FED-STD-H28/16

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Superseding
NBS Handbook H28 (1957)
Part III, Section XVI

# FEDERAL STANDARD

# SCREW-THREAD STANDARDS FOR FEDERAL SERVICES

## SECTION 16

## MICROSCOPE OBJECTIVE AND NOISE-PIECE, 0.800 - 36AMO

This standard was approved by the Commissioner Federal Supply Service, General Services Administration, for the use of all Federal agencies.

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New and revised pages will be issued under Change Notices which will be numbered consecutively and will bear the date of issuance. Change Notices should be retained and filed in front of the Standard until such time as they are superseded by a reissue of the entire Standard.

## NOTICE

From 1939, the Interdepartmental Screw Thread Committee (ISTC), under the Chairmanship of the National Bureau of Standards (NBS), Department of Commerce had developed and published NBS Handbook H28, Screw-Thread Standards for Federal Services.

Section 487 of Title 40 of the U.S. Code states that the authority for development of Federal Standards for procurement purposes rests with the General Services Administration (GSA).

In November 1976, the ISTC was terminated, and the General Services Administration (GSA) accepted the responsibility for NBS Handbook H28 and agreed to convert it and maintain it as a Federal Standard.

The standards which had been published as NBS Handbook H28, Part I, Part II and Part III will now be promulgated as a fully coordinated FED-STD-H28, maintaining the existing sections and identifying them with slant lines. For example, NBS Handbook H28, Part I, Section 3 will be detailed standard FED-STD-H28/3 which must be procured individually.

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The text of this section is reprinted from the NBS HANDBOOK H28 with minor editorial corrections.

Reorganization of the document from NBS HANDBOOK H28 to FED-STD-H28 creates an editorial inconvenience, when maintaining continuity of cross references amongst the pages, paragraphs, tables and figures of the different sections. For this standard individual sections will be numbered sequentially starting with (1) one. If the reprinted text refers to another page, such as Page 6.3, this will be understood to mean section 6 page 3. All figures and tables will maintain the established designations, prefixed with the section; e.g. Table 3.1 and Figure 2.5 to identify their location in this standard. All appendices will be incorporated in the basic document FED-STD-H28 with other general information and will continue to be identified with the prefix A.

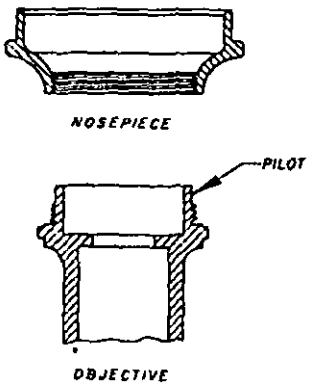


FIGURE 16.1 —*Typical arrangement of microscope objective and nosepiece.*

## 1. GENERAL AND HISTORICAL

The standardization of the microscope objective and nosepiece threads is one of the projects toward unification of screw thread standards among inch-using countries. In Great Britain, the Royal Microscopical Society had established standards for microscope objective threads in 1858, based on the Whitworth screw thread system, which were subsequently used throughout the world. The history of this standard is in the *Transactions* of the Society: 1858, p. 39; 1859, p. 92; 1896, pp. 389, 487; 1911, p. 175; 1915, p. 230; 1924, p. 266; and 1936, p. 377.

In practice, American manufacturers of this thread have always employed modifications of the Whitworth form because of their preference for flat crests, such modified threads being completely interchangeable with the RMS threads. At the Conference on Unification of Engineering Standards held in Ottawa in 1945, the American Delegation presented ASA Paper B1/57 and A.O. Drawing ED-95 giving limits of size for a truncated Whitworth thread. Since a thread form with rounded crest is preferred in Great Britain for optical instruments, it was recommended that the title of this document be amended to read, "Proposed Permitted Truncation and Tolerances for RMS Thread."

On the basis of this proposal a draft of a proposed American Standard, dated April, 1948, was circulated to the B1 Sectional Committee membership for comment. In conformity with comments received, a revised draft, dated October, 1954, was approved by Subcommittee No. 4 on Instrument Screw Threads and subsequently submitted to the Sectional Committee for approval. Final approval as an American Standard was given on January 7, 1958, by ASA.

