

Specification for

Screw gauge limits and tolerances —

**Part 3: Gauges for ISO metric screw
threads**

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Co-operating organizations

The Mechanical Engineering Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

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	National Coal Board
	National Physical Laboratory (Ministry of Technology)*
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The Government departments and the organization marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

British Bolt, Nut, Screw and Rivet Federation	Scientific Instrument Manufacturers' Association
Fasteners and Turned Parts Institute	Screw Thread Tool Manufacturers' Association
Gauge and Tool Makers' Association	Society of British Aerospace Companies Ltd.
Ministry of Defence, Navy Department	Society of Motor Manufacturers and Traders Ltd.

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Foreword

This British Standard has been prepared under the authority of the Mechanical Engineering Industry Standards Committee and is based on ISO Recommendation No. 1502, “ISO general purpose metric screw threads. Gauging”. The numerical values it contains are fully in accordance with those in the ISO Recommendation.

No recommendations for the inspection of product threads by measurement are given in this standard. This matter has still to be discussed by the ISO Screw Thread Committee and will be the subject of a further ISO Recommendation. For the time being it is recommended that the information concerning inspection of screw threads by measurement given in BS 919-1, “Gauges for screw threads of Unified form”, should be used.

NOTE Attention is drawn to the fact that, for reasons of economy, this standard provides for wear limits for some GO gauges which are outside those of the product thread.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 28, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of this British Standard contains the recommended gauging system for checking ISO metric screw threads of nominal diameters 1 mm and larger which have been made in accordance with BS 3643¹⁾.

Provision is made for the following types of gauges:

- 1) *Screw gauges*
 - a) GO and NOT GO screw plug gauges.
 - b) GO and NOT GO screw ring gauges, solid type.
 - c) GO and NOT GO screw ring gauges, adjustable type.
 - d) GO and NOT GO screw calliper gauges, adjustable type.
- 2) *Plain gauges*. GO and NOT GO plug gauges and GO and NOT GO calliper and ring gauges for the crest diameters of product threads.
- 3) *Setting plugs*. Setting plugs for GO and NOT GO adjustable screw ring gauges and for GO and NOT GO screw calliper gauges.
 - a) Double length.
 - b) Single length.
- 4) *Check plugs*. GO and NOT GO check plug gauges for solid type GO and NOT GO screw ring gauges.
- 5) *Wear check plugs*. NOT GO wear check plug gauges for solid type GO and NOT GO screw ring gauges.

Information is given about the functions and methods of use of the various types of gauges and a recommended procedure is given for the settlement of disputes which may arise when borderline products are inspected.

General design features of gauges are described and recommended tolerances on gauges are specified: the method of calculating the manufacturing limits of the gauges is outlined.

2 Nomenclature

For definitions of terms, reference should be made to BS 2517²⁾.

3 Function and method of use of the various types of gauges

3.1 Gauges for external screw threads

3.1.1 Solid or adjustable GO screw ring gauge. This gauge checks that the virtual pitch (effective) diameter of the product thread is not too large. The major and minor diameters of the product thread are not checked by this gauge. It must be possible to screw the gauge by hand, without using excessive force, over the complete length of the product thread.

3.1.2 Solid or adjustable NOT GO screw ring gauge. This gauge checks that the simple pitch (effective) diameter of the product thread is not too small. Ideally it should not be possible for the product thread to enter the gauge, but as external threads are often slightly tapered at the leading end it is permissible to allow entry provided that, on withdrawal, disengagement takes place within two full turns of thread. If the product has a length of thread of three turns or less the gauge should not screw completely on to the product thread. The gauge should be applied by hand without using excessive force.

3.1.3 Adjustable GO screw calliper gauge. This gauge is intended to check that the virtual pitch (effective) diameter of the product thread is not too large. The major and minor diameters of the product thread are not checked by this gauge. The gauge is generally applied to the product thread under its own weight or in accordance with a fixed working load at three positions at least evenly spaced around the circumference of the thread. The gauge must pass completely over the product thread at any of the positions at which it is applied.

