

Australian Standard[®]

**GAUGING OF METRIC SCREW
THREADS**

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**GAUGING OF METRIC SCREW
THREADS**

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PREFACE

This edition of this standard was prepared by the Association's Committee on Screw Threads, to supersede AS 1014—1971.

Following the recent (1980) revision of the ISO screw thread and screw thread gauging standards, the committee is currently engaged in revising all of the Australian standards on metric screw threads and associated gauges and gauging practices. This standard is a part of that program.

The current edition of ISO 1502, ISO General Purpose Metric Screw Threads—Gauging, contains few major technical changes from ISO R 1502—1970 on which it is based. The main reason for this complete revision of AS 1014, however, is to more closely align with ISO practices than was previously the case. This agrees with the policy of Committee ME/28 'that in order to provide the best benefits of standardized metric screw threads and associated gauges and gauging practices, the Australian Standards should be completely aligned with their ISO counterparts wherever practical, irrespective of how Australia voted on the ISO standard'. In the case of ISO 1502, Australia cast a negative vote for technical reasons.

This new edition of AS 1014 incorporates the technical changes in ISO 1502, but the most important technical change is the adoption of the ISO symbols for the screw thread parameters. This change recognizes that most of the world's industrial countries have elected to adopt the ISO metric screw thread system and associated gauges as their national standards without change. Hence it would be unrealistic for Australia, whose industries are so linked to international design and procurement, to depart substantially from standards which have almost complete acceptance throughout the world.

This standard is technically identical with ISO 1502.

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STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard
for
GAUGING OF METRIC SCREW THREADS

SECTION 1. SCOPE AND GENERAL

1.1 SCOPE. This standard specifies requirements for gauges for single start parallel general purpose metric screw threads.

The standard covers types of gauges, inspection of screw threads, design features of screw gauges, material and hardness requirements, and limits and tolerances of gauging elements.

The standard also gives information on symbols for screw threads and screw thread gauge parameters.

Appendices are included giving notes on the function, use and checking of gauges (Appendix A), the bases for the gauge deviations and tolerances (Appendix B), and detailed examples of deriving specific gauge limits (Appendix C).

1.2 APPLICATION. The gauges and gauging practices specified in this standard apply to parallel metric screw threads manufactured in accordance with either AS 1275 or AS 1721.

1.3 REFERENCED DOCUMENTS. The following standards are referred to in this standard:

AS 1098	Roller-type Screw Calliper Gauges
AS 1275	Metric Screw Threads for Fasteners
AS 1721	General Purpose Metric Screw Threads
AS 2710	Screw Gauges—Verification
AS XXXX	Glossary of Terms for Screw Threads*
AS B129	Designs for Geometric Limit Gauges (Plain and Screwed in Inch Units)

1.4 DEFINITIONS. For the purpose of this standard, the definitions given in AS XXXX apply.

1.5 SYMBOLS. The symbols used in this standard to define the screw thread and screw gauge parameters are given in Table 1.1.

NOTE: These symbols are now aligned with the ISO symbols. For comparison of the current symbols with those used in AS 1014—1971, see Appendix D.

1.6 TYPES OF GAUGES.

1.6.1 General. This standard specifies the following types of gauges to be used for checking product threads, together with associated setting and check gauges.

1.6.2 Gauges for external threads and associated check and setting gauges.

1.6.2.1 Screw gauges.

GO and NOT GO solid screw ring gauges.
GO and NOT GO adjustable screw ring gauges.
GO and NOT GO screw calliper gauges.

1.6.2.2 Associated check and setting gauges.

GO and NOT GO screw check plugs for new solid GO screw ring gauges.

GO and NOT GO screw check plugs for new solid NOT GO screw ring gauges.

Wear screw check plugs for solid GO screw ring gauges.

Wear screw check plugs for solid NOT GO screw ring gauges.

Setting plugs for adjustable screw ring and calliper gauges.

1.6.2.3 Plain gauges for checking the major diameter.

GO and NOT GO plain ring gauges.

GO and NOT GO plain calliper gauges.

1.6.3 Gauges and internal threads.

GO and NOT GO screw plug gauges.

GO and NOT GO plain plug gauges, for checking the minor diameter.

1.7 MATERIALS AND HARDNESS.

1.7.1 Material. Gauges and/or gauge elements, as appropriate, shall be manufactured from a high quality tool steel or other suitable material with similar properties.

1.7.2 Hardness. The hardness of the gauging surfaces shall be within 697 HV to 800 HV (60 HRC to 64 HRC).

1.8 REFERENCE TEMPERATURE. The temperature to which the dimensions of the gauges are referred is 20°C.

1.9 MARKING. Each gauge shall be clearly and permanently marked with the information necessary for positive identification. For plug gauges with renewable inserts, the marking shall appear on the gauge handle and gauge insert(s) wherever practicable.

The following particulars shall be included in the marking:

- (a) The designation of the screw thread in accordance with either AS 1275 or AS 1721.
- (b) The size of the gauge, i.e. the limiting dimensions of the relevant product thread, as appropriate.
For screw gauges, this should be the maximum or minimum pitch diameter of the relevant product thread.
- (c) If the product thread is to be coated, the gauges should be marked 'BEF COAT' or 'AFT COAT', as appropriate. However, care should be taken to avoid unnecessary duplication of gauges.
- (d) 'GO' or 'NOT GO'.
- (e) 'SET' for setting plugs.
- (f) 'CHK' for check plugs.
- (g) 'WEAR CHK' for wear check plugs.
- (h) The manufacturer's name or trademark.
- (j) A serial number, if required.

* In course of preparation

TABLE 1.1
SYMBOLS AND EXPLANATIONS

Symbol	Explanation
b_1	Width of the clearance groove at the major diameter of the thread profile with complete flanks
b_2	Width of the clearance groove at the minor diameter of the thread profile with complete flanks
b_3	Width of the clearance groove at the major diameter and minor diameter respectively of the thread profile with truncated flanks
d, D	Basic major diameter of the workpiece thread
D_1	Basic minor diameter of the internal workpiece thread
d_2, D_2	Basic pitch diameter of the workpiece thread
es	Fundamental deviation of the external thread (for tolerance position h the fundamental deviation es is equal to zero)
EI	Fundamental deviation of the internal thread (for tolerance position H the fundamental deviation EI is equal to zero)
F_1	The radial distance between the pitch diameter line and the end of the straight part of the flank in the direction of the crest for thread profiles with truncated flanks
F_2	The radial distance between the pitch diameter line and the end of the straight part of the flank in the direction of the root for thread profiles with truncated flanks
H	Height of the triangle of the thread profile
H_1	Tolerance for plain plug gauges
H_2	Tolerance for plain calliper gauges and plain ring gauges
H_p	Tolerance for reference gauges for plain calliper gauges
m	Distance between the middle of the tolerance zones T_R of the screw ring gauges and T_{cp} of the GO check plug

Symbol	Explanation
P	Pitch
s	Displacement of the clearance groove with truncated flanks
T_{cp}	Tolerance for the pitch diameter of GO and NOT GO screw check plugs and wear check plugs and setting plugs
T_d	Tolerance for the major diameter of the workpiece external thread
T_{d2}	Tolerance for the pitch diameter of the workpiece external thread
T_{D1}	Tolerance for the minor diameter of the workpiece internal thread
T_{D2}	Tolerance for the pitch diameter of the workpiece internal thread
T_{PL}	Tolerance for the pitch diameter of GO and NOT GO screw plug gauges
T_R	Tolerance for the pitch diameter of GO and NOT GO screw ring gauges
W_{GO}	Amount available for the permissible wear of GO screw plug gauge and GO screw ring gauge.
W_{NG}	Amount available for the permissible wear of the NOT GO screw plug gauge and NOT GO screw ring gauge
Z_1	Distance between the middle of the tolerance zone H_1 of the GO plug gauge and the lower limit of the workpiece minor diameter
Z_2	Distance between the middle of the tolerance zone H_2 of the GO calliper gauge or the GO ring gauge and the upper limit of the workpiece major diameter
Z_{PL}	Distance between the middle of the tolerance zone T_{PL} of the GO screw plug gauge and the lower limit of the workpiece thread
Z_R	Distance between the middle of the tolerance zone T_R of the GO screw ring gauge and the upper limit of the workpiece thread
r_1	Root radius for plug type gauges
r_2	Root radius for ring and calliper gauges

SECTION 2. INSPECTION OF SCREW THREADS

2.1 SCOPE OF SECTION. This Section sets out requirements for the verification of screw threads using either screw gauges or direct measurement. Further discursive material on the 'Taylor Principle', and notes on the function, use and checking of screw gauges is given in Appendix A.

2.2 GENERAL CONSIDERATIONS. The purpose of inspecting screw threads is to verify whether or not they conform to the limiting dimensions appropriate to the specified thread class. This may be achieved using a system of limit gauges or by direct measurement.

The preferred method of determining the acceptability of screw threads is by the use of limit gauges.

As previously indicated screw threads may be verified by measurement, but this method is complex and generally not a practical proposition. It is relatively simple to measure the simple pitch diameter and the flank angles, but measurement of the pitch is a little more difficult. The major problem, however, is to combine diametral measurements with measurements of form and then arrive at an envelope size in an effective manner. Direct measurement of screw threads therefore should only be used when the quantities of screw threads to be verified do not warrant the costs of limit gauges.

2.3 GAUGING OF SCREW THREADS.

2.3.1 General. Limit gauges which are normally used for verifying screw threads are—

- (a) GO gauges for determining that the maximum material limit of the screw threads has not been exceeded; and
- (b) NOT GO gauges for determining that the screw threads are not outside the least material limit.

It must be noted that screw thread gauges do have limitations. The most important is that they do not thoroughly check the roots of external threads. This aspect is of concern for screw threads which are to be used in applications involving high stress or dynamic loading and in these cases gauging must be supplemented by profile tests using optical instruments.

2.3.2 Gauging of external threads. Solid or adjustable GO screw ring gauges should preferably be used to check the maximum material condition. It may sometimes be convenient to use GO screw calliper gauges, but it is recommended that they be supplemented by random sampling with GO screw ring gauges. GO screw calliper gauges should not be used for gauging thin-walled or other non-rigid products,

or where the production process is likely to produce lobed threads, local pitch errors or burrs of the start of the thread.

NOT GO screw calliper gauges should be used for checking the least material limit for all screw threads except those on thin-walled or other non-rigid products. Such threads should be checked with solid or adjustable NOT GO ring gauges.

The major (crest) diameter is checked by GO and NOT GO plain gauges. The type of gauge, i.e. plain ring or plain calliper gauge, should be selected, using the same principles as for screw gauges.

2.3.3 Gauging of internal threads. An internal screw thread is gauged using GO and NOT GO screw plug gauges.

The minor (crest) diameter is gauged using GO and NOT GO plain plug gauges.

2.3.4 Gauge wear. In principle, screw gauges should not be allowed to wear outside the product thread limits. However, to provide a reasonable life for the gauges, this standard gives a small 'wear allowance', which theoretically could lead to screw threads being accepted which are outside the specified limits.

The probability of this occurrence is quite small but nevertheless a degree of caution must be exercised when advantage is taken of this allowance. The direction of wear of the GO gauge is such that it could permit the acceptance of smaller internal threads and larger external threads than prescribed by the specified limits, and so reduce the amount of clearance available for assembly. In cases involving deviations H/h , assembly may not be possible.

2.4 DISPUTES. Disagreement on whether or not screw threads are within their specified limits can occur when they are close to the limits of size.

When such disputes arise, a screw thread shall be accepted if it is shown to be satisfactory by any of the appropriate gauges (see Clause 2.3), i.e. solid or adjustable GO screw ring gauges, etc, known to be within the limits specified by this standard.

For external threads, gauging with a GO screw ring gauge and a NOT GO screw calliper gauge is decisive.

In cases of dispute, checking the ring gauges by check plugs is decisive, unless otherwise agreed between the manufacturer and the purchaser.

NOTE: The possibility of disputes can be reduced to a minimum by grading the gauges, so that those used for manufacture provide a more stringent check than those used for inspection. Generally this can be achieved by using new or slightly worn GO gauges and used NOT GO gauges for manufacture; and GO gauges approaching their maximum limit of wear and new NOT GO gauges for inspection.

SECTION 3. DESIGN FEATURES OF SCREW GAUGES

3.1 SCOPE OF SECTION. This Section sets out requirements for the general features of screw gauges and covers general construction, thread profiles, axial lengths of gauge threads and feather edges.

3.2 GENERAL CONSTRUCTION.

3.2.1 Gauge blanks and handles. The general requirements of gauge blanks and handles for all gauges for internal and external threads, including plain limit gauges, shall be in accordance with AS B129, except in some cases (e.g. for threads with long axial engagement) where the length of thread may require modification (see Clause 3.2.3).

3.2.2 Gauging surfaces. The general form and dimensions of the gauging surfaces are based on the product thread and shall be of one of the designs shown in Figs 3.2, 3.3, 3.4 and 3.5, according to the type and application of the gauge.

3.2.3 Axial length of gauge thread. As stated in Clause 3.2.1, for general purposes the length of gauge thread is determined by the gauge blank, but shall also comply with the following requirements:

- GO gauges.* The length of gauge thread should preferably be equal to the length of product thread to be gauged, and be not less than 80 percent of this length.
- Single length setting plugs.* The length of thread shall be not less than that of the GO screw calliper gauge concerned.
- Double length setting plugs.* The length of thread of each portion shall be not less than that of the adjustable GO screw ring gauge concerned.