This section covers the thread used for mounting the microscope objective to the nosepiece. A typical arrangement is shown in figure 16.1. This thread is recommended also for other optical assemblies of microscopes and associated apparatus, such as photomicrographic equipment. The thread is based on, and intended to be interchangeable with, the thread introduced and adopted many years ago by the Royal Microscopical Society of Great Britain and generally known as the "RMS thread." This thread has become almost universally accepted as the basic standard for microscope objective and nosepiece threads. Formal recognition, however, has been extremely limited.

Experience has established that the principal attributes of a good fit for microscope objective and nosepiece threads are:

(*a*) Adequate clearance to afford protection against binding due to the presence of foreign particles or small thread crest damage.

(*b*) Sufficient depth of thread engagement to assure security in the short lengths of engagement commonly encountered.

(*c*) Allowances for limited eccentricities so that centralization and squareness of the objective are not influenced by such deviations in manufacture.

The need for the above characteristics stems principally from the inherent longevity of optical equipment and the repeated uses to which objectives and nosepiece threads are subjected.

## 2. SPECIFICATIONS

1. FORM OF THREAD.—This section covers only one nominal size of thread which has a basic major diameter of 0.800 in. and 36 tpi. Because of its British origin, the basic thread possesses the British Standard Whitworth form, having an included angle of 55° and rounded crests and roots. The thread is of the single-start type.[1] Symbols, formulas, and basic and design dimensions for the threads are given in table 16.1.

2. ALLOWANCES.—Positive allowances (minimum clearances) are provided on the pitch, major,

TABLE 16.1 —*Symbols, formulas, and basic and design dimensions, 0.800 - 38AMO*

| | Symbol | Formula | Dimension |
|---|---|---|---|
| **Basic thread form** | | | |
| Half angle of thread | $\alpha$ | | 27°30′ |
| Included angle of thread | $2\alpha$ | | 55°00′ |
| Number of threads per inch | $n$ | | 36 |
| Pitch | $p$ | $1/n$ | 0.027778 in. |
| Height of fundamental triangle | $H$ | $0.960491p$ | .026680 in. |
| Height of basic thread | $h_b$ | $.640327p$ | .0178 in. |
| Radius at crest and root of British Standard Whitworth basic thread (not used). | $r$ | $.137329p$ | .0038 in. |
| **Design thread form** | | | |
| Height of truncated Whitworth thread. | $h$ | $h_b - U = 0.566410p$ | 0.0157 in. |
| Width of flat at crest | $F_c$ | $0.243624p$ | .0068 in. |
| Width of flat at root | $F_r$ | $.166667p$ | .0046 in. |
| Basic truncation of crest from basic Whitworth form. | $U$ | $.073917p$ | .00203 in. |
| **Basic and design sizes** | | | |
| Major diameter, nominal and basic. | $D$ | | 0.800 in. |
| Major diameter of internal (nosepiece) thread. | $D_n$ | $D$ | .800 in. |
| Major diameter of external (objective) thread.[a] | $D_o$ | $D - 2U - G$ | .7941 in. |
| Pitch diameter, basic | $E$ | $D - h_b$ | .7822 in. |
| Pitch diameter of internal (nosepiece) thread. | $E_n$ | $D - h_b$ | .7822 in. |
| Pitch diameter of external (objective) thread.[b] | $E_o$ | $D - h_b - G$ | .7804 in. |
| Minor diameter, basic | $K$ | $D - 2h_b$ | .7644 in. |
| Minor diameter of internal (nosepiece) thread. | $K_n$ | $D - 2K$ | .7583 in. |
| Minor diameter of external (objective) thread.[a] | $K_o$ | $D - 2h_b - G$ | .7626 in. |
| Allowance at pitch diameter [a, b] | $G$ | | .0018 in. |

[a] An allowance equal to that on the pitch diameter is also provided on the major and minor diameters of the external (objective) thread for additional clearance and centralizing.

[b] Allowance (minimum clearance) on pitch diameter is the same as on British RMS thread.

and minor diameters of the external (objective) thread. The allowance on the pitch diameter is 0.0018 in., the value established by the British Royal Microscopical Society in 1924 and now widely regarded as a basic requirement. The same allowance is also applied on both the major and minor diameters.

