Designation: E210 – 63 (Reapproved 2016)

Standard Specification for Microscope Objective Thread[1]

This standard is issued under the fixed designation E210; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

GENERAL AND HISTORICAL

1. Scope

1.1 This standard covers the screw thread used for mounting the objective assembly to the body or lens turret of microscopes. It is based on, and intended to be interchangeable with, the screw thread introduced and adopted many years ago by the Royal Microscopical Society of Great Britain, generally known as the "RMS thread" and now almost universally accepted as the basic standard for microscope objective mountings. Formal recognition, however, has been extremely limited.

1.2 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

2. Referenced Documents

2.1 *ASA Standard:*[2]

ASA B1.6–1944 Truncated Whitworth Threads

2.2 *ANSI Standard:*[3]

B1.7–1949 Nomenclature, Definitions, and Letter Symbols for Screw Threads

3. Terminology

3.1 The nomenclature, definitions, and letter symbols used in this standard are in conformance with ANSI B1.7–1949.

4. Truncated Whitworth Thread

4.1 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. This same full Whitworth form is also employed as the design, or maximum material, form by the British. The presence (American National) standard, however, the design thread form established in American War Standard ASA B1.6–1944, has been adopted.

5. Pitch Diameter Allowance and Tolerances

5.1 The pitch diameter allowance and tolerances promulgated in June 1924 for the RMS thread were subsequently applied by most American manufacturers to their truncated versions and found to be acceptable. Uniformity of practice with regard to the allowances and tolerances for the other diameters never materialized.

6. Attributes of Good Fit

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

6.1.1 Adequate clearance to afford protection against binding due to the presence of foreign particles or minor thread crest damage.

6.1.2 Sufficient depth of thread engagement to assure security in the short lengths of engagement commonly encountered.

6.1.3 Allowances for limited eccentricities so that centralization and squareness of the objective are not influenced by such errors in manufacture.

7. Need for Good Fit

7.1 The need for the above characteristics stems principally from the inherent longevity of optical equipment and the repeated use to which objective threads are subjected. The measures necessary to provide these properties precluded adoption of the allowances and tolerances recommended for threads of this pitch in the American War Standard ASA B1.6–1944. The more significant departures from the standard are:

7.1.1 A larger allowance on the pitch diameter of the external thread.

7.1.2 Smaller tolerances on the major diameter of the external thread and the minor diameter of the internal thread.

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[1] This specification is under the jurisdiction of ASTM Committee E41 on Laboratory Apparatus and is the direct responsibility of Subcommittee E41.06 on Laboratory Instruments and Equipment.

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[2] Discontinued 1951, Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, http://www.nist.gov.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

7.1.3 The provision of allowances on the major and minor diameters of the external thread.

7.2 The values established and further details regarding them are given under Specifications.

8. Other Applications

8.1 Though utilized principally for microscope objective mountings, this screw thread is recommended also for other optical assemblies of microscopes and associated apparatus, such as photomicrographic equipment.

SPECIFICATIONS

9. Basic Form of Thread

9.1 The basic form of the thread for this standard is the British Standard Whitworth form. Basic dimensions are given in Table 1.

10. Design Form of Thread

10.1 The design, or maximum material, forms of both the external and internal threads conform to the ASA B1.6–1944. The design dimensions are given in Table 1.

11. Lead of Thread

11.1 The thread is of the single (single-start) type.

12. Classification

12.1 There is established herein only one class of thread which experience has proved to be adequate to meet the demands of the applications.

13. Nominal Sizes

13.1 There is only one nominal size having a basic major diameter of 0.800 in. and a pitch of 0.027778 in. (36 threads per in.).

14. Allowances

14.1 Positive allowances (minimum clearances) are provided on the pitch, major, and minor diameters of the external 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.

14.2 Where interchangeability with product having full-form Whitworth threads is not required, the allowances on the major and minor diameters of the external thread are not necessary, since the forms at the root and crest of the truncated internal 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 standard.