3.3 BREAKING OF SHARP EDGES.

3.3.1 General. All undesirable sharp edges on all types of screw gauges and plain gauges shall be removed.

3.3.2 Feather edges. To avoid feather edges on screw plug gauges, screw ring gauges and setting plugs, the partial thread at the end(s) of the gauge shall normally be removed to a blunt start. Not more than one complete turn of thread shall be removed to the point where the full form thread is obtained (see Fig. 3.1).

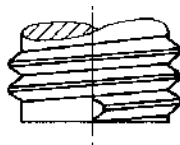


Fig. 3.1. BLUNT START AT END OF THREAD ON GAUGE

For screw ring gauges up to and including M12 or with pitches less than 1.5 mm, and screw plug gauges and setting plugs with pitches less than 1.25 mm, a 60-degree chamfer from the axis of the gauge is permitted in lieu of the removal of the partial thread.

For double length setting plugs with pitches of 1 mm and coarser, the feather edge between the full form and truncated portions of the thread, shall be completely removed.

It is not necessary to remove the feather edge of screw plug gauges and setting plugs with external centres.

3.4 DIRT GROOVES. GO screw plug gauges over M6 diameter should be provided with a dirt groove cut axial to the thread to a depth slightly below the thread root. The groove shall be positioned at the point where the first thread attains full form and run the full length of the threaded portion. The recommended groove widths are as follows:

Gauges > M6 ≤ M10	0.8 mm
Gauges > M10 ≤ M50	1.5 mm
Gauges > M50	2.5 mm

3.5 THREAD PROFILES.

3.5.1 Thread profiles with complete flanks.

3.5.1.1 Screw plug gauges, check plug gauges and setting plugs. The following types of gauges shall have thread profiles as shown in Fig. 3.2:

GO screw plug gauge.

GO check plug for solid GO screw ring gauge.

GO check plug for solid NOT GO screw ring gauge.

NOT GO check plug for solid NOT GO screw ring gauge.

Wear check plug for solid and adjustable NOT GO screw ring gauge.

Double length setting plugs for adjustable GO screw ring gauge (one portion).

Double length setting plug for adjustable NOT GO screw ring gauge (one portion).

Single length setting plug for adjustable GO screw calliper gauge.

Single length setting plug for adjustable NOT GO screw calliper gauge.

3.5.1.2 Screw ring and calliper gauges. The following types of gauges shall have thread profiles as shown in Fig. 3.3

GO screw ring gauges, solid and adjustable.

Anvils of GO screw calliper gauges.

NOTE: The thread form of some types of GO screw calliper gauges may require modification. For further information, see AS 1098.

3.5.2 Thread profiles with truncated flanks.

3.5.2.1 Screw plug gauges, check plug gauges and setting plugs. The following types of gauges shall have thread profiles as shown in Fig. 3.4:

NOT GO screw gauge.

NOT GO check plug for solid GO screw ring gauge.
Wear check plug for solid and adjustable screw ring gauge.

Setting plug for adjustable GO screw ring gauge (one portion).

Setting plug for adjustable NOT GO screw ring gauge (one portion).

3.5.2.2 Screw ring and calliper gauges. The following types of gauges shall have thread profiles as shown in Fig. 3.5:

NOT GO screw ring gauges, solid and adjustable.
Anvils of NOT GO screw calliper gauges.

NOTE: The thread form of some types of NOT GO screw calliper gauges may require modification. For further information, see AS 1098.

3.5.2.3 Symmetry of clearance groove. The clearance groove (dimensions b_3 in Figs 3.4 and 3.5) shall be symmetrical to the centre of the profile $P/2$ within the value for s given in Table 3.1 (see Fig. 3.6).

3.5.2.4 Width of clearance groove. The width of the clearance groove (dimension b_3), for clearance groove designs B and C shall conform to the limiting dimensions given in Table 3.1.

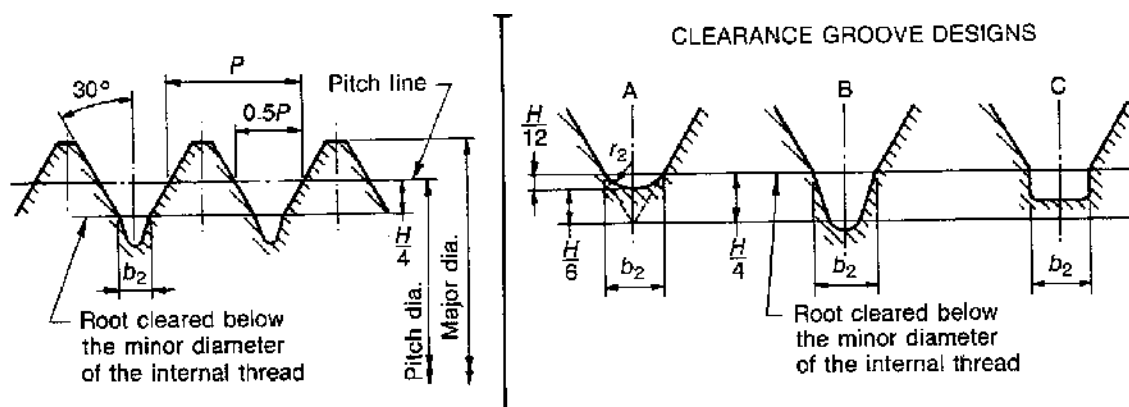


Fig. 3.2. PROFILE FOR PLUG TYPE GAUGES WITH COMPLETE FLANKS

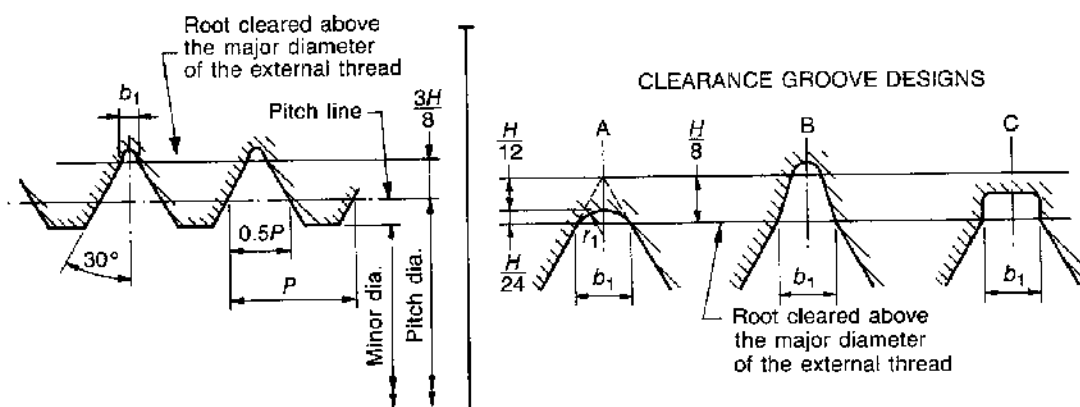


Fig. 3.3. PROFILE FOR RING AND CALLIPER GAUGES WITH COMPLETE FLANKS

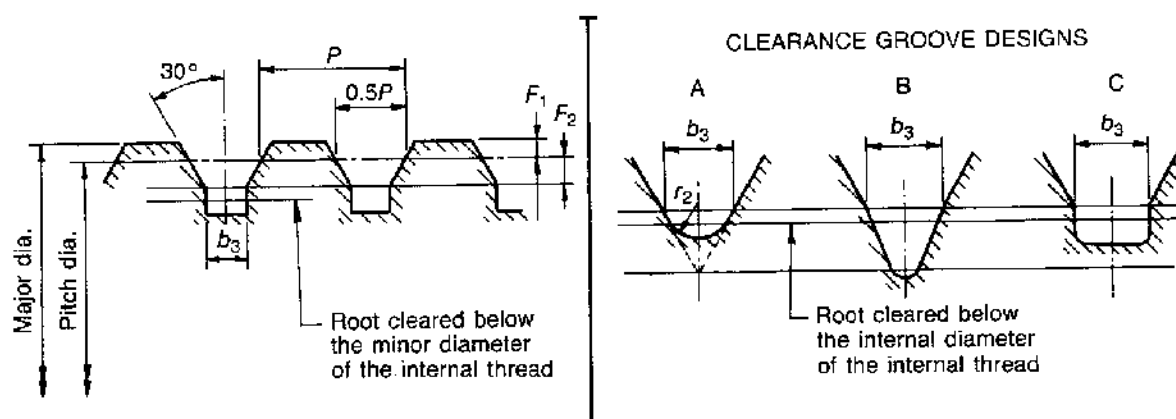


Fig. 3.4. PROFILE FOR PLUG TYPE GAUGES WITH TRUNCATED FLANKS

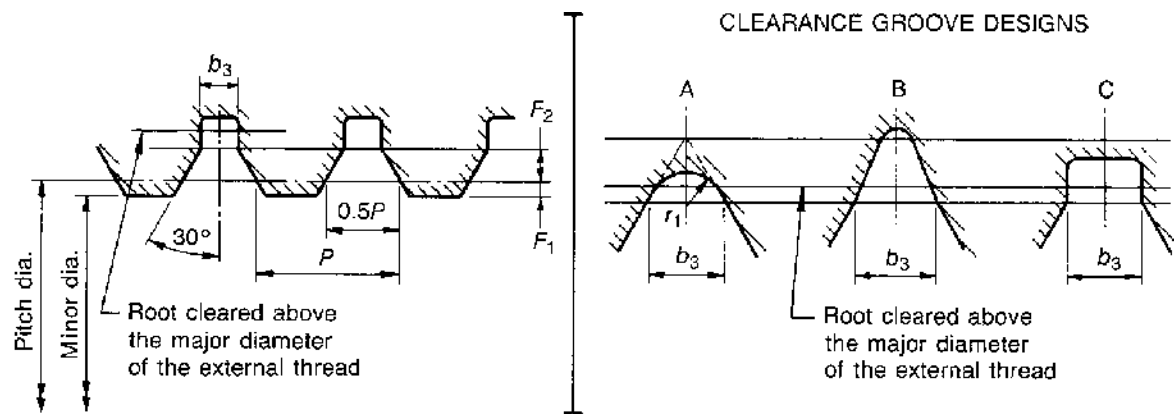


Fig. 3.5. PROFILE FOR RING AND CALLIPER GAUGES WITH TRUNCATED FLANKS

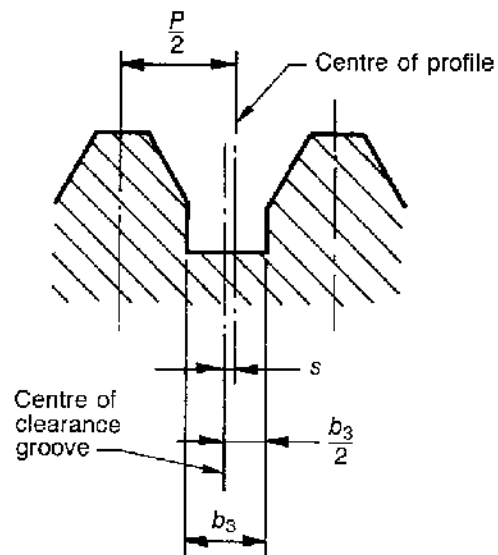


Fig. 3.6. SYMMETRY OF THE CLEARANCE GROOVE FOR THE PROFILE WITH TRUNCATED FLANKS

TABLE 3.1
VALUES FOR THE DESIGN OF GAUGE THREAD PROFILES

millimetres											
1	2	3	4	5	6	7	8	9	10	11	12
Pitch P	r_1 (max.) $= 0.072P$	r_2 (max.) $= 0.144P$	b_1 (max.) $= 0.125P$	b_2 (max.) $0.250P$	b_3^*		F_1 $= 0.1P$	F_2^\dagger	$\frac{H}{24}$	s	$\frac{3H}{4}$
					Min.	Max.					
0.2	0.014	0.029	—	—	—	—	0.02	—	0.007	—	0.130
0.25	0.018	0.036	—	—	—	—	0.025	—	0.009	—	0.162
0.3	0.022	0.043	—	—	—	—	0.03	—	0.011	—	0.195
0.35	0.025	0.050	—	—	—	—	0.035	—	0.012	—	0.227
0.4	0.029	0.058	—	—	—	—	0.04	—	0.014	—	0.260
0.45	0.032	0.065	—	—	—	—	0.045	—	0.016	—	0.292
0.5	0.036	0.072	—	—	—	—	0.05	—	0.018	—	0.325
0.6	0.043	0.086	—	0.15	—	—	0.06	—	0.022	—	0.390
0.7	0.050	0.10	—	0.17	—	—	0.07	—	0.025	—	0.455
0.75	0.054	0.11	—	0.19	—	—	0.075	—	0.027	—	0.487
0.8	0.058	0.11	—	0.20	—	—	0.08	—	0.029	—	0.520
1.0	0.072	0.14	—	0.25	—	—	0.10	—	0.036	—	0.650
1.25	0.090	0.18	0.15	0.31	0.26	0.34	0.125	0.25	0.045	0.04	0.812
1.5	0.108	0.21	0.19	0.37	0.36	0.44	0.15	0.30	0.054	0.04	0.974
1.75	0.126	0.25	0.22	0.44	0.40	0.50	0.175	0.35	0.063	0.05	1.137
2.0	0.144	0.29	0.25	0.50	0.45	0.55	0.20	0.40	0.072	0.05	1.300
2.5	0.180	0.36	0.32	0.61	0.75	0.85	0.25	0.375	0.090	0.05	1.624
3.0	0.217	0.43	0.40	0.75	0.92	1.08	0.30	0.45	0.108	0.08	1.950
3.5	0.253	0.50	0.48	0.88	1.02	1.18	0.35	0.525	0.126	0.08	2.273
4.0	0.288	0.58	0.50	1.00	1.20	1.40	0.40	0.60	0.144	0.10	2.598
4.5	0.325	0.65	0.55	1.10	1.60	1.80	0.45	0.45	0.162	0.10	2.923
5.0	0.361	0.72	0.60	1.25	1.80	2.00	0.50	0.50	0.180	0.10	3.250
5.5	0.397	0.79	0.70	1.40	2.00	2.20	0.55	0.55	0.198	0.10	3.572
6.0	0.433	0.86	0.80	1.50	2.20	2.40	0.60	0.60	0.217	0.10	3.897

* $b_3 = \frac{P}{2} - 2F_2 \tan 30^\circ$

† $F_2 = 0.2P$ (for pitches $\geq 1.25 \leq 2$ mm).
 $0.15P$ (for pitches $\geq 2.5 \leq 4$ mm).
 $0.1P$ (for pitches > 4 mm).