Where interchangeability with product having full-form Whitworth threads is not required the allowances on the major and minor diameters of the external (objective) thread are not necessary, since the forms at the root and crest of the truncated internal (nosepiece) thread provide the desired clearances. In such cases, either both limits or only the maximum limit of the major and minor diameters may be increased by the amount of the allowance. Benefits are derived principally from changes in the major diameter where increasing both limits improves the depth of thread engagement, and increasing only the maximum limit grants a larger manufacturing tolerance.

However, unless such deviations are specifically covered in purchase negotiations, it is to be assumed that the threads will be supplied in accordance with the tables in this section.

3. TOLERANCES.—In accordance with standard practice, tolerances on the internal (nosepiece) thread shall be applied plus from the basic (design) size and tolerances on the external (objective) thread shall be applied minus from its design (maximum material) size.

The pitch diameter tolerances for the external and internal thread are the same and include both lead and angle deviations. They are derived from the RMS standard of 1924 and are the same as for the current British RMS thread.

The tolerance on the major diameter of the external thread and the tolerance on the minor diameter of the internal thread are the minimum values which experience has demonstrated to be practicable. Adequate depth of thread engagement is thereby assured.

All tolerances are given in table 16.2.

4. LENGTHS OF ENGAGEMENT.—The tolerances specified herein are applicable to lengths of engagement ranging from ¼ to ⅝ in. (approximately 15 to 50 percent of the basic diameter). Lengths of engagement exceeding these limits are seldom employed and, consequently, are not provided for in this section.

For microscope objective and nosepiece assemblies, the length of engagement most generally employed is ⅜ in.

5. PILOT ON OBJECTIVE THREAD.—A pilot (plain portion) shall be provided at the leading end of the objective thread for ease of assembly with the nosepiece thread. The diameter of the pilot shall not exceed 0.7626 in. (See fig. 16.1)

TABLE 16.2—*Limits of size and tolerances, 0.800 - 38AMO*

| Diameter | External (objective) thread | | | | | Internal (nosepiece) thread | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Maximum | | Minimum | | Tolerance | Minimum | | Maximum | | Tolerance |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| | in. | mm | in. | mm | in. | in. | mm | in. | mm | in. |
| Major | 0.7941 | 20.170 | 0.7911 | 20.094 | 0.0030 | 0.8000 | 20.320 | [b] 0.8022 | [b] 20.554 | ..... |
| Pitch | .7804 | 19.822 | .7774 | 19.746 | .0030 | .7822 | 19.864 | .7852 | 19.943 | 0.0030 |
| Minor | .7626 | 19.370 | [a] .7552 | [a] 19.182 | ..... | .7685 | 19.520 | .7715 | 19.596 | .0030 |

[a] Extreme minimum minor diameter produced by a new threading tool having a minimum flat of $p/12$ (=0.0023 in.). This minimum diameter is not controlled by gages but by the form of the threading tool.

[b] Extreme maximum major diameter produced by a new threading tool having a minimum flat of $p/20$ (=0.0014 in.). This maximum diameter is not controlled by gages but by the form of the threading tool.

