|----------------------------------------------------------------------------|---------|------------------------------------------------------|-------------------------------------------------------------------------|--------------------|
|                          |                 |                                | Max.                              | Min.    | Max.                                                                       | Min.    |                                                      |                                                                         |                    |
| M16 × 1.5                | 6g              | 0.00126                        | 0.62866                           | 0.61937 | 0.59031                                                                    | 0.58480 | 0.56472                                              | 0.54843                                                                 | 0.05906            |
| M16 × 1.5                | 6h              | 0.00000                        | 0.62992                           | 0.62063 | 0.59157                                                                    | 0.58606 | 0.56598                                              | 0.54969                                                                 | 0.05906            |
| M16 × 1.5                | 4g6g            | 0.00126                        | 0.62866                           | 0.61937 | 0.59031                                                                    | 0.58677 | 0.56472                                              | 0.55039                                                                 | 0.05906            |
| M17 × 1                  | 6g              | 0.00102                        | 0.66827                           | 0.66118 | 0.64268                                                                    | 0.63803 | 0.62563                                              | 0.61378                                                                 | 0.03937            |
| M17 × 1                  | 6h              | 0.00000                        | 0.66929                           | 0.66220 | 0.64370                                                                    | 0.63906 | 0.62665                                              | 0.61480                                                                 | 0.03937            |
| M17 × 1                  | 4g6g            | 0.00102                        | 0.66827                           | 0.66118 | 0.64268                                                                    | 0.63972 | 0.62563                                              | 0.61547                                                                 | 0.03937            |
| M18 × 1.5                | 6g              | 0.00126                        | 0.70740                           | 0.69811 | 0.66906                                                                    | 0.66354 | 0.64346                                              | 0.62717                                                                 | 0.05906            |
| M18 × 1.5                | 6h              | 0.00000                        | 0.70866                           | 0.69937 | 0.67031                                                                    | 0.66480 | 0.64472                                              | 0.62843                                                                 | 0.05906            |
| M18 × 1.5                | 4g6g            | 0.00126                        | 0.70740                           | 0.69811 | 0.66906                                                                    | 0.66551 | 0.64346                                              | 0.62913                                                                 | 0.05906            |
| M20 × 2.5                | 6g              | 0.00165                        | 0.78575                           | 0.77256 | 0.72181                                                                    | 0.71512 | 0.67917                                              | 0.65449                                                                 | 0.09843            |
| M20 × 2.5                | 6h              | 0.00000                        | 0.78740                           | 0.77421 | 0.72346                                                                    | 0.71677 | 0.68083                                              | 0.65614                                                                 | 0.09843            |
| M20 × 2.5                | 4g6g            | 0.00165                        | 0.78575                           | 0.77256 | 0.72181                                                                    | 0.71764 | 0.67917                                              | 0.65701                                                                 | 0.09843            |
| M20 × 1.5                | 6g              | 0.00126                        | 0.78614                           | 0.77685 | 0.74780                                                                    | 0.74228 | 0.72220                                              | 0.70591                                                                 | 0.05906            |
| M20 × 1.5                | 6h              | 0.00000                        | 0.78740                           | 0.77811 | 0.74906                                                                    | 0.74354 | 0.72346                                              | 0.70717                                                                 | 0.05906            |
| M20 × 1.5                | 4g6g            | 0.00126                        | 0.78614                           | 0.77685 | 0.74780                                                                    | 0.74425 | 0.72220                                              | 0.70787                                                                 | 0.05906            |
| M20 × 1                  | 6g              | 0.00102                        | 0.78638                           | 0.77929 | 0.76079                                                                    | 0.75783 | 0.74374                                              | 0.73358                                                                 | 0.03937            |
| M20 × 1                  | 6h              | 0.00000                        | 0.78740                           | 0.78031 | 0.76181                                                                    | 0.75717 | 0.74476                                              | 0.73291                                                                 | 0.03937            |
| M20 × 1                  | 4g6g            | 0.00102                        | 0.78638                           | 0.77929 | 0.76079                                                                    | 0.75783 | 0.74374                                              | 0.73358                                                                 | 0.03937            |
| M22 × 2.5                | 6g              | 0.00165                        | 0.86449                           | 0.85130 | 0.80055                                                                    | 0.79386 | 0.75791                                              | 0.73323                                                                 | 0.09843            |
| M22 × 2.5                | 6h              | 0.00000                        | 0.86614                           | 0.85295 | 0.80220                                                                    | 0.79551 | 0.75957                                              | 0.73488                                                                 | 0.09843            |
| M22 × 1.5                | 6g              | 0.00126                        | 0.86488                           | 0.85559 | 0.82654                                                                    | 0.82102 | 0.80094                                              | 0.78465                                                                 | 0.05906            |
| M22 × 1.5                | 6h              | 0.00000                        | 0.86614                           | 0.85685 | 0.82780                                                                    | 0.82228 | 0.80220                                              | 0.78591                                                                 | 0.05906            |