SECTION 4. DEVIATIONS AND TOLERANCES OF GAUGES

4.1 SCOPE OF SECTION. This Section sets out the permissible deviations and tolerances for all the gauge types specified in Clause 1.6. It includes information on the disposition of the gauge tolerances relative to the product thread limits for both screwed and plain gauges. For information on the function, use and checking of gauges, see Appendix A.

4.2 PITCH ERRORS. The errors (from nominal) in pitch between any number of threads of an individual gauge shall be within the deviations given in Table 4.1. The deviations apply to both periodic and cumulative pitch errors.

For double length setting plugs, the deviations apply separately to each portion of the gauge.

4.3 FLANK ANGLE ERRORS. The flank angles of the thread profile for all types of gauges shall not deviate from nominal by more than the values given in Table 4.2.

4.4 PERMISSIBLE DEVIATIONS FOR GAUGES FOR EXTERNAL THREADS.

4.4.1 General. The limits for gauges for external product threads and associated check and setting plugs are derived from the tolerances for the product threads as indicated in Clauses 4.4.2 to 4.4.5.

The disposition of the screw gauge limits relative to the product thread limits for the pitch diameter are

shown schematically in Fig. 4.1.

Formulas for the derivation of gauge tolerances and deviations are given in Appendix B.

The disposition of the tolerance zones for plain gauges for checking the major diameter, relative to the major diameter limits of the product threads is shown in Fig. 4.2.

**TABLE 4.1
PITCH DEVIATIONS**

Gauge thread length, mm	≤ 32	> 32 ≤ 50	> 50 ≤ 80
Permissible deviation, $\mu\text{m} \pm$	5	6	7

4.4.2 Limits for GO solid screw ring gauges. The upper and lower limits for the simple pitch diameter are obtained by the algebraic addition of the deviations given in Table 4.3 to the maximum pitch diameter of the external product thread.

The upper and lower limits for the minor diameter are obtained by the algebraic addition of the deviations given in Table 4.3 to the basic minor diameter of the internal product thread minus the fundamental deviation of the external product thread.

The major diameter is cleared as shown in Fig. 3.3.

**TABLE 4.2
FLANK ANGLE DEVIATIONS**

Pitch of thread mm	Flank angle deviation minutes \pm	Pitch of thread mm	Flank angle deviation minutes \pm	Pitch of thread mm	Flank angle deviation minutes \pm
0.2	60	0.7	20	2.5	10
0.25	50	0.75	15	3.0	10
0.3	40	0.8	15	3.5	10
0.35	35	1.0	15	4.0	10
0.4	30	1.25	15	4.5	10
0.45	25	1.5	10	5.0	10
0.5	25	1.75	10	5.5	10
0.6	20	2.0	10	6.0	10

**TABLE 4.3
DEVIATIONS FOR NEW GO SOLID SCREW RING GAUGES**

Pitch diameter tolerance for external product thread	micrometres			
	Deviation for simple pitch diameter		Deviation for minor diameter	
	Upper	Lower	Upper	Lower
> 24 ≤ 50	+ 8	0	+ 4	− 4
> 50 ≤ 80	+ 7	− 3	+ 5	− 5
> 80 ≤ 125	+ 5	− 9	+ 7	− 7
> 125 ≤ 200	+ 1	− 17	+ 9	− 9
> 200 ≤ 315	− 1	− 24	+ 11	− 11
> 315 ≤ 500	− 5	− 35	+ 15	− 15
> 500 ≤ 670	− 9	− 47	+ 19	− 19

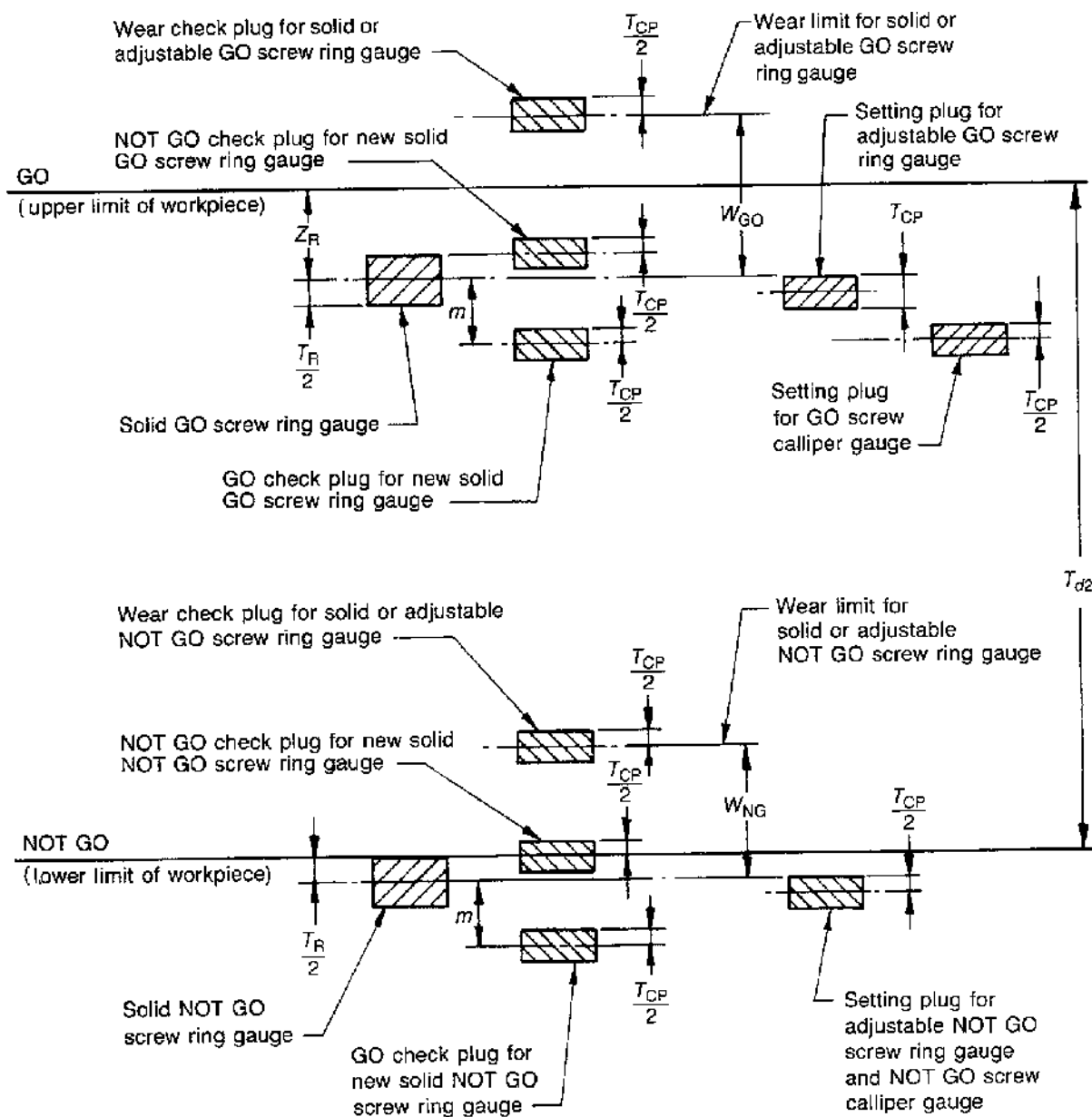


Fig. 4.1. TOLERANCE ZONES FOR THE PITCH DIAMETER OF EXTERNAL THREADS

4.4.3 Limits for NOT GO solid screw ring gauges. The upper and lower limits for the simple pitch diameter are obtained by the algebraic addition of the deviations given in Table 4.4 to the minimum pitch diameter of the external product thread.

The upper and lower limits for the minor diameter are obtained by the algebraic addition of the deviations given in Table 4.4 to the minimum pitch diameter of the external product thread minus $0.2P$.

The major diameter is cleared as shown in Fig. 3.5.

4.4.4 Limits for GO and NOT GO adjustable screw ring and calliper gauges. The limits for the pitch diameter, pitch and flank angles are determined by adjusting to the appropriate setting plug as specified in Clauses 4.6.2 and 4.6.4. The wear on adjustable GO screw ring gauges is controlled by the wear check gauges as specified in Clause 4.6.5. The limits of adjustable gauges are not therefore given directly.

The minor diameters of GO and NOT GO adjustable screw gauges shall conform to the limits given for GO and NOT GO solid screw ring gauges in Tables 4.3 and 4.4. The term 'diameter' in relation to screw calliper gauges means the shortest distance between the anvils for the parameter concerned, i.e. the minor diameter.

4.4.5 Limits for GO and NOT GO plain ring and calliper gauges. The upper, lower and wear limits for the GO gauge are obtained by the algebraic addition of the deviations given in Table 4.5 to the maximum major diameter of the external product thread.

The upper and lower limits for the NOT GO gauge are obtained by the algebraic addition of the deviations given in Table 4.5 to the minimum major diameter of the external product thread. No wear limits are given for the NOT GO gauge.

4.5 PERMISSIBLE DEVIATIONS FOR GAUGES FOR INTERNAL THREADS.

4.5.1 General. The limits for gauges for internal product threads are derived from the tolerance for the product threads as indicated in Clauses 4.5.2 to 4.5.4.

The disposition of the screw gauge limits relative to the product thread limits for the pitch diameter is shown schematically in Fig. 4.3.

Formulas for the derivation of gauge tolerances and deviations are given in Appendix B.

The disposition of tolerance zones for plain gauges for checking the minor diameter, relative to the minor diameter limits of the product threads is shown in Fig. 4.4.

TABLE 4.4
DEVIATIONS FOR NEW NOT GO SOLID SCREW RING GAUGES

Pitch diameter tolerance for external product thread	micrometres			
	Deviation for simple pitch diameter		Deviation for minor diameter	
	Upper	Lower	Upper	Lower
$> 24 \leq 50$	0	- 8	+ 4	- 12
$> 50 \leq 80$	0	- 10	+ 5	- 15
$> 80 \leq 125$	0	- 14	+ 7	- 21
$> 125 \leq 200$	0	- 18	+ 9	- 27
$> 200 \leq 315$	0	- 23	+ 11	- 34
$> 315 \leq 500$	0	- 30	+ 15	- 45
$> 500 \leq 670$	0	- 38	+ 19	- 57

TABLE 4.5
DEVIATIONS FOR GO AND NOT GO PLAIN RING AND CALLIPER GAUGES

Major diameter tolerance for external product thread	micrometres				
	Deviation for GO gauges			Deviation for NOT GO gauges	
	New gauges		Worn gauges	New Gauges	
	Upper	Lower	Upper	Upper	Lower
$> 36 \leq 85$	- 4	- 12	0	+ 4	- 4
$> 85 \leq 140$	- 15	- 25	0	+ 5	- 5
$> 140 \leq 335$	- 30	- 46	0	+ 8	- 8
$> 335 \leq 850$	- 39	- 69	0	+ 15	- 15
$> 850 \leq 950$	- 39	- 81	0	+ 21	- 21

