

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 1502

ISO GENERAL PURPOSE METRIC SCREW THREADS

GAUGING

1st EDITION

June 1970

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BRIEF HISTORY

The ISO Recommendation R 1502, *ISO general purpose metric screw threads – Gauging*, was drawn up by Technical Committee ISO/TC 1, *Screw threads*, the Secretariat of which is held by the Sveriges Standardiseringskommission (SIS).

Work on this question led to the adoption of Draft ISO Recommendation No. 1502, which was circulated to all the ISO Member Bodies for enquiry in May 1968. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Austria	Israel	Romania
Belgium	Italy	South Africa, Rep. of
Chile	Japan	Spain
Czechoslovakia	Korea, Rep. of	Sweden
Denmark	Netherlands	Thailand
France	Norway	Turkey
Germany	Peru	U.A.R.
Hungary	Poland	United Kingdom
India	Portugal	

The following Member Bodies opposed the approval of the Draft :

Australia	Switzerland
Canada	U.S.A.
New Zealand	U.S.S.R.

This Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in June 1970, to accept it as an ISO RECOMMENDATION.

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ISO GENERAL PURPOSE METRIC SCREW THREADS

GAUGING

1. SCOPE

This ISO Recommendation contains the necessary instructions for the manufacture and use of gauges for checking ISO general purpose metric screw threads complying with ISO Recommendation R 68,* *ISO general purpose screw threads – Basic profile*, and R 261,* *ISO general purpose metric screw threads – General plan*.

It is recognized that other methods of checking may be used, for example measurement with indicating instruments. Checking with gauges in accordance with this ISO Recommendation is always decisive.

The aim of this ISO Recommendation is to provide means of distinguishing between workpiece threads that comply with the limits of size and those that do not.

In order to ensure the interchangeability of workpiece threads and to avoid disputes between manufacturer and purchaser, the following principles should be applied :

- (a) the manufacturer must not deliver any workpiece thread the actual thread size (e.g. pitch diameter and the virtual pitch diameter) of which lies outside the specified limits;
- (b) the purchaser must not reject any workpiece thread the actual thread size (e.g. pitch diameter and the virtual pitch diameter) of which lies inside the specified limits.

In order to satisfy these two principles, this ISO Recommendation establishes the requisite types and sizes of gauges for the checking of screw threads, the conditions under which these gauges are to be used and rules for the inspection of the workpiece threads.

2. TYPES OF GAUGES

This ISO Recommendation specifies the essential features of the types of gauges** listed in clauses 2.1 and 2.2 which are recommended for the checking of workpiece external and internal screw threads and for the setting and checking of certain of the screw gauges.

2.1 Gauges for workpiece external threads and their check plugs and setting plugs

- (a) Solid GO screw ring gauge.
- (b) Adjustable GO screw ring gauge.
- (c) Check plugs (GO and NOT GO) for new solid GO screw ring gauge.
- (d) Setting plug for adjustable GO screw ring gauge.
- (e) Wear check plug for solid or adjustable GO screw ring gauge.
- (f) GO screw calliper gauge.
- (g) Setting plug for GO screw calliper gauge.
- (h) NOT GO screw calliper gauge.
- (i) Setting plug for NOT GO screw calliper gauge.
- (j) Solid NOT GO screw ring gauge.
- (k) Adjustable NOT GO screw ring gauge.
- (l) Check plugs (GO and NOT GO) for new solid NOT GO screw ring gauge.
- (m) Setting plug for adjustable NOT GO screw ring gauge.
- (n) Wear check plug for solid or adjustable NOT GO screw ring gauge.
- (o) Plain gauges for major diameter (ring or calliper gauges).

* 2nd Edition – 1969.

** The GO and NOT GO gauges may be combined.

2.2 Gauges for workpiece internal threads

- (a) GO screw plug gauge.
- (b) NOT GO screw plug gauge.
- (c) Plain gauges for minor diameter (plug gauges).

3. GAUGING OF WORKPIECES

It is not necessary to use all the gauges mentioned in section 2 in the workshop or inspection department. However, in gauging the limits (checking that the tolerances have been respected), it is essential that a GO and NOT GO gauging always will be carried out with one of the GO screw gauges and one of the NOT GO screw gauges referred to above.

3.1 Gauging of external threads

A solid or adjustable GO screw ring gauge should preferably be used for gauging an external thread.

To save time, for convenience in checking, or in cases where the GO screw ring gauge is not applicable, a GO screw calliper gauge may be employed.

It is, however, recommended that a gauging with GO screw calliper gauges should be supplemented by random sampling with the GO screw ring gauge, so that when a large number of parts is checked with a GO screw calliper gauge, a certain percentage receives an additional check with a GO screw ring gauge, thus giving greater assurance of interchangeability between the workpiece threads.

The GO screw calliper gauge should not be used if the manufacturing process is likely to cause deviations in the workpiece thread, which this gauge is not certain to detect, for example local pitch errors in milled threads or burrs at the start of the thread. Further, the GO screw calliper gauge is not suitable for checking non-rigid parts, for example thin-walled parts which would be deformed by this gauge. In these cases, checking should be carried out with a GO screw ring gauge.