3.1.4 Adjustable NOT GO screw calliper gauge. This gauge checks that the simple pitch (effective) diameter of the product thread is not too small. It is generally applied to the product thread under its own weight or under a fixed working load at three positions at least evenly spaced around the circumference of the thread. The gauge must not pass over the product thread except possibly for the first two turns of thread.

3.1.5 GO and NOT GO plain ring or calliper gauges. These gauges check that the major diameter of the product thread is between the specified limits. The gauges are applied to the product thread under the same conditions as the corresponding screw gauges.

¹⁾ BS 3643, "ISO metric screw threads".

²⁾ BS 2517, "Definitions for use in mechanical engineering".

3.1.6 Setting plugs (Double length) for adjustable GO and NOT GO screw ring gauges. These setting plugs are used to set the adjustable screw ring gauges to the specified pitch (effective) diameters. Each setting plug has a length of thread approximately equal to twice the length of the screw ring gauge to be controlled. The pitch (effective) diameter of the setting plug is constant throughout, but half the length of the setting plug has a full form thread and the remaining half has a truncated form of thread. The screw ring gauge is adjusted to be a snug fit on the full form portion of the setting plug. The setting plug is then unscrewed by hand, without using excessive force, through the screw ring gauge until the truncated portion of the setting plug completely engages the screw ring gauge. In the latter condition there shall be no perceptible shake or play between the setting plug and the screw ring gauge: shake or play is an indication of an unacceptable error of thread form of the adjustable screw ring gauge.

3.1.7 Setting plugs (single length) for adjustable GO and NOT GO screw calliper gauges. These setting plugs are used to set the adjustable screw calliper gauges. The setting plugs for the GO and NOT GO screw calliper gauges have full form threads. The screw calliper is adjusted so that it just passes over the appropriate setting plug under its own weight or under a fixed working load.

3.1.8 Screw check plugs for new solid GO and NOT GO screw ring gauges. These GO and NOT GO screw check plugs are used to check that the pitch (effective) diameters of the screw ring gauges are within the specified limits. It should be possible to screw the GO check plug by hand completely through the appropriate screw ring gauge. The NOT GO check plug when screwed by hand, without using excessive force, may be allowed to enter both ends of the screw ring gauge provided that on withdrawal, disengagement takes place within one full turn of thread.

When setting a new calliper gauge with the setting plugs recommended in **3.1.7**, an additional check should be made with the NOT GO check plug for the corresponding new screw ring gauge; this latter check may also be applied to a used calliper gauge to ensure that the thread form is not worn. The wear check plug for the screw ring gauge should not be used as a wear check plug for the calliper gauge.

3.1.9 Plain check plugs for new solid GO and NOT GO screw ring gauges. These GO and NOT GO check plugs are used to verify that the minor diameter of the screw ring gauge is between the specified limits. The GO check plug should assemble completely with the screw ring gauge. The NOT GO check plug may enter both ends of the screw ring gauge by not more than a distance of one turn.

3.1.10 NOT GO screw wear check plugs for used solid GO and NOT GO³⁾ screw ring gauges. These wear check plug gauges are used to check that the appropriate solid screw ring gauges have not worn beyond the specified limits of wear.

The wear check plug gauge, when screwed by hand, without using excessive force, may be allowed to enter both ends of the screw ring gauge provided that on withdrawal, disengagement takes place within one full turn of thread.

3.2 Gauges for internal screw threads

3.2.1 GO screw plug gauge. This gauge checks that the virtual pitch (effective) diameter and the major diameter of the product thread are not smaller than the minimum limits specified. It does not check the minimum minor diameter of the product thread. It must be possible to screw the GO screw plug gauge by hand, without using excessive force, into the complete length of the product thread.