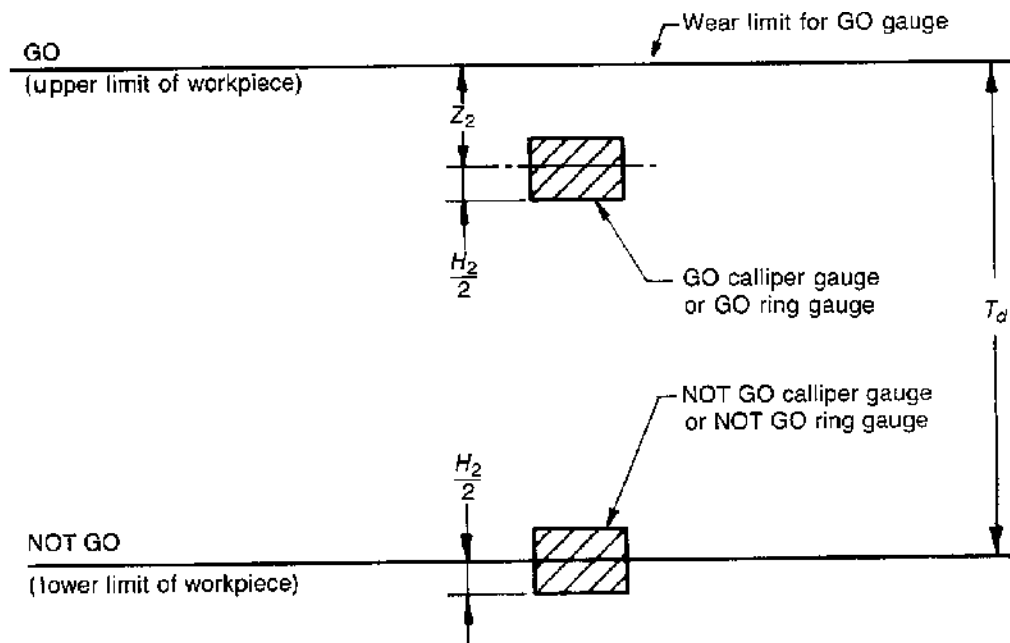


Fig. 4.2. TOLERANCE ZONES FOR PLAIN GAUGES FOR THE MAJOR DIAMETER

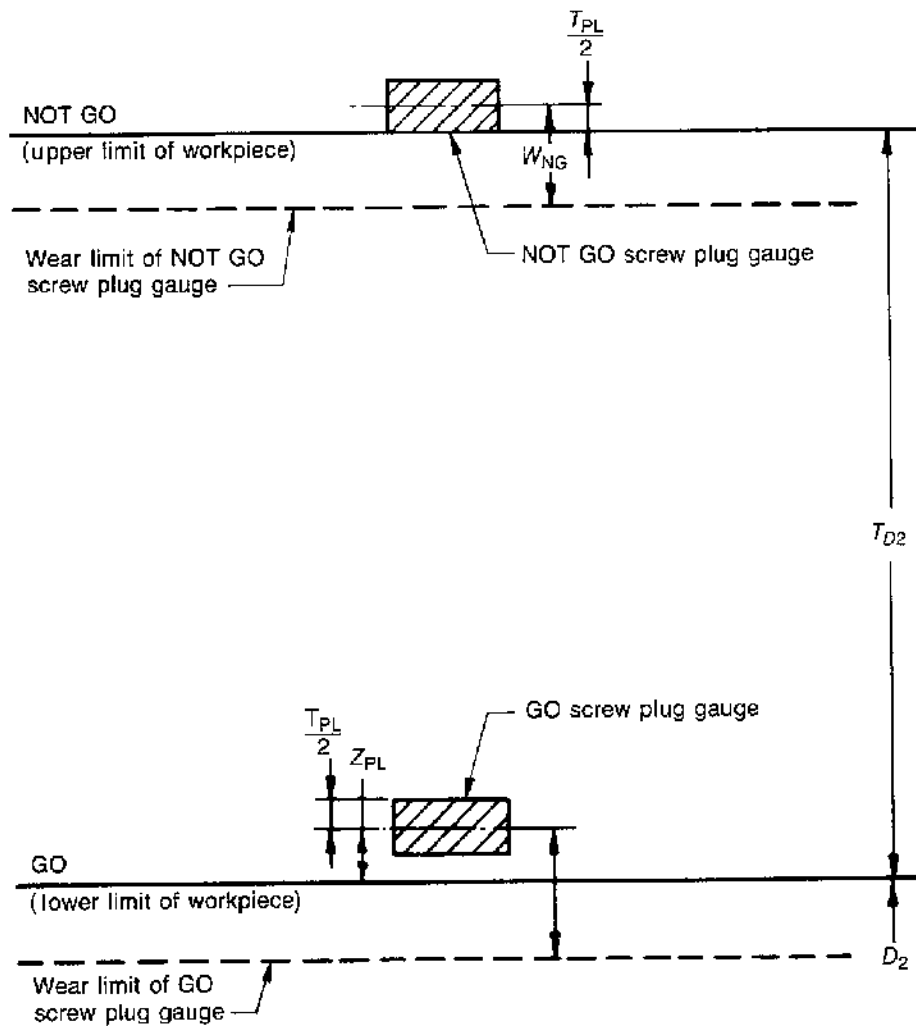


Fig. 4.3. TOLERANCE ZONES FOR THE PITCH DIAMETER OF INTERNAL THREADS

4.5.2 Limits for GO screw plug gauges. The upper, lower and wear limits for the simple pitch diameter are obtained by the algebraic addition of the deviations given in Table 4.6 to the minimum pitch diameter of the internal product thread.

The upper and lower limits for the major diameter are obtained by the algebraic addition of the deviations given in Table 4.6 to the minimum pitch diameter of the internal product thread plus $0.75H$.

The minor diameter is cleared as shown in Fig. 3.2.

4.5.3 Limits for NOT GO screw plug gauges. The upper, lower and wear limits for the simple pitch diameter are obtained by the algebraic addition of the deviations given in Table 4.7 to the maximum pitch diameter of the internal product thread.

The upper and lower limits for the major diameter are obtained by the algebraic addition of the deviations given in Table 4.7 to the maximum pitch diameter of the internal product thread plus $0.2P$.

The minor diameter is cleared as shown in Fig. 3.4.

TABLE 4.6
DEVIATIONS FOR GO SCREW PLUG GAUGES

micrometres					
Pitch diameter tolerance for internal thread	Deviation for simple pitch diameter			Deviation for major diameter	
	New gauges		Worn gauges		
	Upper	Lower	Upper	Upper	Lower
> 24 ≤ 50	+ 3	− 3	− 8	+ 6	− 6
> 50 ≤ 80	+ 6	− 1	− 7	+ 9	− 5
> 80 ≤ 125	+ 11	+ 2	− 6	+ 15	− 3
> 125 ≤ 200	+ 18	+ 6	− 5	+ 23	+ 1
> 200 ≤ 315	+ 23	+ 9	− 5	+ 30	+ 2
> 315 ≤ 500	+ 33	+ 15	− 3	+ 42	+ 6
> 500 ≤ 670	+ 43	+ 21	− 1	+ 54	+ 10

TABLE 4.7
DEVIATIONS FOR NOT GO SCREW PLUG GAUGES

micrometres					
Pitch diameter tolerance for internal thread	Deviation for simple pitch diameter			Deviation for major diameter	
	New gauges		Worn gauges		
	Upper	Lower	Upper	Upper	Lower
> 24 ≤ 50	+ 6	0	− 3	+ 9	− 3
> 50 ≤ 80	+ 7	0	− 4	+ 10	− 4
> 80 ≤ 125	+ 9	0	− 5	+ 13	− 5
> 125 ≤ 200	+ 11	0	− 6	+ 16	− 6
> 200 ≤ 315	+ 14	0	− 8	+ 21	− 7
> 315 ≤ 500	+ 18	0	− 10	+ 27	− 9
> 500 ≤ 670	+ 22	0	− 12	+ 33	− 11

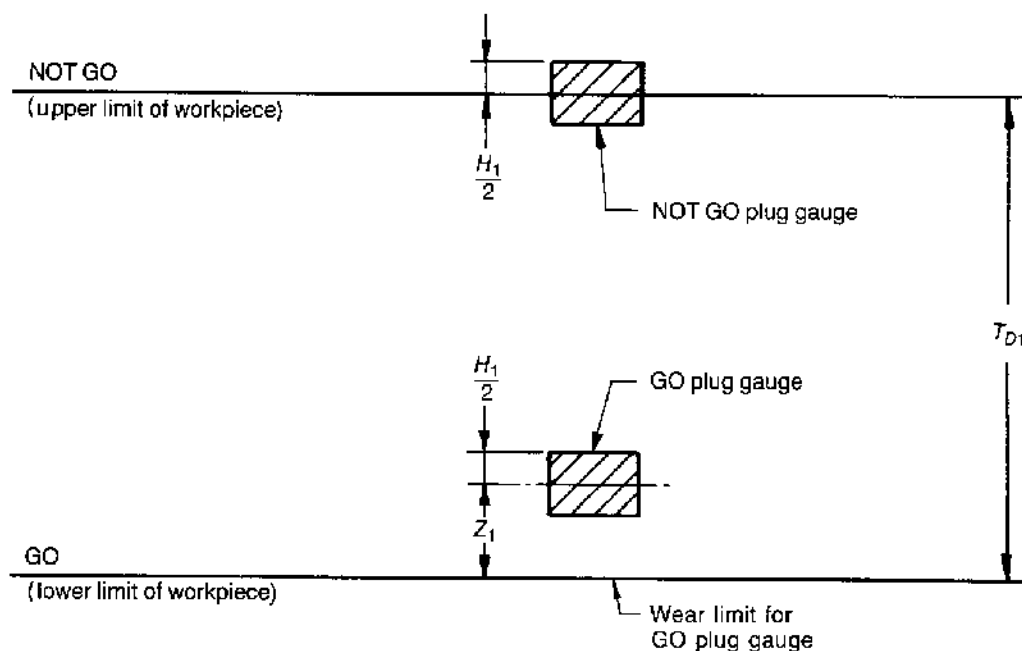


Fig. 4.4. TOLERANCE ZONES FOR PLAIN GAUGES FOR THE MINOR DIAMETER

4.5.4 Limits for GO and NOT GO plain plug gauges. The upper, lower and wear limits for the GO gauge are obtained by the algebraic addition of the deviations given in Table 4.8 to the minimum minor diameter of the internal product thread.

The upper and lower limits for the NOT GO gauge are obtained by the algebraic addition of the deviations given in Table 4.8 to the maximum minor diameter of the internal product thread.

4.6 LIMITS FOR SETTING PLUG AND CHECK PLUG GAUGES.

4.6.1 General. The limits for setting and check plug gauges, which are used for checking and setting gauges for external product threads, are derived from the tolerances for the product threads as indicated in Clauses 4.6.2 to 4.6.11.

The disposition of the limits of these gauges, relative to the screw gauge and product thread limits for the pitch diameter are shown in Fig. 4.1.

The limits for GO and NOT GO plain check plugs used to check the minor diameter of solid screw ring gauges are derived from the tolerances for the minor diameter of the screw ring gauge.

For notes on the function, use and checking of gauges, see Appendix A.

4.6.2 Limits for GO screw check plugs for new GO solid screw ring gauges and single length setting plugs for GO screw calliper gauges. The upper and lower limits for the simple pitch diameter are obtained by the algebraic addition of the deviations given in Table 4.9 to the maximum pitch diameter of the external product thread.

The upper and lower limits for the major diameter are obtained by the algebraic addition of the deviations given in Table 4.9 to the maximum major diameter of the external product thread.

The minor diameter is cleared as shown in Fig. 3.2.

4.6.3 Limits for NOT GO screw check plugs for new GO solid screw ring gauges. The upper and lower limits for the simple pitch diameter are obtained by the algebraic addition of the deviations given in Table 4.10 to the maximum pitch diameter of the external product thread.

The upper and lower limits for the major diameter are obtained by the algebraic addition of the deviations given in Table 4.10 to the maximum pitch diameter of the external product thread plus $0.2P$.

The minor diameter is cleared as shown in Fig. 3.4.

TABLE 4.8
DEVIATIONS FOR GO AND NOT GO PLAIN PLUG GAUGES

Pitch diameter tolerance for internal thread	Deviation for GO gauges			Deviation for NOT GO gauges	
	New gauges		Worn gauges		
	Upper	Lower	Upper	Upper	Lower
$> 38 \leq 100$	+ 13	+ 5	0	+ 4	– 4
$> 100 \leq 180$	+ 27	+ 17	0	+ 5	– 5
$> 180 \leq 375$	+ 46	+ 30	0	+ 8	– 8
$> 375 \leq 710$	+ 65	+ 39	0	+ 13	– 13
$> 710 \leq 1250$	+ 88	+ 42	0	+ 23	– 23

TABLE 4.9
DEVIATIONS FOR GO SCREW CHECK PLUGS FOR NEW GO SOLID SCREW RING GAUGES AND SINGLE LENGTH SETTING PLUGS FOR GO SCREW CALLIPER GAUGES

Pitch diameter tolerance for external thread	Deviation for simple pitch diameter		Deviation for minor diameter	
	Upper	Lower	Upper	Lower
$> 24 \leq 50$	– 3	– 9	+ 6	– 6
$> 50 \leq 80$	– 7	– 14	+ 7	– 7
$> 80 \leq 125$	– 13	– 21	+ 9	– 9
$> 125 \leq 200$	– 22	– 31	+ 11	– 11
$> 200 \leq 315$	– 28	– 40	+ 14	– 14
$> 315 \leq 500$	– 40	– 55	+ 18	– 18
$> 500 \leq 670$	– 52	– 70	+ 22	– 22

TABLE 4.10
DEVIATIONS FOR NOT GO SCREW CHECK PLUGS FOR NEW GO SOLID SCREW RING GAUGES

Pitch diameter tolerance for external thread	Deviation for simple pitch diameter		Deviation for minor diameter	
	Upper	Lower	Upper	Lower
$> 24 \leq 50$	+ 11	+ 5	+ 11	+ 5
$> 50 \leq 80$	+ 10	+ 3	+ 10	+ 3
$> 80 \leq 125$	+ 9	+ 1	+ 9	0
$> 125 \leq 200$	+ 6	– 3	+ 7	– 4
$> 200 \leq 315$	+ 5	– 7	+ 6	– 8
$> 315 \leq 500$	+ 2	– 13	+ 4	– 14
$> 500 \leq 670$	0	– 18	+ 2	– 20

4.6.4 Limits for double length setting plugs for adjustable GO screw ring gauges. The upper and lower limits for the simple pitch diameter are obtained by the algebraic addition of the deviations given in Table 4.11 to the maximum pitch diameter of the external product thread.