15. Tolerances

15.1 In accordance with standard practice, tolerances on the internal thread are applied in a plus direction from the basic

TABLE 1 Definitions, Formulas, Basic and Design Dimensions

Property	Symbol	Formula	Dimension
Basic Thread Form			
Half angle of thread[A]	α	...	27° 30 min
Included angle of thread[A]	2α	...	55° 00 min
Number of threads per inch[A]	n	...	36°
Pitch	p	$1/n$	0.027778
Height of fundamental triangle	H	$0.960491p$	0.026680
Height of basic thread	h_b	$0.640327p$	0.0178
Radius at crest and root of British Standard Whitworth basic thread (not used)	r	$0.137329p$	0.0038
Design Thread Form			
Height of truncated Whitworth thread	k	$h_b - U = 0.566410p$	0.0157
Width of flat at crest	F_c	$0.243624p$	0.0068
Width of flat at root	F_r	$0.166667p$	0.0046
Basic truncation of crest from basic Whitworth form	U	$0.073917p$	0.00205
Basic and Design Sizes			
Major diameter, nominal and basic	D	...	0.800
Major diameter of internal thread	D_n	D	0.800
Major diameter of external thread[B]	D_s	$D - 2U - G$	0.7941
Pitch (effective) diameter, basic	E	$D - h_b$	0.7822
Pitch (effective) diameter of internal thread	E_n	$D - h_b$	0.7822
Pitch (effective) diameter of external thread[C]	E_s	$D - h_b - G$	0.7804
Minor diameter, basic	K	$D - 2h_b$	0.7644
Minor diameter of internal thread	K_n	$D - 2_k$	0.7685
Minor diameter of external thread[B]	K_s	$D - 2h_b - G$	0.7626
Allowance at pitch (effective) diameter[B,C]	G	...	0.0018

[A] All other dimensions are given in inches.
[B] An allowance equal to that on the pitch diameter is also provided on the major and minor diameters of the external thread for additional clearance and centralizing.
[C] Allowance (minimum clearance) on pitch (effective) diameter is the same as on British RMS thread.

TABLE 2 Limits of Size and Tolerances[A] 0.800—36 AMO

Element	Major Diameter			Pitch Diameter			Minor Diameter		
	max	min	tolerance	max	min	tolerance	max	min	tolerance
External thread	0.7941	0.7911	0.0030	0.7804	0.7774	0.0030	0.7626	0.7552[C]	0.0030
Internal thread	0.8092[B]	0.8000		0.7852	0.7822	0.0030	0.7715	0.7685	

[A] All dimensions are given in inches.
[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.
[C] 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.

(also design) size and tolerances on the external thread are applied in a minus direction from its design (maximum material) size.

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

15.3 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.

15.4 All tolerances are given in Table 2.

16. Lengths of Engagement

16.1 The tolerances specified herein are applicable to lengths of engagement ranging from ⅛ to ⅜ in. (approximately 15 to 50 % of the basic diameter). Lengths of engagement exceeding these limits are seldom employed and, consequently, are not provided for in this standard.

16.2 For microscope objective assemblies the length of engagement most generally employed is ⅛ in.

17. Limits of Size

17.1 The limits of size for both the external and internal thread are given in Table 2. Their application is illustrated in Fig. 1.