3.2.2 NOT GO screw plug gauge. This gauge checks that the maximum simple pitch (effective) diameter of the product thread is not too large. Ideally it should not be possible for the gauge to enter the product thread but, as internal threads are often slightly bell-mouthed, it is permissible to allow entry provided that, on withdrawal, disengagement takes place within two full turns of thread. If the product has a length of thread of three turns or less, the gauge should not screw completely through the product thread. The gauge should be applied by hand without using excessive force.

3.2.3 GO and NOT GO plain plug gauges. These gauges check that the minor diameter of the product thread is between its specified limits. The GO plain plug gauge should assemble completely with the product thread. The NOT GO plain plug gauge may enter the product thread by not more than a distance of two full turns of the thread. If the product has a length of thread of three turns or less, the NOT GO gauge should not pass completely through the product thread.

³⁾ See footnote to Table 6.

3.3 Notes on gauging product threads. It is not necessary for all the different types of screw gauges described in 3.1 to be used for checking external threads on products, but it is essential for one of the types of GO screw gauges and one of the types of NOT GO screw gauges to be used.

For preference a solid or adjustable GO screw ring gauge should always be used for gauging the maximum effective diameter of an external thread, but to save time in checking, a GO screw calliper gauge may be employed. It is recommended that gauging with GO screw calliper gauges should be supplemented by random sampling with a GO screw ring gauge, thus giving greater assurance of not accepting parts outside the limits. In cases of dispute, gauging with the GO screw ring gauge is decisive. The GO screw calliper gauge should *not* be used if the manufacturing process is likely to introduce errors in the product thread which this gauge is not certain to detect, e.g. lobing, local pitch errors in milled threads and burrs at the start of the thread. Furthermore, the GO screw calliper gauge is not suitable for checking non-rigid, e.g. thin-walled, parts which would deform when the gauge is applied; in such cases checking must be carried out with a GO screw ring gauge.

For large screw threads (over about 100 mm diameter) the size to which the GO screw calliper gauge is set may be reduced to compensate for the effect of form errors that may occur in these threads; this procedure reduces the possibility of accepting screw threads that are outside the specified limits.

A NOT GO screw calliper gauge is generally recommended for checking the minimum pitch (effective) diameter of an external thread. The solid or adjustable NOT GO screw ring gauge should only be used to check non-rigid product threads, e.g. those on thin-walled parts which would deform if a NOT GO screw calliper were applied.

It is recommended that all solid screw ring gauges be inspected periodically for wear by means of the appropriate NOT GO wear check plugs, GO and NOT GO screw plug gauges should similarly be regularly checked by measurement. The thread profiles of all screw gauges should be inspected regularly for wear.

The above remarks concerning the precautions to be observed when using screw calliper gauges also apply to the use of plain calliper gauges for checking the major diameter of the product external thread.

4 Inspection procedures and the settlement of disputes

4.1 Inspection by the manufacturer. Generally speaking, where product threads are made and also checked at the manufacturer's works, his inspection department can use the same kind of gauges as the workshop. In order to avoid differences between the results obtained by the workshop and the inspection department, it is recommended that the workshop use new or only slightly worn GO gauges while the inspection department is provided with GO gauges the pitch (effective) diameter of which lies nearer the permissible wear limit. The reverse procedure should be adopted for NOT GO gauges.

In case of dispute, the product threads are regarded as satisfactory when the gauges with which they are checked and passed conform to the sizes specified for those gauges, including the permissible wear limits. This can be proved by measuring the gauges or by checking them with the check plugs specified.

NOTE In some special cases where it is essential to ensure that threads which may be outside the limits are not accepted and in the case of GO gauges used for sample inspection, gauges which have worn beyond the maximum metal limit of the product thread should not be used.