The upper and lower limits for the major diameter are obtained by the algebraic addition of the deviations given in Table 4.11 as follows:

- Full form portion to the maximum major diameter of the external product thread.
- Truncated portion to the maximum pitch diameter of the external product thread plus $0.2P$.

The minor diameter is cleared as shown in Fig. 3.4.

4.6.5 Limits for wear check plugs for GO screw ring gauges (solid and adjustable). The upper and lower limits for the simple pitch diameter are obtained by the algebraic addition of the deviations given in Table 4.12 to the maximum pitch diameter of the external product thread.

The upper and lower deviations for the major diameter are obtained by the algebraic addition of the deviations given in Table 4.12 to the maximum pitch diameter of the external product thread plus $0.2P$.

The minor diameter is cleared as shown in Fig. 3.4.

4.6.6 Limits for GO screw check plugs for new NOT GO solid screw ring gauges. The upper and lower limits for the simple pitch diameter are obtained by the algebraic addition of the deviations given in Table 4.13 to the minimum pitch diameter of the external product thread.

The upper and lower deviations for the major diameter are obtained by the algebraic addition of the deviations given in Table 4.13 to the maximum major diameter of the external product thread.

The minor diameter is cleared as shown in Fig. 3.2.

NOTE: The crest of the major diameter should not be sharp and the crest may be broken even if this violates the limits as given above.

TABLE 4.11
DEVIATIONS FOR DOUBLE LENGTH SETTING PLUGS FOR GO
ADJUSTABLE SCREW RING GAUGES

Pitch diameter tolerance for external thread	Deviation for simple pitch diameter		Deviation for major diameter			
			Full form portion		Truncated portion	
	Upper	Lower	Upper	Lower	Upper	Lower
$> 24 \leq 50$	+ 4	− 2	+ 6	− 6	+ 4	− 2
$> 50 \leq 80$	+ 2	− 5	+ 7	− 7	+ 2	− 5
$> 80 \leq 125$	− 2	− 10	+ 9	− 9	− 2	− 11
$> 125 \leq 200$	− 8	− 17	+ 11	− 11	− 7	− 18
$> 200 \leq 315$	− 12	− 24	+ 14	− 14	− 11	− 25
$> 315 \leq 500$	− 20	− 35	+ 18	− 18	− 19	− 37
$> 500 \leq 670$	− 28	− 46	+ 22	− 22	− 26	− 48

TABLE 4.12
DEVIATIONS FOR WEAR CHECK PLUGS FOR GO SCREW RING
GAUGES

Pitch diameter tolerance for external thread	Deviation for simple pitch diameter		Deviation for major diameter	
	Upper	Lower	Upper	Lower
$> 24 \leq 50$	+ 17	+ 11	+ 17	+ 11
$> 50 \leq 80$	+ 17	+ 10	+ 17	+ 10
$> 80 \leq 125$	+ 18	+ 10	+ 18	+ 9
$> 125 \leq 200$	+ 18	+ 9	+ 19	+ 8
$> 200 \leq 315$	+ 19	+ 7	+ 20	+ 6
$> 315 \leq 500$	+ 20	+ 5	+ 22	+ 4
$> 500 \leq 670$	+ 22	+ 4	+ 24	+ 2

TABLE 4.13
DEVIATIONS FOR GO CHECK PLUGS FOR NEW NOT GO SOLID SCREW
RING GAUGES

Pitch diameter tolerance for external thread	Deviation for simple pitch diameter		Deviation for major diameter*	
	Upper	Lower	Upper	Lower
$> 24 \leq 50$	− 11	− 17	+ 6	− 6
$> 50 \leq 80$	− 14	− 21	+ 7	− 7
$> 80 \leq 125$	− 18	− 26	+ 9	− 9
$> 125 \leq 200$	− 23	− 32	+ 11	− 11
$> 200 \leq 315$	− 28	− 40	+ 14	− 14
$> 315 \leq 500$	− 35	− 50	+ 18	− 18
$> 500 \leq 670$	− 43	− 61	+ 22	− 22

* See also Note to Clauses 4.6.6.

4.6.7 Limits for NOT GO screw check plugs for new NOT GO solid screw ring gauges. The upper and lower limits for the simple pitch diameter are obtained by the algebraic addition of the deviations given in Table 4.14 to the minimum pitch diameter of the external product thread.

The upper and lower limits for the major diameter are obtained by the algebraic addition of the deviations given in Table 4.14 to the maximum major diameter of the external product thread minus the pitch diameter tolerance for that thread.

The minor diameter is cleared as shown in Fig. 3.2.

4.6.8 Limits for single length setting plugs for NOT GO screw calliper gauges. The upper and lower limits for the simple pitch diameter are obtained by the algebraic addition of the deviations given in Table 4.15 to the minimum pitch diameter of the external product thread.

The upper and lower limits for the major diameter are obtained by the algebraic addition of the deviations

given in Table 4.15 to the maximum major diameter of the external product thread minus the pitch diameter tolerance for that thread.

The minor diameter is cleared as shown in Fig. 3.2.

4.6.9 Limits for double length setting plugs for NOT GO adjustable screw ring gauges. The upper and lower limits for the simple pitch diameter are obtained by the algebraic addition of the deviations given in Table 4.16 to the minimum pitch diameter of the external product thread.

The upper and lower limits for the major diameter are obtained by the algebraic addition of the deviations given in Table 4.16 as follows:

- Full form portion to the maximum major diameter of the external product thread, minus the pitch diameter tolerance for that thread.
- Truncated portion to the minimum pitch diameter of the external product thread plus $0.2P$.

The minor diameter is cleared as shown in Fig. 3.4.

TABLE 4.14
DEVIATIONS FOR NOT GO CHECK PLUGS FOR NEW NOT GO SOLID
SCREW RING GAUGES

Pitch diameter tolerance for external thread	micrometres			
	Deviation for simple pitch diameter		Deviation for major diameter	
	Upper	Lower	Upper	Lower
$> 24 \leq 50$	+ 3	− 3	+ 6	− 6
$> 50 \leq 80$	+ 3	− 4	+ 7	− 7
$> 80 \leq 125$	+ 4	− 4	+ 9	− 9
$> 125 \leq 200$	+ 4	− 5	+ 11	− 11
$> 200 \leq 315$	+ 6	− 6	+ 14	− 14
$> 315 \leq 500$	+ 7	− 8	+ 18	− 18
$> 500 \leq 670$	+ 9	− 9	+ 22	− 22

TABLE 4.15
DEVIATIONS FOR SINGLE LENGTH SETTING PLUGS FOR NOT GO SCREW
CALLIPER GAUGES

Pitch diameter tolerance for external thread	micrometres			
	Deviation for simple pitch diameter		Deviation for major diameter	
	Upper	Lower	Upper	Lower
$> 24 \leq 50$	− 4	− 10	+ 6	− 6
$> 50 \leq 80$	− 5	− 12	+ 7	− 7
$> 80 \leq 125$	− 7	− 15	+ 9	− 9
$> 125 \leq 200$	− 9	− 18	+ 11	− 11
$> 200 \leq 315$	− 11	− 23	+ 14	− 14
$> 315 \leq 500$	− 15	− 30	+ 18	− 18
$> 500 \leq 670$	− 19	− 37	+ 22	− 22

TABLE 4.16
DEVIATIONS FOR DOUBLE LENGTH SETTING PLUGS FOR NOT GO
ADJUSTABLE SCREW RING GAUGES

Pitch diameter tolerance for external thread	micrometres					
	Deviation for simple pitch diameter		Deviation for major diameter			
			Full form portion		Truncated portion	
	Upper	Lower	Upper	Lower	Upper	Lower
$> 24 \leq 50$	− 4	− 10	+ 2	− 10	− 1	− 13
$> 50 \leq 80$	− 5	− 12	+ 2	− 12	− 2	− 16
$> 80 \leq 125$	− 7	− 15	+ 2	− 16	− 2	− 20
$> 125 \leq 200$	− 9	− 18	+ 2	− 20	− 3	− 25
$> 200 \leq 315$	− 12	− 24	+ 2	− 26	− 4	− 32
$> 315 \leq 500$	− 15	− 30	+ 3	− 33	− 5	− 41
$> 500 \leq 670$	− 19	− 37	+ 3	− 41	− 6	− 50

4.6.10 Limits for wear check plugs for NOT GO screw ring gauges (solid and adjustable). The upper and lower limits for the simple pitch diameter are obtained by the algebraic addition of the deviations given in Table 4.17 to the minimum pitch diameter of the external product thread.

The upper and lower limits for the major diameter are obtained by the algebraic addition of the deviations given in Table 4.17 to the maximum major diameter of the external product thread, minus the pitch diameter tolerance for that thread.

The minor diameter is cleared as shown in Fig. 3.2.

4.6.11 Limits for GO and NOT GO plain check plugs (for checking the minor diameter of solid ring gauges). The minor diameter of new GO and NOT GO solid ring gauges is checked by check gauges conforming to the following limits.

- (a) GO plain check plug; the limits are obtained by the algebraic addition of the deviations given in Table 4.18 to the minimum minor diameter of the screw ring gauge.
- (b) NOT GO plain check plug; the limits are obtained by the algebraic additions of the deviations given in Table 4.18 to the maximum minor diameter of the screw ring gauge.

TABLE 4.17
DEVIATIONS FOR WEAR CHECK PLUGS FOR NOT GO SCREW RING GAUGES

Pitch diameter tolerance for external thread	micrometres			
	Deviation for simple pitch diameter		Deviation for major diameter	
	Upper	Lower	Upper	Lower
$> 24 \leq 50$	+ 6	0	+ 9	– 3
$> 50 \leq 80$	+ 7	0	+ 11	– 3
$> 80 \leq 125$	+ 9	+ 1	+ 14	– 4
$> 125 \leq 200$	+ 11	+ 2	+ 17	– 5
$> 200 \leq 315$	+ 14	+ 2	+ 22	– 6
$> 315 \leq 500$	+ 17	+ 2	+ 28	– 8
$> 500 \leq 670$	+ 21	+ 3	+ 34	– 10

TABLE 4.18
DEVIATIONS FOR GO AND NOT GO PLAIN CHECK PLUGS FOR SOLID SCREW RING GAUGES

Pitch diameter tolerance for external thread	micrometres			
	Deviation for check plugs			
	GO gauge		NOT GO gauge	
	Upper	Lower	Upper	Lower
$> 24 \leq 50$	0	– 2	+ 2	0
$> 50 \leq 80$	0	– 2	+ 2	0
$> 80 \leq 125$	0	– 2	+ 2	0
$> 125 \leq 200$	0	– 2	+ 2	0
$> 200 \leq 315$	0	– 3	+ 3	0
$> 315 \leq 500$	0	– 4	+ 4	0
$> 500 \leq 670$	0	– 5	+ 5	0

APPENDIX A

FUNCTION, USE AND CHECKING OF SCREW GAUGES

A1 SCOPE. This Appendix sets out notes on the function, use and checking of screw gauges to ensure that the product threads conform to the specified limits. Notes are also included on the principle of gauging the 'envelope condition' of the screw threads (commonly referred to as the 'Taylor Principle') and why this is the preferred method of screw thread verification. Deviations from the ideal of the Taylor Principle are also discussed.

A2 THE PRINCIPLE OF GAUGING.

A2.1 General. Limit gauges should ideally accept all screw threads which conform dimensionally to a specification and reject all those which do not. Limit gauges made in strict compliance with the Taylor Principle (see Paragraph A2.2) would achieve this, but for practical reasons departures have to be made from this principle. The departures adopted in this standard do not, however, significantly detract from the effectiveness of limit gauges in the practical control of the screw thread dimensions.

A2.2 The 'Taylor Principle'. The maximum material condition of a workpiece (screw thread, etc) shall be checked by means of a GO gauge of full form and made exactly to the maximum material condition of that workpiece; the degree (amount) of engagement of the GO gauge shall be the same as that of the component intended to assemble with the workpiece being checked.

The least material limit of a workpiece shall be checked by means of a NOT GO gauge(s) designed to check individually each separate element of the workpiece and made exactly to the least material size for that element.

NOTES:

1. The above principle was initially developed in 1905 by William Taylor of Leicester, England, who was granted a patent covering 'Improvements in Gauges for Screws'. The essential feature of this patent was that the GO gauges were to be of 'full form', thus simultaneously checking all the elements at the maximum material condition, while NOT GO gauges were to be used separately on the various elements of the screw at the least material condition.

This principle, which has become known as the 'Taylor Principle' was subsequently applied to limit gauging in general.