| M22 × 1.5                | 4g6g            | 0.00126                        | 0.86488                           | 0.85559 | 0.82654                                                                    | 0.82299 | 0.80094                                              | 0.78661                                                                 | 0.05906            |
| M24 × 3                  | 6g              | 0.00189                        | 0.94299                           | 0.92823 | 0.86626                                                                    | 0.85839 | 0.81512                                              | 0.78563                                                                 | 0.11811            |
| M24 × 3                  | 6h              | 0.00000                        | 0.94488                           | 0.93012 | 0.86815                                                                    | 0.86028 | 0.81701                                              | 0.78752                                                                 | 0.11811            |
| M24 × 3                  | 4g6g            | 0.00189                        | 0.94299                           | 0.92823 | 0.86626                                                                    | 0.86134 | 0.81512                                              | 0.78858                                                                 | 0.11811            |
| M24 × 2                  | 6g              | 0.00150                        | 0.94339                           | 0.93236 | 0.89224                                                                    | 0.88555 | 0.85815                                              | 0.83705                                                                 | 0.07874            |
| M24 × 2                  | 6h              | 0.00000                        | 0.94488                           | 0.93386 | 0.89374                                                                    | 0.88705 | 0.85965                                              | 0.83854                                                                 | 0.07874            |
| M24 × 2                  | 4g6g            | 0.00150                        | 0.94339                           | 0.93236 | 0.89224                                                                    | 0.88807 | 0.85815                                              | 0.83957                                                                 | 0.07874            |
| M25 × 1.5                | 6g              | 0.00126                        | 0.98299                           | 0.97370 | 0.94465                                                                    | 0.93874 | 0.91906                                              | 0.90236                                                                 | 0.05906            |
| M25 × 1.5                | 6h              | 0.00000                        | 0.98425                           | 0.97496 | 0.94591                                                                    | 0.94000 | 0.92031                                              | 0.90362                                                                 | 0.05906            |
| M25 × 1.5                | 4g6g            | 0.00126                        | 0.98299                           | 0.97370 | 0.94465                                                                    | 0.94091 | 0.91906                                              | 0.90453                                                                 | 0.05906            |

Table C-1 Inch Translation for External Thread — Limiting Dimensions M Profile (Cont'd)

| Basic Thread Designation | Tolerance Class | Allowance, $e_s$<br>[Note (1)] | Major Diameter, $d$<br>[Note (2)] |         | Pitch Diameter, $d_2$ and Functional Diameter<br>[Notes (2), (3), and (4)] |         | Max. Minor Diameter<br>(Flat Form), $d_1$<br>[Note (2)] | Min. Minor Diam.<br>(Rounded Form), $d_3$<br>[Note (5)]<br>(For Reference) | Nominal Pitch, $P$ |
|--------------------------|-----------------|--------------------------------|-----------------------------------|---------|----------------------------------------------------------------------------|---------|---------------------------------------------------------|----------------------------------------------------------------------------|--------------------|
|                          |                 |                                | Max.                              | Min.    | Max.                                                                       | Min.    |                                                         |                                                                            |                    |
| M27 × 3                  | 6g              | 0.00189                        | 1.06110                           | 1.04634 | 0.98437                                                                    | 0.97650 | 0.93323                                                 | 0.90374                                                                    | 0.11811            |
| M27 × 3                  | 6h              | 0.00000                        | 1.06299                           | 1.04823 | 0.98626                                                                    | 0.97839 | 0.93512                                                 | 0.90563                                                                    | 0.11811            |
| M27 × 2                  | 6g              | 0.00150                        | 1.06150                           | 1.05047 | 1.01035                                                                    | 1.00366 | 0.97626                                                 | 0.95516                                                                    | 0.07874            |
| M27 × 2                  | 6h              | 0.00000                        | 1.06299                           | 1.05197 | 1.01185                                                                    | 1.00516 | 0.97776                                                 | 0.95665                                                                    | 0.07874            |
| M27 × 2                  | 4g6g            | 0.00150                        | 1.06150                           | 1.05047 | 1.01035                                                                    | 1.00618 | 0.97626                                                 | 0.95768                                                                    | 0.07874            |
| M30 × 3.5                | 6g              | 0.00209                        | 1.17902                           | 1.16228 | 1.08953                                                                    | 1.08118 | 1.02984                                                 | 0.99630                                                                    | 0.13780            |
| M30 × 3.5                | 6h              | 0.00000                        | 1.18110                           | 1.16437 | 1.09161                                                                    | 1.08327 | 1.03193                                                 | 0.99839                                                                    | 0.13780            |
| M30 × 3.5                | 4g6g            | 0.00209                        | 1.17902                           | 1.16228 | 1.08953                                                                    | 1.08433 | 1.02984                                                 | 0.99945                                                                    | 0.13780            |
| M30 × 2                  | 6g              | 0.00150                        | 1.17961                           | 1.16858 | 1.12846                                                                    | 1.12177 | 1.09437                                                 | 1.07327                                                                    | 0.07874            |
| M30 × 2                  | 6h              | 0.00000                        | 1.18110                           | 1.17008 | 1.12996                                                                    | 1.12327 | 1.09587                                                 | 1.07476                                                                    | 0.07874            |