4.2 Inspection by the purchaser. There are three possible procedures for inspection on behalf of the purchaser by an inspector who is independent of the manufacturing plant concerned:

- 1) The inspector may gauge the product threads with the manufacturer's own gauges. In this case, he should check the accuracy of the ring or calliper gauges employed by means of check plugs and setting plugs which belong either to the manufacturer or to the inspector (purchaser). Screw plugs should be checked by direct measurement.
- 2) The inspector may use his own gauges made in accordance with this standard for gauging product threads. In this case, the remarks in 4.1 concerning checking during manufacture and the procedure for settling disputes apply.
- 3) The inspector may use his own inspection gauges for checking the product threads. The disposition of the tolerance zones for these gauges should be such as to ensure that the purchaser does not reject product threads the actual size (e.g. pitch diameter) of which lies within the limits specified for the product.

4.3 This standard does not specify which gauges are to be used but recommends that the purchaser inform the manufacturer when ordering what procedure will be employed for the inspection of the product threads.

5 Reference temperature

In accordance with ISO Recommendation R1⁴⁾, the sizes of both the gauge and the workpiece are related to the standard temperature of 20 °C.

If the workpieces and the gauges have the same thermal coefficient of expansion (e.g. steel workpieces and steel gauges), the checking temperature may deviate from 20 °C without detriment to the result, always provided that the temperatures of both gauges and workpieces are the same at the time of gauging.

If the workpieces and gauges have different thermal coefficients of expansion (e.g. steel workpieces and carbide gauges or brass workpieces and gauges of steel or carbide), the temperatures of both gauges and workpieces should, in principle, be close to 20 °C at the time of gauging.

6 General design features and tolerances of gauges

6.1 General dimensions of gauges. The general dimensions of gauges shall be in accordance with the recommendations of BS 1044⁵⁾, subject to any special requirements as indicated below. For normal purposes, the length of thread will be determined by the length of the gauge blank.

6.2 Thread profiles of screw gauges. The various types of screw gauges have full flank or truncated thread profiles. Nominal full flank profiles for screw plug, ring and calliper gauges are shown in Figure 2a and Figure 2b. The corresponding truncated thread profiles are shown in Figure 3a and Figure 3b.

Values for the maximum widths b_1 and b_2 of the clearance grooves shown on the full flank profiles in Figure 2a and Figure 2b are given in Table 1. It should be noted that no clearance grooves need be provided on full flank profiles provided the flanks are continued to clear width b_1 or b_2 as appropriate, and the root is radiused as shown. Maximum values for r_1 and r_2 are also given in Table 1. For fine pitches (below 1.25 mm on ring gauges and 0.6 mm on plug gauges) it is not practicable to provide separate clearance grooves.

The forms of the clearance grooves and crest truncations on the gauges with truncated profiles are shown in Figure 3a and Figure 3b. Values for F_1 , F_2 and b_3 are given in Table 2. The form of root clearance is optional but it must not be displaced in relation to the centre of the profile by more than the amount $S = 0.05p$.

Alternative forms of GO and NOT GO calliper gauge anvils for product threads having fine pitches are shown in Figure 4 and Figure 5.

6.3 Flank angle and pitch tolerances on screw gauges. Recommended flank angle tolerances for gauges having full flank threads and truncated threads respectively are given in Table 3.

Recommended pitch tolerances for gauges are given in Table 4.

6.4 Disposition of pitch (effective) diameter tolerance zones of gauges. The positions of the simple pitch (effective) diameter tolerance zones of the GO and NOT GO screw gauges, setting plugs and various check plugs are shown in relation to the pitch (effective) diameter limits of the product threads in Figure 6 to Figure 9 inclusive.

6.5 Diametral tolerances on screw gauges. Limits of tolerance (upper and lower deviations) for the simple pitch (effective) diameters of the various types of gauges are given in Table 5 to Table 7 inclusive.

Limits of tolerance for the crest diameters of the various types of gauges are given in Table 8 to Table 10 inclusive.

6.6 Tolerances on plain gauges

6.6.1 Limits of tolerance (upper and lower deviations) for GO and NOT GO plain calliper and ring gauges are given in Table 11, and for GO and NOT GO plain plug gauges in Table 12.