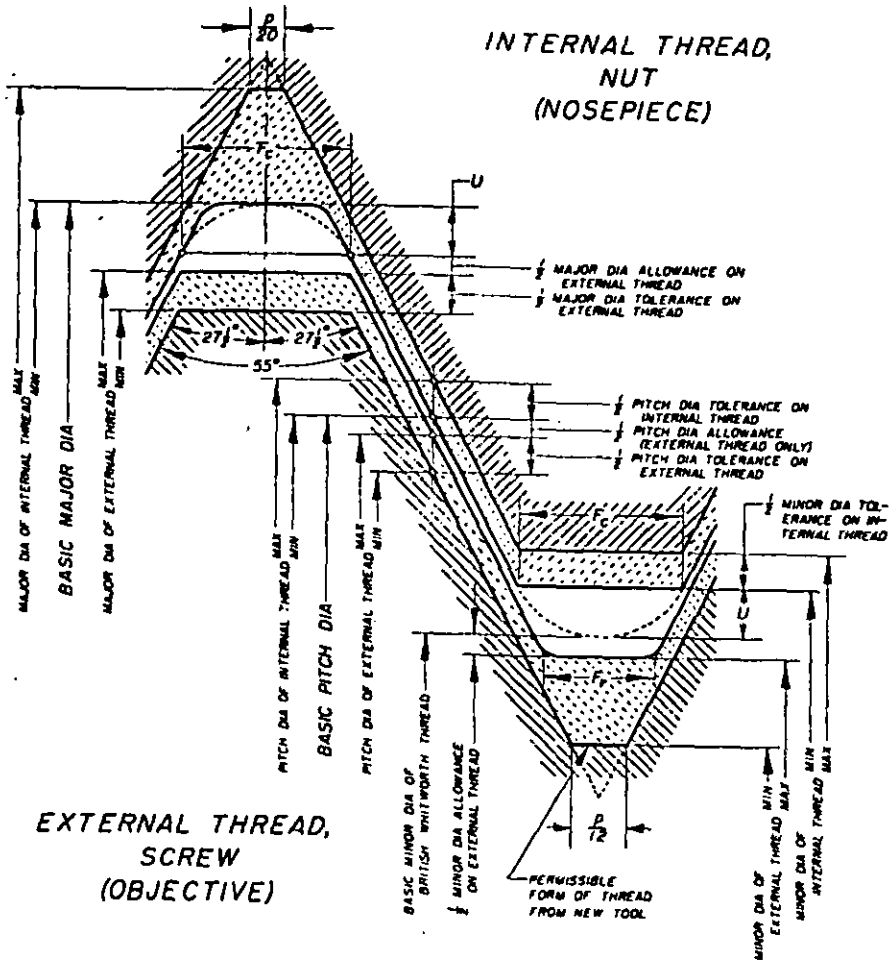


FIGURE 16.2 —*Disposition of tolerances, allowances, and crest clearances for 0.800—36AMO thread.*

See table 16.1 for interpretation of symbols.

6. LIMITS OF SIZE.—The limits of size for both the external and internal thread are given in table 16.2. Their application is illustrated in figure 16.2.

7. THREAD DESIGNATION.—This thread is to be designated on engineering drawings, in specifications, and on tools and gages by the symbol "AMO" preceded by the basic major diameter in inches and the number of threads per inch, as given below:

0.800—36AMO.

### 3. GAGE DIMENSIONS

Recommended gage dimensions are listed in table 16.3.

### 4. BRITISH STANDARD FOR MICROSCOPE OBJECTIVE AND NOSEPIECE THREADS

The British and American threads are the same with the following exceptions:

The British thread has a basic and design thread form as shown in figure 16.3 whereas the American thread has truncated crests and roots as shown in figure 16.2. The limits of size of the British thread are given in table 16.4.

The length of thread on the British objective is 0.125 in. (3.175 mm.) whereas the lengths of engagement for the American thread may range from ⅛ to ⅜ in. However, the length of engagement most generally employed for the American thread is ¼ in.

TABLE 16.3 —*Recommended gage dimensions for microscope objective and nosepiece thread, 0.800—38AMO*