2. For screw threads, strict application of the Taylor Principle would entail the following procedure:
 - (a) The maximum material condition would be checked by a screw plug or screw ring gauge of perfect form, with a length of engagement equal to the length of the screw thread, and the major, pitch and minor diameters exactly equal to the maximum material limit(s) of the screw thread. This gauge should be able to fully pass into or over the screw thread.
 - (b) The least material limits would be checked by separate gauges for the major, pitch and minor diameters, each one designed to contact the relevant parameter at two diametrically opposite points, separated by a distance exactly equal to the least material limit of that parameter. These gauges should not be able to pass into or over the screw thread at any position.

A2.3 Permissible departures from the Taylor Principle. For practical reasons, the following departures from the Taylor Principle are adopted in this standard.

Gauges cannot be made exactly to the maximum or minimum limiting sizes of the screw thread, and also, even if this were possible, the gauges would quickly wear beyond these limits. Therefore a manufacturing tolerance and wear allowance is necessary to ensure reasonable life for the gauges. This applies to both the GO and NOT GO gauging members.

At the maximum material condition a full form GO screw ring or screw plug gauge should be used, the length of which may be somewhat less than the length of the screw thread, to facilitate the use of standard gauge blanks. It may be more convenient to use screw calliper gauges, but it is again emphasized that in any case of dispute, gauging using screw ring gauges is authoritative.

At the least material condition it is only necessary to determine the least material size of the pitch diameter, this being the main parameter which determines the character of fit. Moreover, it is impracticable to use two point measurement and also to design a gauge which contacts the screw thread exactly on the pitch line, a short length of flank being necessary for gauge life. Gauging at the least material limits therefore should be carried out using screw calliper gauges with a truncated thread form for external threads, and NOT GO screw plug gauges, also with truncated thread form, for internal threads.

A3 FUNCTION AND USE OF GAUGES.

A3.1 Gauges for external threads.

A3.1.1 *Solid and adjustable GO screw ring gauges.* Solid and adjustable GO screw ring gauges check the maximum material condition of the external thread to ensure that the specified limits are not transgressed. The gauge simultaneously checks the maximum material size of the pitch diameter together with the thread form, pitch, straightness and roundness, and also ensures that the root radius does not encroach on the flanks of the screw thread.

They do not check the major or minor diameters of the thread.

These gauges should be applied by hand without using excessive force, and the gauge(s) must pass over the complete length of the screw thread.

A3.1.2 *Solid and adjustable NOT GO screw ring gauges.* Solid and adjustable NOT GO screw ring gauges check the least material limit of the pitch diameter of the external screw thread to ensure that the specified limits are not transgressed.

These gauges should be applied by hand without using excessive force, and ideally the external thread should not enter the gauge. However, it is permissible for the thread to enter the gauge, provided that on withdrawal disengagement takes place within two turns of the thread.

A3.1.3 *Adjustable GO screw calliper gauges.* Adjustable GO screw calliper gauges check the maximum material conditions of the external thread to ensure that the specified limits are not transgressed. The gauge simultaneously checks the same parameters as a GO screw ring gauge, except that it does not check some forms of out of roundness, e.g. lobing.

These gauges should be applied under their own weight or under a fixed working load to at least three positions evenly spaced around the circumference of the screw thread. The gauge must completely pass over the thread at all positions at which it is applied.

A3.1.4 *Adjustable NOT GO screw calliper gauges.* Adjustable NOT GO screw calliper gauges check the least material limit of the pitch diameter of the external thread to ensure that the specified limits are not transgressed.

The gauges are applied in the same manner as GO screw calliper gauges. The gauge must not pass over the thread at any position at which it is applied.

A3.1.5 *GO and NOT GO plain ring and calliper gauges.* GO and NOT GO plain ring and calliper gauges check the major diameter of the external thread to ensure that it is within the specified limits.

The application of these gauges and criterion for acceptance of the thread are the same as those given for the relevant type of screw gauge.

A3.2 Gauges for internal threads.

A3.2.1 *GO screw plug gauges.* GO screw plug gauges check the maximum material condition of the internal thread to ensure that the specified limits are not transgressed. The gauge simultaneously checks the maximum material size of the pitch diameter, together with the thread form, pitch, straightness and roundness, and also ensures that the root radius does not encroach on the thread flanks.

They do not check the major or minor diameters of the thread.

These gauges should be applied by hand without using excessive force, and the gauge(s) must pass through the complete length of the screw thread.

A3.2.2 *NOT GO screw plug gauges.* NOT GO screw plug gauges check the least material limit of the pitch diameter of the internal thread to ensure that the specified limits are not transgressed.

These gauges should be applied by hand without using excessive force, and ideally the gauge should not enter the thread. However, it is permissible for the gauge to enter the screw thread, provided that on withdrawal disengagement takes place within two turns of the thread.

If the thread has a length of three turns or less, the gauge must not pass right through the thread.

A3.2.3 *GO and NOT GO plain plug gauges.* GO and NOT GO plain plug gauges check the minor diameter of the internal thread to ensure that it is within the specified limits.

The application of these gauges and criterion for acceptance of the thread are the same as those given for the relevant type of screw gauge.

A3.3 Setting and check plug gauges.

A3.3.1 Single length setting plug gauges. Single length setting plug gauges are used to set adjustable GO and NOT GO screw calliper gauges. The GO setting plug is used for the GO calliper gauge, and the NOT GO is used for the NOT GO calliper gauge.

The setting plugs should be applied to the GO or NOT GO calliper, as relevant, and the gauges should be adjusted so that the screw calliper passes over the setting plug(s) under its own weight or under a fixed load. There should be no perceptible clearance between the setting plug and the calliper.

A3.3.2 Double length setting plug gauges. Double length setting plug gauges are used to set adjustable GO and NOT GO screw ring gauges.

The thread length of the gauges contains two successive portions of thread. The first portion has full form threads (with the minor diameter relieved) and is used to set the size of the relevant GO or NOT GO screw ring gauge. The second portion has truncated threads and is used to check that the pitch diameter of the screw ring gauge is satisfactory.

These setting plugs should be applied to the relevant ring gauge by hand without using excessive force, and after adjustment shall pass through the ring gauge without perceptible clearance. When the portion with truncated threads is screwed through the ring gauge, no perceptible clearance should be present between the setting plug and the screw ring gauge. If clearance is present, the screw ring gauge should be discarded for rectification.

A3.3.3 Screw check plug gauges. Screw check plug gauges are used to check new GO and NOT GO solid screw ring gauges. A GO and NOT GO screw check plug is required for both a GO and NOT GO solid screw ring gauge.

GO screw check plugs have full form threads (with the minor diameter relieved) and simultaneously check the maximum material size of the pitch diameter together with the thread form, pitch, straightness and roundness, and also ensure that the root radius does not encroach on the flanks.

They do not check the major or minor diameters of the screw ring gauge.

NOT GO screw check plugs have a truncated thread and check that the pitch diameter of the screw ring gauges is not too large.

The gauges should be applied by hand without using excessive force. The GO gauge should pass through the screw ring gauge.

The NOT GO gauge should not enter the screw ring gauge. However, it is permissible for the check plug to enter the gauge, provided that on withdrawal disengagement takes place with one turn of the thread.

A3.3.4 NOT GO wear check plug gauges. NOT GO wear check plug gauges are used to check whether excessive wear has taken place on used solid screw ring gauges. A wear check plug is required for both the GO and NOT GO solid screw ring gauge.

Wear check plug gauges have truncated threads and check that the pitch diameter of the screw ring gauge has not exceeded the wear limit.

The gauges should be applied by hand without using excessive force, and should not enter the screw ring gauge. However, it is permissible for the check plug to enter the gauge, provided that on withdrawal disengagement takes place within one turn of the thread.

A3.3.5 GO and NOT GO plain plug gauges. GO and NOT GO plain plug gauges check the minor diameter of new GO and NOT GO solid screw ring gauges. A GO and NOT GO plain plug gauge is required for both a GO and NOT GO solid screw ring gauge.

The application of these gauges and the criterion for acceptance of the ring gauge are the same as those given for gauges for internal threads in Paragraph A3.2.

A4 CHECKING (VERIFICATION) OF GAUGES. Gauges to this standard should be verified in accordance with the provisions of Paragraph A3 and AS 2710.

APPENDIX B
BASES FOR DEVIATIONS AND TOLERANCES OF SCREW
GAUGES

B1 SCOPE. This Appendix sets out the formulas and associated numerical values for the derivation of the gauge deviations for external and internal threads. The information is intended to explain the basis of the gauge system and also to provide the means for calculating gauge tolerances for non-standard metric threads.

B2 DEVIATION FOR GAUGES FOR EXTERNAL THREADS.

B2.1 Deviations for screw gauges and associated check and setting plugs. The formulas for the derivation of deviations for gauges for external threads are given in Table B1. Values for the expressions used in the formulas are given in Table B2.

B2.2 Deviations for plain GO and NOT GO gauges for the major diameter. The formulas for the derivation of the deviations for gauges for the major diameter of external threads are given in Table B3. Values for the expressions used in the formulas are given in Table B4.

B3 DEVIATIONS FOR GAUGES FOR INTERNAL THREADS.

B3.1 Deviations for screw gauges. The formulas for the derivation of deviations for gauges for internal threads are given in Table B5. Values for the expressions used in the formulas are given in Table B2.

B3.2 Deviations for plain GO and NOT GO gauges for the minor diameter. The formulas for the derivation of the deviations for gauges for the minor diameter of internal threads are given in Table B6. Values for the expressions used in formulas are given in Table B7.

TABLE B1
FORMULAS FOR GAUGES FOR EXTERNAL THREADS

Type of gauge*	Thread profile Fig.	Major diameter		Pitch diameter		Minor diameter	
		Basic size	Deviation	Basic size	Deviation	Basic size	Deviation
GO solid screw ring	3.3	$d - es + \frac{H}{12} + T_{PL} \dagger$	—	$d_2 - es - Z_R$	$\pm \frac{T_R}{2}$	$D_1 - es$	$\pm \frac{T_R}{2}$
GO adjustable screw ring	3.3	$d - es + \frac{H}{12} + T_{PL} \dagger$	—	See Clause 4.4.4	—	$D_1 - es$	$\pm \frac{T_R}{2}$
GO screw check plug for new solid GO screw ring	3.2	$d - es$	$\pm T_{PL}$	$d_2 - es - Z_R - m$	$\pm \frac{T_{CS}}{2}$	$D_1 - es - Z_R - m - \frac{H}{6} \ddagger$	—
NOT GO screw check plug for new solid GO screw ring	3.4	$d_2 - es - Z_R + \frac{T_R}{2} + 2F_1$	$\pm \frac{T_R}{2}$	$d_s - es - Z_R + \frac{T_R}{2}$	$\pm \frac{T_{CS}}{2}$	$D_1 - es - \frac{T_R}{2} - \frac{H}{6} \ddagger$	—
Single length setting plug	3.2	$d - es$	$\pm T_{PL}$	$d_2 - es - Z_R - m$	$\pm \frac{T_{CS}}{2}$	$D_1 - es - Z_R - m - \frac{H}{6} \ddagger$	—
Double length setting plug	3.2	$d - es$	$\pm T_{PL}$	$d_2 - es - Z_R - \frac{T_{CS}}{2}$	$\pm \frac{T_{CS}}{2}$	$D_1 - es - \frac{T_R}{2} - \frac{H}{6} \ddagger$	—
	3.4	$d_2 - es - Z_R - \frac{T_{CS}}{2} + 2F_1$	$\pm \frac{T_R}{2}$				
Wear check plug for solid or adjustable GO screw ring	3.4	$d_2 - es - Z_R + W_{GO} + 2F_1$	$\pm \frac{T_R}{2}$	$d_2 - es - Z_R + W_{GO}$	$\pm \frac{T_{CS}}{2}$	$D_1 - es - \frac{T_R}{2} - \frac{H}{6} \ddagger$	—
NOT TO solid screw ring	3.5	$d - es + T_{PL} \dagger$	—	$d_2 - es - T_{d2} - \frac{T_R}{2}$	$\pm \frac{T_R}{2}$	$d_2 - es - T_{d2} - \frac{T_R}{2} - 2F_1$	$\pm T_R$
NOT GO adjustable screw ring	3.5	$d - es + T_{PL} \dagger$	—	See Clause 4.4.4	—	$d_2 - es - T_{d2} - \frac{T_R}{2} - 2F_1$	$\pm T_R$
GO screw check plug for new solid NOT GO screw ring	3.2	$d - es$	$\pm T_{PL}$	$d_2 - es - T_{d2} - \frac{T_R}{2} - m$	$\pm \frac{T_{CS}}{2}$	$D_1 - es - T_{d2} - \frac{T_R}{2} - m - \frac{H}{6} \ddagger$	—
NOT GO screw check plug for new solid NOT GO screw ring	3.2	$d - es - T_{d2}$	$\pm T_{PL}$	$d_2 - es - T_{d2}$	$\pm \frac{T_{CS}}{2}$	$D_1 - es - T_{d2} - \frac{H}{6} \ddagger$	—
Single length setting plug	3.2	$d - es - T_{d2}$	$\pm T_{PL}$	$d_2 - es - T_{d2} - \frac{T_R}{2} - \frac{T_{CS}}{2}$	$\pm \frac{T_{CS}}{2}$	$D_1 - es - T_{d2} - \frac{T_R}{2} - m - \frac{H}{6} \ddagger$	—
Double length setting plug	3.2	$d - es - T_{d2} - \frac{T_R}{2}$	$\pm T_{PL}$	$d_2 - es - T_{d2} - \frac{T_R}{2} - \frac{T_{CS}}{2}$	$\pm \frac{T_{CS}}{2}$	$D_1 - es - T_{d2} - \frac{H}{6} \ddagger$	—
	3.4	$d_2 - es - T_{d2} - \frac{T_R}{2} - \frac{T_{CS}}{2} + 2F_1$					
Wear check plug for solid or adjustable NOT TO screw ring	3.2	$d - es - T_{d2} - \frac{T_R}{2} + W_{NG}$	$\pm T_{PL}$	$d - es - T_{d2} - \frac{T_R}{2} + W_{NG}$	$\pm \frac{T_{CS}}{2}$	$D_1 - es - T_{d2} - \frac{H}{6} \ddagger$	—

* Calliper gauges are not included because their sizes are determined by setting plugs.