6.6.2 GO and NOT GO plain check plugs for the minor diameters of solid GO and NOT GO screw ring gauges. Recommended limits of tolerance for these plain check plugs are given in Table 8. These limits of tolerance are applied to the appropriate deviations for the minor diameter of the screw ring gauge.

6.7 Determination of gauge limits. Information needed for calculating the screw gauge limits is summarized in Table 13 to Table 17 inclusive.

6.8 Other general requirements

6.8.1 Hardness. A steel gauge should be hardened to the value most appropriate to its type, size and pitch and to the steel from which it is made. Experience has shown that if the hardness of steel gauges is kept within the range 650 HV to 800 HV (57 HRC to 62 HRC) the threads do not easily burr nor are they brittle.

Experience has also shown that the gauging surfaces of plain plug and calliper gauges should be hardened within the range 750 HV to 850 HV (61 HRC to 63 HRC).

⁴⁾ ISO/R1, "Standard reference temperature for industrial length measurements".

⁵⁾ BS 1044, "Gauge blanks".

6.8.2 Feather edges. To avoid feather edges on screw plug and ring gauges and setting plugs, the partial thread at both ends of the gauge shall normally be removed to a blunt start (see Figure 1). Not more than one complete turn of the thread shall be removed to the point where the full thread form is obtained.

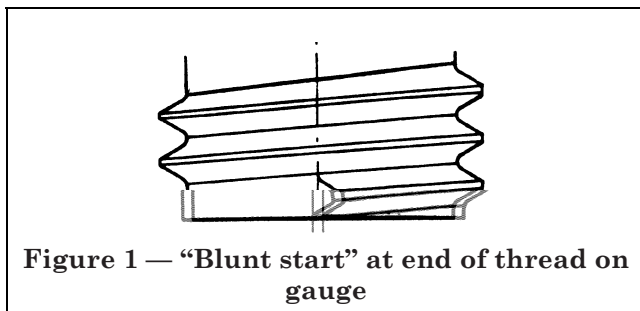


Figure 1 — “Blunt start” at end of thread on gauge

On screw ring gauges of 12 mm nominal size and smaller or with pitches of 1.25 mm and finer and on all screw plug gauges and setting plugs with pitches of 1 mm and finer, a 60° chamfer from the axis of the gauge is permitted in lieu of the removal of the partial thread.

On double length setting plugs with pitches of 1 mm and coarser, the feather edge shall be completely removed where the truncated portion meets the full form portion.

On screw plug gauges and setting plugs in sizes below 4 mm and/or with external core centres it is not considered necessary to remove the feather edge.

6.8.3 Dirt clearance grooves. When specified by the user, screw plug gauges shall have dirt clearance grooves cut axially to the thread to a depth slightly below the root of the thread. This groove should be cut at the position where the thread commences its full section as described in 6.8.2.

6.8.4 Removal of sharp edges. All undesirable sharp edges on the gauging portions and handles shall be removed.

7 Marking

Each gauge shall be plainly and permanently marked with the minimum marking essential for positive identification. In the case of plug gauges of the renewable end type, in addition to marking the handle, the marking shall also appear on the face of the gauging member where practicable.

Unless otherwise specified by the purchaser, the following particulars shall be included in the marking:

- 1) The designation of the corresponding product thread in accordance with the recommendations in BS 3643⁶⁾.

NOTE In the case of left-hand screw gauges, the symbol L.H. follows the designation.

- 2) The size of the gauge, i.e. the limiting size of the product thread which the gauge is intended to control.
- 3) GO or NOT GO.
- 4) SET in the case of setting plugs for adjustable screw ring or calliper gauges.
- 5) CHECK in the case of check plugs for solid screw rings or calliper gauges.
- 6) The manufacturer's name or trade mark.
- 7) A serial number if required for recording purposes.

⁶⁾ BS 3643, “ISO metric screw threads”.