| Dimension symbol | Description | Formula | Dimension |
|---|---|---|---|
| | **EXTERNAL (OBJECTIVE) THREAD** | | |
| | **"GO" SETTING THREAD PLUG GAGE (A—GO)** | | in. |
| $D_1$ Max | Major diameter, maximum | $D_1$ Max | 0.7941 |
| $D_1$ Min | Major diameter, minimum | $D_1$ Max −0.0004 | .7937 |
| $E_1$ Max | Pitch diameter, maximum | $E_1$ Max | .7804 |
| $E_1$ Min | Pitch diameter, minimum | $E_1$ Max −0.0002 | .7802 |
| | **"NOT GO" SETTING THREAD PLUG GAGE (A—NOT GO)** | | |
| $D_1$ Min | Major diameter, minimum | $D_1$ Max | .7941 |
| $D_1$ Max | Major diameter, maximum | $D_1$ Min +0.0004 | .7945 |
| $E_1$ Min | Pitch diameter, minimum | $E_1$ Min | .7774 |
| $E_1$ Max | Pitch diameter, maximum | $E_1$ Min +0.0002 | .7776 |
| | **"GO" THREAD RING GAGE** | | |
| $E_2$ Max | Pitch diameter, maximum | $E_2$ Max "Go" A Plug | .7804 |
| $E_2$ Min | Pitch diameter, minimum | $E_2$ Min "Go" A Plug | .7802 |
| $K_2$ Max | Minor diameter, maximum | $D_n$ Min $-2h_1$ | .7644 |
| $K_2$ Min | Minor diameter, minimum | $K_2$ Max −0.0004 | .7640 |
| | **"NOT GO" THREAD RING GAGE** | | |
| $E_2$ Min | Pitch diameter, minimum | $E_2$ Min "Not Go" A Plug | .7774 |
| $E_2$ Max | Pitch diameter, maximum | $E_2$ Max "Not Go" A Plug | .7776 |
| $K_2$ Min | Minor diameter, minimum | $E_2$ Min $-p/3$ | .7681 |
| $K_2$ Max | Minor diameter, maximum | $K_2$ Min +0.0004 | .7685 |
| | **INTERNAL (NOSEPIECE) THREAD** | | |
| | **"GO" THREAD PLUG GAGE** | | |
| $D_2$ Min | Major diameter, minimum | $D_n$ Min | 0.8000 |
| $D_2$ Max | Major diameter, maximum | $D_2$ Min +0.0004 | .8004 |
| $E_2$ Min | Pitch diameter, minimum | $E_2$ Min | .7822 |
| $E_2$ Max | Pitch diameter, maximum | $E_2$ Min +0.0002 | .7824 |
| | **"NOT GO" THREAD PLUG GAGE** | | |
| $D_2$ Max | Major diameter, maximum | $E_2$ Max $+p/3$ | .7945 |
| $D_2$ Min | Major diameter, minimum | $D_2$ Max −0.0004 | .7941 |
| $E_2$ Max | Pitch diameter, maximum | $E_2$ Max | .7852 |
| $E_2$ Min | Pitch diameter, minimum | $E_2$ Max −0.0002 | .7850 |
| Tolerance on lead | | | ±0.0002 in. |
| Tolerance on half-angle of thread | | | ±0 deg 20 min |

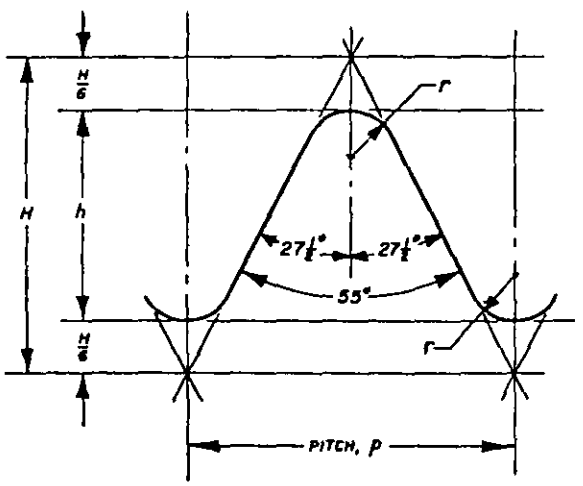


FIGURE 16.3 —*Basic form of Whitworth thread.*

$H=0.960491p$ $\quad H/6=0.160082p$
$h=2/3H=0.640327p$ $\quad r=0.137329p$

TABLE 16.4 —*Limits of size for the British microscope objective and nosepiece thread*

| Diameter | External (objective) thread | | | | Internal (nosepiece) thread | | | |
|---|---|---|---|---|---|---|---|---|
| | Maximum | | Minimum | | Minimum | | Maximum | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| | in. | mm | in. | mm | in. | mm | in. | mm |
| Major | 0.7982 | 20.274 | 0.7952 | 20.198 | 0.8000 | 20.320 | ..... | ..... |
| Simple effective | .7804 | 19.822 | .7774 | 19.746 | .7822 | 19.868 | 0.7852 | 19.944 |
| Minor | .7626 | 19.370 | ..... | ..... | .7644 | 19.416 | .7674 | 19.492 |

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