† The formula gives the minimum size.

‡ The formula give the maximum size.

TABLE B2
VALUES FOR SCREW GAUGES

VALUES FOR SCREW GAUGES											micrometres
T_{d2} or T_{D2} as relevant	New gauges and check plugs						W_{GO}		W_{NG}		
	Tolerance			Centre distance							
	T_R	T_{PL}	T_{CP}	m	Z_R	Z_{PL}	GO screw ring gauge	GO screw plug gauge	NOT GO screw ring gauge	NOT GO screw plug gauge	
> 24 ≤ 50	8	6	6	10	−4	0	10	8	7	6	
> 50 ≤ 80	10	7	7	12	−2	2	12	9.5	9	7.5	
> 80 ≤ 125	14	9	8	15	2	6	16	12.5	12	9.5	
> 125 ≤ 200	18	11	9	18	8	12	21	17.5	15	11.5	
> 200 ≤ 315	23	14	12	22	12	16	25.5	21	19.5	15	
> 315 ≤ 500	30	18	15	27	20	24	33	27	25	19	
> 500 ≤ 670	38	22	18	33	28	32	41	33	31	23	

TABLE B3
FORMULAS FOR PLAIN RING AND CALLIPER GAUGES

(For values of $\frac{H_2}{2}$ and Z_2 , see Table B4)

Type of gauge	Basic size	Tolerance
GO plain ring or clipper gauge	$D - es - Z_2$	$\pm \frac{H_2}{2}$
NOT GO plain ring or calliper gauge	$D - es - T_d$	$\pm \frac{H_2}{2}$

NOTE: Wear limit for GO gauges is the upper limit of the major diameter of the screw thread.

TABLE B4
VALUES FOR $\frac{H_2}{2}$ AND Z_2

(See also Table B3)

Major diameter tolerance for external thread	$\frac{H_2}{2}$	Z_2
> 36 ≤ 85	4	8
> 85 ≤ 140	5	20
> 140 ≤ 335	8	38
> 335 ≤ 850	15	54
> 850 ≤ 950	21	60

TABLE B5
FORMULAS FOR GAUGES FOR INTERNAL THREADS

Type of gauge	Thread profile Fig.	Condition of gauge	Major diameter		Pitch diameter		Minor diameter
			Basic size	Deviation	Basic size	Deviation	Maximum size
GO screw plug gauge	3.2	New	$D + EI + Z_{PL}$	$\pm T_{PL}$	$D_2 + EI + Z_{PL}$	$\pm \frac{T_{PL}}{2}$	$D_1 + EI - \frac{H}{6}$
		Worn			$D_2 + EI + Z_{PL} - W_{GO}$	—	
NOT GO screw plug gauge	3.4	New	$D_2 + EI + T_{D2} + \frac{T_{PL}}{2} + 2F_1$	$\pm T_{PL}$	$D_2 + EI + T_{D2} + \frac{T_{PL}}{2}$	$\pm \frac{T_{PL}}{2}$	$D_1 + EI - \frac{H}{6}$
		Worn			$D_2 + EI + T_{D2} + \frac{T_{PL}}{2} - W_{NF}$	—	

TABLE B6
FORMULAS FOR PLAIN PLUG GAUGES

(For values of $\frac{H_1}{2}$ and Z_1 , see Table B7)

Type of gauge	Basic size	Tolerance
Plain GO plug gauge	$D_1 + EI + Z_1$	$\pm \frac{H_1}{2}$
Plain NOT GO plug gauge	$D_1 + EI + T_{D1}$	$\pm \frac{H_1}{2}$

NOTE: Wear limit for GO gauges is the lower limit of the minor diameter of the screw thread.

TABLE B7
VALUES FOR $\frac{H_2}{2}$ AND Z_1

(See also Table B6)

Major diameter tolerance for external thread	$\frac{H_2}{2}$	Z_1
> 38 ≤ 100	4	9
> 100 ≤ 180	5	22
> 180 ≤ 375	8	38
> 375 ≤ 710	13	52
> 710 ≤ 1250	23	65

APPENDIX C

EXAMPLES OF CALCULATING GAUGE LIMITS

C1 SCOPE. This Appendix sets out detailed examples for calculating the limiting sizes for gauges, using the information tabled in the standard. The examples given cover all types of gauges for product threads together with associated check plugs and setting gauges.

C2 GAUGES FOR EXTERNAL THREADS AND ASSOCIATED CHECK AND SETTING PLUGS.

C2.1 General. The following examples of gauges for external threads are calculated for an $M36 \times 4 - 6g$ screw thread, assuming normal length of axial thread engagement (see AS 1721).

$M36 \times 4 - 6g$ screw thread limits:

Major diameter:

Maximum 35.940 mm

Minimum 35.465 mm

Tolerance 0.475 mm

Pitch diameter:

Maximum 33.342 mm

Minimum 33.118 mm

Tolerance 0.224 mm

Minor diameter:

Minimum 30.654 mm

C2.2 Solid 'GO' screw ring gauge and associated check plugs.

C2.2.1 *Solid 'GO' screw ring gauge* (see Clause 4.4.2 and Table 4.3).

- (a) *Pitch diameter* = maximum pitch diameter (external thread) – deviations in Table 4.3

$$\text{Maximum} = 33.342 - 0.001 = 33.341 \text{ mm}$$

$$\text{Minimum} = 33.342 - 0.024 = 33.318 \text{ mm}$$

- (b) *Minor diameter* = basic minor diameter (internal thread) – fundamental deviation \pm deviations in Table 4.3

$$\text{Maximum} = 31.670 - 0.060 + 0.011 = 31.621 \text{ mm}$$

$$\text{Minimum} = 31.670 - 0.060 - 0.011 = 31.599 \text{ mm}$$

- (c) *Major diameter:* cleared as shown in Fig. 3.3.

C2.2.2 *'GO' screw check plug for new solid 'GO' screw ring gauge* (see Clause 4.6.2 and Table 4.9).

- (a) *Pitch diameter* = maximum pitch diameter (external product thread) – deviations in Table 4.9

$$\text{Maximum} = 33.342 - 0.028 = 33.314 \text{ mm}$$

$$\text{Minimum} = 33.342 - 0.040 = 33.302 \text{ mm}$$

- (b) *Major diameter* = maximum major diameter (external product thread) \pm deviations in Table 4.9

$$\text{Maximum} = 35.940 + 0.014 = 35.954 \text{ mm}$$

$$\text{Minimum} = 35.940 - 0.014 = 35.926 \text{ mm}$$

- (c) *Minor diameter:* cleared as shown in Fig. 3.2.

C2.2.3 *'NOT GO' screw check plug for new solid 'GO' screw ring gauge* (see Clause 4.6.3 and Table 4.10).

- (a) *Pitch diameter* = maximum pitch diameter (external product thread) \pm deviations in Table 4.10

$$\text{Maximum} = 33.342 + 0.005 = 33.347 \text{ mm}$$

$$\text{Minimum} = 33.342 - 0.007 = 33.335 \text{ mm}$$

- (b) *Major diameter* = maximum pitch diameter (external product thread) + $0.2P$ \pm deviations in Table 4.10

$$\text{Maximum} = 33.342 + 0.800 + 0.006 = 34.148 \text{ mm}$$

$$\text{Minimum} = 33.342 + 0.800 - 0.008 = 34.134 \text{ mm}$$

- (c) *Minor diameter:* cleared as shown in Fig. 3.4.

C2.2.4 *Wear check plug for solid 'GO' screw ring gauge* (see Clause 4.6.5 and Table 4.12).

- (a) *Pitch diameter* = maximum pitch diameter (external thread) + deviations given in Table 4.12

$$\text{Maximum} = 33.342 + 0.019 = 33.361 \text{ mm}$$

$$\text{Minimum} = 33.342 + 0.007 = 33.349 \text{ mm}$$

- (b) *Major diameter* = maximum pitch diameter (external thread) + $0.2P$ + deviations given in Table 4.12

$$\text{Maximum} = 33.342 + 0.800 + 0.020 = 34.162 \text{ mm}$$

$$\text{Minimum} = 33.342 + 0.800 + 0.006 = 34.148 \text{ mm}$$

- (c) *Minor diameter*: cleared as shown in Fig. 3.4.

C2.2.5 *'GO' and 'NOT GO' plain check plugs for the minor diameter of new solid 'GO' screw ring gauge* (see Clause 4.6.11 and Table 4.18).

- (a) *'GO' gauge* = minimum minor diameter of 'GO' ring gauge – deviations given in Table 4.18

$$\text{Maximum} = 31.599 + 0 = 31.599 \text{ mm}$$

$$\text{Minimum} = 31.599 - 0.003 = 31.596 \text{ mm}$$

- (b) *'NOT GO' gauge* = maximum minor diameter of 'GO' ring gauge + deviations given in Table 4.18

$$\text{Maximum} = 31.621 + 0.002 = 31.623 \text{ mm}$$

$$\text{Minimum} = 31.621 + 0 = 31.621 \text{ mm}$$

C2.3 Solid 'NOT GO' screw ring gauge and associated check plugs.

C2.3.1 *Solid 'NOT GO' screw ring gauge* (see Clause 4.4.3 and Table 4.4).

- (a) *Pitch diameter* = minimum pitch diameter (external thread) – deviations given in Table 4.4

$$\text{Maximum} = 33.118 + 0 = 33.118 \text{ mm}$$

$$\text{Minimum} = 33.118 - 0.023 = 33.095 \text{ mm}$$

- (b) *Minor diameter* = minimum pitch diameter (external thread) $-0.2P \pm$ deviations given in Table 4.4

$$\text{Maximum} = 33.118 - 0.800 + 0.011 = 32.329 \text{ mm}$$

$$\text{Minimum} = 33.118 - 0.800 - 0.034 = 32.284 \text{ mm}$$

- (c) *Major diameter*: cleared as shown in Fig. 3.5.

C2.3.2 *'GO' screw check plug for new solid 'NOT GO' ring gauge* (see Clause 4.6.6 and Table 4.13).

- (a) *Pitch diameter* = minimum pitch diameter (external thread) – deviations given in Table 4.13

$$\text{Maximum} = 33.118 - 0.028 = 33.090 \text{ mm}$$

$$\text{Minimum} = 33.118 - 0.040 = 33.078 \text{ mm}$$

- (b) *Major diameter* = maximum major diameter (external thread) \pm deviations given in Table 4.13

$$\text{Maximum} = 35.940 + 0.014 = 35.954 \text{ mm}$$

$$\text{Minimum} = 35.940 - 0.014 = 35.926 \text{ mm}$$

- (c) *Minor diameter*: cleared as shown in Fig. 3.2.

C2.3.3 *'NOT GO' screw check plug for new solid 'NOT GO' ring gauge* (see Clause 4.6.7 and Table 4.14).

- (a) *Pitch diameter* = minimum pitch diameter (external thread) \pm deviations given in Table 4.14.

$$\text{Maximum} = 33.118 + 0.006 = 33.124 \text{ mm}$$

$$\text{Minimum} = 33.118 - 0.006 = 33.112 \text{ mm}$$

- (b) *Major diameter* = maximum major diameter (external thread) – pitch diameter tolerance \pm deviations given in Table 4.14

$$\text{Maximum} = 35.940 - 0.224 + 0.014 = 35.730 \text{ mm}$$

$$\text{Minimum} = 35.940 - 0.224 - 0.014 = 35.702 \text{ mm}$$

- (c) *Minor diameter*: cleared as shown in Fig. 3.2.

C2.3.4 *'GO' and 'NOT GO' plain check plugs for the minor diameter of new solid 'NOT GO' screw ring gauge* (see Clause 4.6.11 and Table 4.18).

- (a) *'GO' gauge* = minimum minor diameter of 'NOT GO' screw ring gauge—
deviation given in Table 4.18

$$\text{Maximum} = 32.284 - 0 = 32.284 \text{ mm}$$

$$\text{Minimum} = 32.284 - 0.002 = 32.282 \text{ mm}$$

- (b) *'NOT GO' gauge* = maximum minor diameter of 'NOT GO' screw ring gauge
and deviations given in Table 4.18

C2.4 'GO' and 'NOT GO' adjustable screw ring and calliper gauges and associated setting plugs.

C2.4.1 *'GO' and 'NOT GO' adjustable screw ring and calliper gauges* (see Clause 4.4.4).