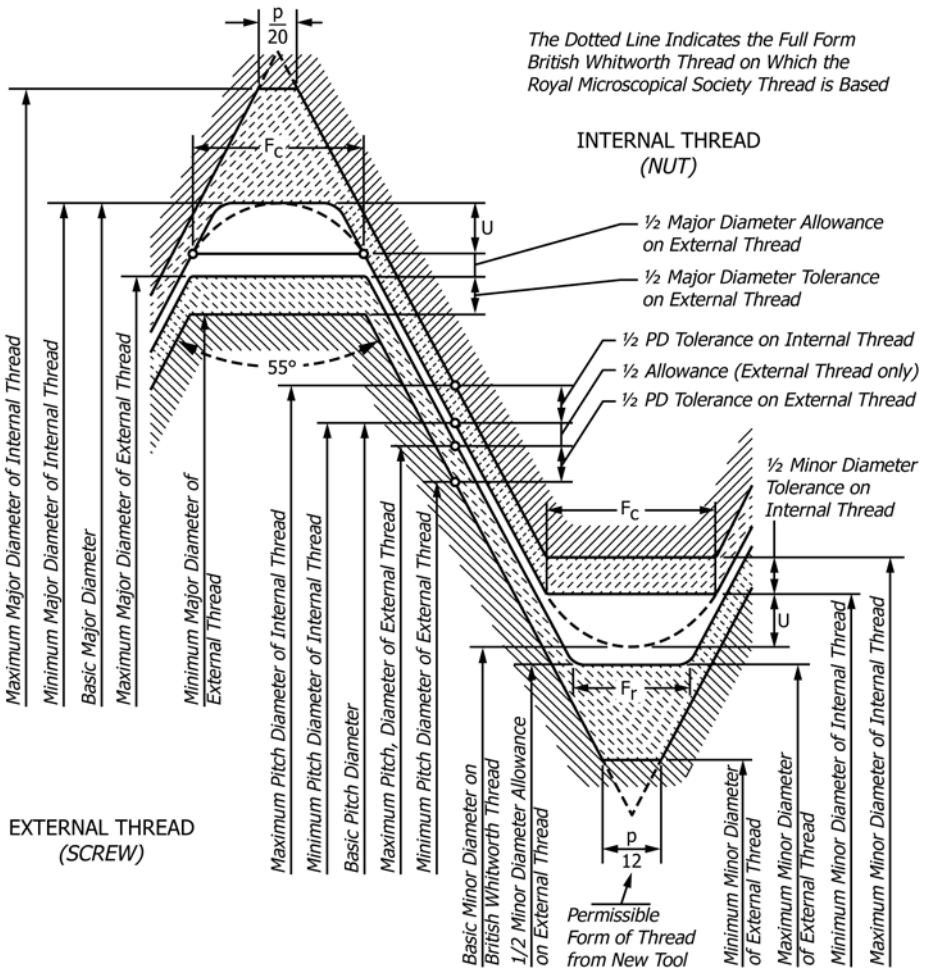

FIG. 1 Disposition of Tolerances, Allowances, and Crest Clearances for AMO Thread

18. Thread Designation

18.1 This screw thread shall 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:

$$0.800 - 36\,AMO \quad (1)$$

19. Keywords

19.1 microscope; thread

APPENDIX

(Nonmandatory Information)

X1. Recommended Gage Dimensions of Microscope Objective Thread 0.800–36 AMO

TABLE X1.1 Recommended Gage Dimensions of Microscope Objective Thread 0.800—36 AMO

NOTE 1—Ring and plug gages made in accordance with the above dimensions are not suitable for checking British product, the rounded roots of which will not pass the flat crest truncations of the gages. However, British gages, which are made to check the full Whitworth form of thread, will accept American product.

Dimension Symbol		Formula	Dimension[A]
	"Go Setting" Thread Plug Gage (A—Go)		
D_g max	Major diameter, max	D_s Max	0.7941
D_g min	Major diameter, min	D_g Max – 0.0004	0.7937
E_g max	Pitch (effective) diameter, max	E_s Max	0.7804
E_g min	Pitch (effective) diameter, min	E_g Max – 0.0002	0.7802
	"Not Go Setting" Thread Plug Gage (A—Not Go)		
D_g min	Major diameter, min	D_s Max	0.7941
D_g max	Major diameter, max	D_g Min + 0.0004	0.7945
E_g min	Pitch (effective) diameter, min	E_s Min	0.7774
E_g max	Pitch (effective) diameter, max	E_g Min + 0.0002	0.7776
	"Go" Thread Ring Gage (G—Go)		
E_g max	Pitch (effective) diameter, max	E_g Max" Go" A Plug	0.7804
E_g min	Pitch (effective) diameter, min	E_g Min "Go" A Plug	0.7802
K_g max	Minor diameter, max	D_n Min – $2h_b$	0.7644
K_g min	Minor diameter, min	K_g Max – 0.0004	0.7640
	"Not Go" Thread Ring Gage (G—Not Go)		
E_g min	Pitch (effective) diameter, min	E_g Min "Not Go" A Plug	0.7774
E_g max	Pitch (effective) diameter, max	E_g Max "Not Go" A Plug	0.7776
K_g min	Minor diameter, min	E_s Min – $p/3$	0.7681
K_g max	Minor diameter, max	K_g Min + 0.0004	0.7685
	"Go" Thread Plug Gage (C—Go)		
D_g min	Major diameter, min	D_n Min	0.8000
D_g max	Major diameter, max	D_g Min + 0.0004	0.8004
E_g min	Pitch (effective) diameter, min	E_n Min	0.7822
Eg max	Pitch (effective) diameter, max	E_g Min + 0.0002	0.7824
	"Not Go" Thread Plug Gage (C—Not Go)		
D_g max	Major diameter, max	E_n Max + $p/3$	0.7945
D_g min	Major diameter, min	D_g Max – 0.0004	0.7941
E_g max	Pitch (effective) diameter, max	E_n Max	0.7852
E_g min	Pitch (effective) diameter, min	E_g Max – 0.0002	0.7850
	Tolerance in lead	±0.0002 in.	
	Tolerance on half-angle of thread	±0° 20 min	

[A] All dimensions are given in inches.