| M30 × 2                  | 4g6g            | 0.00150                        | 1.17961                           | 1.16858 | 1.12846                                                                    | 1.12429 | 1.09437                                                 | 1.07579                                                                    | 0.07874            |
| M30 × 1.5                | 6g              | 0.00126                        | 1.17984                           | 1.17055 | 1.14150                                                                    | 1.13559 | 1.11591                                                 | 1.09921                                                                    | 0.05906            |
| M30 × 1.5                | 6h              | 0.00000                        | 1.18110                           | 1.17181 | 1.16276                                                                    | 1.13685 | 1.11717                                                 | 1.10047                                                                    | 0.05906            |
| M30 × 1.5                | 4g6g            | 0.00126                        | 1.17984                           | 1.17055 | 1.14150                                                                    | 1.13776 | 1.11591                                                 | 1.10138                                                                    | 0.05906            |
| M33 × 2                  | 6g              | 0.00150                        | 1.29772                           | 1.28669 | 1.24657                                                                    | 1.23988 | 1.21248                                                 | 1.19138                                                                    | 0.07874            |
| M33 × 2                  | 6h              | 0.00000                        | 1.29921                           | 1.28819 | 1.24807                                                                    | 1.24138 | 1.21398                                                 | 1.19287                                                                    | 0.07874            |
| M33 × 2                  | 4g6g            | 0.00150                        | 1.29772                           | 1.28669 | 1.24657                                                                    | 1.24240 | 1.21248                                                 | 1.19390                                                                    | 0.07874            |
| M35 × 1.5                | 6g              | 0.00126                        | 1.37669                           | 1.36740 | 1.33835                                                                    | 1.33244 | 1.31276                                                 | 1.29606                                                                    | 0.05906            |
| M35 × 1.5                | 6h              | 0.00000                        | 1.37795                           | 1.36866 | 1.33961                                                                    | 1.33370 | 1.31402                                                 | 1.29732                                                                    | 0.05906            |
| M36 × 4                  | 6g              | 0.00236                        | 1.41496                           | 1.39626 | 1.31268                                                                    | 1.30386 | 1.24449                                                 | 1.20685                                                                    | 0.15748            |
| M36 × 4                  | 6h              | 0.00000                        | 1.41732                           | 1.39862 | 1.31504                                                                    | 1.30622 | 1.24685                                                 | 1.20921                                                                    | 0.15748            |
| M36 × 4                  | 4g6g            | 0.00236                        | 1.41496                           | 1.39626 | 1.31268                                                                    | 1.30717 | 1.24449                                                 | 1.21016                                                                    | 0.15748            |
| M36 × 2                  | 6g              | 0.00150                        | 1.41583                           | 1.40480 | 1.36469                                                                    | 1.35799 | 1.33059                                                 | 1.30949                                                                    | 0.07874            |
| M36 × 2                  | 6h              | 0.00000                        | 1.41732                           | 1.40630 | 1.36618                                                                    | 1.35949 | 1.33209                                                 | 1.31098                                                                    | 0.07874            |
| M36 × 2                  | 4g6g            | 0.00150                        | 1.41583                           | 1.40480 | 1.36469                                                                    | 1.36051 | 1.33059                                                 | 1.31201                                                                    | 0.07874            |
| M39 × 2                  | 6g              | 0.00150                        | 1.53394                           | 1.52291 | 1.48280                                                                    | 1.47610 | 1.44870                                                 | 1.42760                                                                    | 0.07874            |
| M39 × 2                  | 6h              | 0.00000                        | 1.53543                           | 1.52441 | 1.48429                                                                    | 1.47760 | 1.45020                                                 | 1.42909                                                                    | 0.07874            |
| M39 × 2                  | 4g6g            | 0.00150                        | 1.53394                           | 1.52291 | 1.48280                                                                    | 1.47862 | 1.44870                                                 | 1.43012                                                                    | 0.07874            |
| M40 × 1.5                | 6g              | 0.00126                        | 1.57354                           | 1.56425 | 1.53520                                                                    | 1.52929 | 1.50961                                                 | 1.49291                                                                    | 0.05906            |
| M40 × 1.5                | 6h              | 0.00000                        | 1.57480                           | 1.56551 | 1.53646                                                                    | 1.53055 | 1.51087                                                 | 1.49417                                                                    | 0.05906            |
| M40 × 1.5                | 4g6g            | 0.00126                        | 1.57354                           | 1.56425 | 1.53520                                                                    | 1.53146 | 1.50961                                                 | 1.49508                                                                    | 0.05906            |
| M42 × 4.5                | 6g              | 0.00248                        | 1.65106                           | 1.63138 | 1.53598                                                                    | 1.52669 | 1.45925                                                 | 1.41756                                                                    | 0.17717            |
| M42 × 4.5                | 6h              | 0.00000                        | 1.65354                           | 1.63386 | 1.53846                                                                    | 1.52917 | 1.46173                                                 | 1.42004                                                                    | 0.17717            |