- (a) *Pitch diameter.* Limits determined by setting plugs (see Paragraphs C2.4.2 to C2.4.5).
- (b) *Major diameter.* Limits determined by setting plugs (see Paragraphs C2.4.2 to C2.4.5).
- (c) *Minor diameter.*
- (i) *'GO' gauge.* Limits as for solid 'GO' screw ring gauge (see Paragraph C2.2.1(b)).
 - (ii) *'NOT GO' gauge.* Limits as for solid 'NOT GO' screw ring gauge (see Paragraph C2.3.1(b)).

C2.4.2 *Double length setting plugs for adjustable 'GO' screw ring gauges* (see Clause 4.6.4 and Table 4.11).

- (a) *Pitch diameter* = maximum pitch diameter (external thread) – deviations
given in Table 4.11

$$\text{Maximum} = 33.342 - 0.012 = 33.330 \text{ mm}$$

$$\text{Minimum} = 33.342 - 0.024 = 33.318 \text{ mm}$$

- (b) *Major diameter.*

- (i) *Full-form portion* = maximum major diameter (external thread) ±
deviations given in Table 4.11

$$\text{Maximum} = 35.940 + 0.014 = 35.954 \text{ mm}$$

$$\text{Minimum} = 35.940 - 0.014 = 35.926 \text{ mm}$$

- (ii) *Truncated portion* = maximum pitch diameter (external thread) + $0.2P$ –
deviations given in Table 4.11

$$\text{Maximum} = 33.342 + 0.800 - 0.011 = 34.131 \text{ mm}$$

$$\text{Minimum} = 33.342 + 0.800 - 0.025 = 34.117 \text{ mm}$$

- (c) *Minor diameter:* cleared as shown in Fig. 3.4.

C2.4.3 *Single length setting plug for adjustable 'GO' screw calliper gauges* (see Clause 4.6.2 and Table 4.9). The limits and formulas for these setting gauges are the same as those given for 'GO' screw check plugs for new solid 'GO' screw ring gauges (see Paragraph C2.2.2).

C2.4.4 *Double length setting plugs for 'NOT GO' adjustable screw ring gauges* (see Clause 4.6.9 and Table 4.16).

- (a) *Pitch diameter* = minimum pitch diameter (external thread) – deviations
given in Table 4.16

$$\text{Maximum} = 33.118 - 0.012 = 33.106 \text{ mm}$$

$$\text{Minimum} = 33.118 - 0.024 = 33.094 \text{ mm}$$

- (b) *Major diameter.*

- (i) *Full-form portion* = maximum major diameter (external thread) – pitch
diameter tolerance ± deviations given in Table 4.16

$$\text{Maximum} = 35.940 - 0.224 + 0.002 = 35.718 \text{ mm}$$

$$\text{Minimum} = 35.940 - 0.224 - 0.026 = 35.690 \text{ mm}$$

- (ii) *Truncated portion* = minimum pitch diameter + $0.2P$ – deviations given
in Table 4.16

$$\text{Maximum} = 33.118 + 0.800 - 0.004 = 33.914 \text{ mm}$$

$$\text{Minimum} = 33.118 + 0.800 - 0.032 = 33.886 \text{ mm}$$

- (c) *Minor diameter:* cleared as shown in Fig. 3.4.

C2.4.5 *Single length setting plug for adjustable 'NOT GO' screw calliper* (see Clause 4.6.8 and Table 4.15).

- (a) *Pitch diameter* = minimum pitch diameter (external thread) – deviations given in Table 4.15

$$\text{Maximum} = 33.118 - 0.011 = 33.107 \text{ mm}$$

$$\text{Minimum} = 33.118 - 0.023 = 33.095 \text{ mm}$$

- (b) *Major diameter* = maximum major dia (external thread) – pitch diameter tolerance \pm deviations in Table 4.15

$$\text{Maximum} = 35.940 - 0.224 + 0.014 = 35.730 \text{ mm}$$

$$\text{Minimum} = 35.940 - 0.224 - 0.014 = 35.702 \text{ mm}$$

- (c) *Minor diameter*: cleared as shown in Fig. 3.2.

C2.5 ‘GO’ and ‘NOT GO’ plain ring and calliper gauges for checking the major diameter of product threads (see Clause 4.4.5 and Table 4.5).

- (a) *‘GO’ plain ring gauge*. Diameter = maximum major diameter (external thread) – deviations given in Table 4.5

$$\text{Maximum} = 35.940 - 0.039 = 35.901 \text{ mm}$$

$$\text{Minimum} = 35.940 - 0.069 = 35.871 \text{ mm}$$

$$\text{Wear to } 35.940 - 0 = 35.940 \text{ mm}$$

- (b) *‘NOT GO’ plain calliper gauge*.

$$\text{Gap} = \text{minimum major diameter (external thread)} \pm \text{deviations given in Table 4.5}$$

$$\text{Maximum} = 35.465 + 0.015 = 35.480 \text{ mm}$$

$$\text{Minimum} = 35.465 - 0.015 = 35.450 \text{ mm}$$

C3 GAUGES FOR INTERNAL THREADS.

C3.1 General. The following examples of gauges for internal threads are calculated for an M36 \times 4 – 6H screw thread, assuming a normal length of axial thread engagement (see AS 1721).

M36 \times 4 – 6H screw thread limits:

Major diameter:

$$\text{Maximum } 36.000 \text{ mm}$$

Pitch diameter:

$$\text{Maximum } 33.702 \text{ mm}$$

$$\text{Minimum } 33.402 \text{ mm}$$

$$\text{Tolerance } 0.300 \text{ mm}$$

Minor diameter:

$$\text{Maximum } 32.270 \text{ mm}$$

$$\text{Minimum } 31.670 \text{ mm}$$

$$\text{Tolerance } 0.600 \text{ mm}$$

C3.2 ‘GO’ screw plug gauge (see Clause 4.5.2 and Table 4.6).

- (a) *Pitch diameter* = minimum pitch diameter (internal thread) \pm deviations given in Table 4.6

$$\text{Maximum} = 33.402 + 0.023 = 33.425 \text{ mm}$$

$$\text{Minimum} = 33.402 + 0.009 = 33.411 \text{ mm}$$

$$\text{Wear to } 33.402 - 0.005 = 33.397 \text{ mm}$$

- (b) *Major diameter* = minimum pitch diameter (internal thread) + $0.75H \pm$ deviations given in Table 4.6

$$\text{Maximum} = 33.402 + 2.598 + 0.030 = 36.030 \text{ mm}$$

$$\text{Minimum} = 33.402 + 2.598 + 0.002 = 36.002 \text{ mm}$$

NOTE: Values for $0.75H$ are given in Table 3.1.

- (c) *Minor diameter*: cleared as shown in Fig. 3.2.

C3.3 ‘NOT GO’ screw plug gauge (see Clause 4.5.3 and Table 4.7).

- (a) *Pitch diameter* = maximum pitch diameter (internal thread) \pm deviations given in Table 4.7

$$\text{Maximum} = 33.702 + 0.014 = 33.716 \text{ mm}$$

$$\text{Minimum} = 33.702 + 0 = 33.702 \text{ mm}$$

$$\text{Wear to } 33.702 - 0.008 = 33.694 \text{ mm}$$

- (b) *Major diameter* = maximum pitch diameter (internal thread) + $0.2P \pm$ deviations given in Table 4.7

$$\text{Maximum} = 33.702 + 0.800 + 0.021 = 34.523 \text{ mm}$$

$$\text{Minimum} = 33.702 + 0.800 - 0.007 = 34.495 \text{ mm}$$

- (c) *Minor diameter*: cleared as shown in Fig. 3.4.

C3.4 'GO' and 'NOT GO' plain plug gauges for checking the minor diameter (see Clause 4.5.4 and Table 4.8).

- (a) *'GO' gauge* = minimum minor diameter (internal thread) + deviations given in Table 4.8

$$\text{Maximum} = 31.670 + 0.046 = 31.716 \text{ mm}$$

$$\text{Minimum} = 31.670 + 0.030 = 31.700 \text{ mm}$$

$$\text{Wear to } 31.670 + 0 = 31.670 \text{ mm}$$

- (b) *'NOT GO' gauge* = maximum minor diameter (internal thread) \pm deviations given in Table 4.8

$$\text{Maximum} = 32.270 + 0.008 = 32.278 \text{ mm}$$

$$\text{Minimum} = 32.270 - 0.008 = 32.262 \text{ mm}$$

C4 DEVIATIONS FOR ERRORS IN PITCH AND FLANK ANGLES.

C4.1 General. The limiting values for the pitch diameter of all types of screw gauges given in the standard, and hence all the calculated values given in this Appendix, relate to the simple pitch diameter and do not include any effects of pitch or flank angle errors. In the metric screw thread gauging system, these are treated separately and are the same for all types of screw gauges.

C4.2 Pitch errors. For screw ring and screw plug gauges and associated check and setting plugs for an $M36 \times 4 - 6H/6g$ combination, assuming a normal length of axial thread engagement, the permissible deviations of pitch (for nominal) would be $\pm 5 \mu\text{m}$, i.e:

$$\text{Normal length of axial thread engagement} = 18 \text{ mm to } 53 \text{ mm (see AS 1721)}$$

$$\text{Mean length} = 35.5 \text{ mm}$$

$$\text{Axial length of 'GO' gauge} = 35.5 \times 0.8 = 28.4 \text{ mm (see Clause 3.2.3)}$$

$$\text{Permissible pitch deviation} = \pm 0.005 \text{ mm (see Clause 4.2 and Table 4.1)}$$

C4.3 Flank angle errors. For screw ring and screw plug gauges and associated check and setting plugs for an $M36 \times 4 - 6H/6g$ combination, the permissible deviation (from nominal) of the flank angles would be ± 10 minutes of arc (see Clause 4.3 and Table 4.2).

APPENDIX D
COMPARISON OF SYMBOLS USED IN THIS STANDARD,
ISO 1502 AND AS 1014—1971

Parameter	Symbol		
	This standard	ISO 1502	AS 1014—1971
Major diameter (product threads)			
Basic internal	D	D	D_n
Basic external	d	d	D_s
Pitch diameter (product thread)			
Basic internal	D_2	D_2	E_n
Basic external	d_2	d_2	E_s
Minor diameter (product thread)			
Basic internal	D_1	D_1	d_n
Basic external	d_1	d_1	d_s
Height of fundamental triangle	H	H	H
Pitch of thread	P	P	p
Fundamental deviation for pitch diameter (internal thread)	EI	EI	l_n
(general symbol) (external thread)	es	es	u_s
Pitch diameter tolerance (product thread)			
Internal thread	T_{D2}	T_{D2}	TE_n
External thread	T_{d2}	T_{d2}	TE_s
Major diameter tolerance (product thread)			
Internal thread	T_D	T_D	TD_n
External thread	T_d	T_d	TD_s
Minor diameter tolerance (product thread)			
Internal thread	T_{D1}	T_{D1}	Td_n
External thread	T_{d1}	T_{d1}	Td_s
Threads with truncated thread form			
Width of clearance grooves	$b_1 \ b_2 \ b_3$	$b_1 \ b_2 \ b_3$	$c_1 \ c_2 \ c_3$
Radial length of flank from pitch line to crest	F_1	F_1	a
Radial length of flank from pitch line to root	F_2	F_2	b
Pitch diameter tolerance (gauge thread)			
Ring gauges	T_R	T_R	TE_r
Plug gauges	T_{PL}	T_{PL}	TE_p
Check, plug and setting gauges	T_{CP}	T_{CP}	TE_c
Root radius (gauge thread)	$r_1 \ r_2$	$r_1 \ r_2$	$r_n \ r_s$
Tolerances for plain gauges			
Plug gauges	H_1	H_1	T_p
Ring and calliper gauges	H_2	H_2	T_r
Reference gauges for callipers	—	H_p	T_c
Deviations for pitch of thread	—	T_p	δ_p
Deviations for flank angle	—	$T\alpha, T\alpha_2$	$\delta\alpha$
Distance between centrelines of tolerance zones of GO and NOT GO solid screw ring gauges and associated GO check plugs	m	m	m
Distance between maximum material limit of product thread and centreline of solid GO screw ring gauge tolerance zone	Z_R	Z_R	Z_r
Distance between maximum material limit of product thread and centreline of GO screw plug gauge tolerance zone	Z_{PL}	Z_{PL}	Z_p
Wear allowance for GO screw plug and GO screw ring gauge	W_{GO}	W_{GO}	W_G

(continued)

APPENDIX D (*cont'd*)

Parameter	Symbol		
	This standard	ISO 1502	AS 1014—1971
Wear allowance for NOT GO screw plug and NOT GO screw ring gauge	W_{NG}	W_{NG}	W_{N}
Distance between major diameter maximum material limit and centreline of tolerance zone of plain GO calliper or ring gauge	Z_2	Z_2	Z_2
Distance between minor diameter maximum material limit and centreline of tolerance zone of plain GO plug gauge	Z_1	Z_1	Z_1
Axial displacement of clearance groove for threads with truncated form	s	s	—
Major diameter (gauge thread)			
Screw ring gauges	—	—	D_{r}
Screw plug gauges	—	—	D_{p}
Check, wear and setting plugs	—	—	D_{c}
Pitch diameter (gauge thread)			
Screw ring gauges	—	—	E_{r}
Screw plug gauges	—	—	E_{p}
Check, wear and setting plugs	—	—	E_{c}
Minor diameter (gauge thread)			
Screw ring gauges	—	—	d_{r}
Screw plug gauges	—	—	d_{p}
Check, wear and setting plugs	—	—	d_{c}

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