The NOT GO screw calliper gauge is used for checking the simple pitch diameter of the external thread on the NOT GO side.

The solid or adjustable NOT GO screw ring gauge should only be used for non-rigid workpieces, for example thin-walled parts, which would be deformed by checking with a NOT GO screw calliper gauge.

For gauging the major diameter of the workpiece external thread the plain GO and NOT GO gauges are used. Whether a calliper or ring gauge will be used is determined by the form and rigidity of the workpiece. Ring gauges should be used for non-rigid parts.

3.2 Gauging of internal threads

For the gauging of workpiece internal thread the GO screw plug gauge and NOT GO screw plug gauge are used.

For gauging the minor diameter of the workpiece internal thread the GO plain plug gauge and NOT GO plain plug gauge are used.

3.3 Inspection gauging

3.3.1 By the manufacturer. Generally speaking, the inspection department that checks the threads made in the workshop can use the same kind of gauges as are used in the workshop.

Disagreement between manufacturing and inspection can occur when products close to the limits of sizes are gauged.

When disputes do arise, it is recommended that the product shall be accepted if it is shown to be satisfactory by any gauge of the type concerned known to be within the requirements of this ISO Recommendation (taking into consideration the admissible wear).

In cases of dispute checking the ring gauges by check plugs is decisive, if there is no other agreement between manufacturer and purchaser.

NOTE. — The possibility of disputes can be reduced to a minimum by grading the gauges so that those used by manufacturers provide a more stringent check than those used by inspection. Generally, this can be achieved by issuing to the workshops new or only slightly worn GO gauges and slightly worn NOT GO gauges. Inspection should use GO gauges which are approaching the condition of maximum permissible wear and new NOT GO gauges.

3.3.2 *By the purchaser.* There are three possible procedures, as listed below, for inspection of workpiece threads on behalf of the purchaser by an inspector who does not belong to the manufacturing plant concerned.

(a) The inspector gauges the workpiece threads with the manufacturer's gauges.

In this case, he may check the accuracy of the gauges employed by means of check plugs and setting plugs which belong either to the manufacturing plant (manufacturer) or to the inspector (purchaser) or as far as screw plugs are concerned by direct measurement.

(b) The inspector uses his own gauges for gauging workpiece threads.

In cases of dispute it is recommended that the product shall be accepted if it is shown to be satisfactory by any gauge of the type concerned known to be within the requirements of this ISO Recommendation (taking into consideration the admissible wear).

(c) The inspector uses his own *inspection* gauges for gauging the workpiece threads.

The position of the tolerance zone for these gauges should be such as to ensure that the purchaser does not reject threads the actual size of which lies within the limits specified for the workpiece.

This ISO Recommendation does not specify which gauges are to be used by the inspector; it only recommends that the purchaser informs the manufacturer when ordering what procedure will be employed for the inspection of the workpiece threads. Worn gauges should not be used for sample inspection.

4. REFERENCE TEMPERATURE

In accordance with ISO Recommendation R 1, *Standard reference temperature for industrial length measurements*, the dimensions of both the gauge and the workpiece are related to a temperature of 20 °C.

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

If the workpieces and gauges have different coefficients of linear expansion (e.g. steel workpieces and carbide gauges or brass workpieces and gauges of steel or carbide), the temperature of both should be 20 ± 2 °C at the time of gauging. Otherwise the difference of the thermal expansion of the workpiece and of the gauge should be taken into consideration.

5. SYMBOLS AND EXPLANATIONS

In the following list the symbols mentioned in this ISO Recommendation are summarized and explained.

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 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)

Symbol	Explanation
F_1	For thread profiles with truncated flanks the radial distance between the pitch diameter line and the end of the straight part of the flank in the direction of the crest
F_2	For thread profiles with truncated flanks the radial distance between the pitch diameter line and the end of the straight part of the flank in the direction of the root
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 gauge and T_{CP} of the GO check plug
P	Pitch
s	Displacement of the clearance groove with truncated flanks
$T_{\alpha 1}$	Tolerance for the half flank angle of profiles with complete flanks
$T_{\alpha 2}$	Tolerance for the half flank angle of profiles 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_P	Tolerance for the pitch of the gauge 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}	Average amount available for the permissible wear of GO screw plug gauge and GO screw ring gauge
W_{NG}	Average 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

6. FUNCTION, CHECKING AND USE OF GAUGES

Throughout this section, the designations of paragraphs are as follows :

(a) = function; (b) = control; (c) = use.

6.1 Gauges for workpiece external threads and their check plugs and setting plugs

6.1.1 *Solid or adjustable GO screw ring gauge*

- (a) The GO screw ring gauge checks the virtual size of the external thread on the GO side (gauging the virtual pitch diameter), i.e. it checks the maximum material limit of the pitch diameter, taking into account deviations of form (departures from roundness, lack of straightness of the thread axis over the gauge length) and pitch errors, helix variations, errors in the flank angles, which produce an apparent enlargement of the pitch diameter (virtual pitch diameter) of the workpiece. In addition, this gauge checks whether the length of the straight flank is adequate, i.e. that the rounding at the root of the profile does not encroach too far upon the flank of the thread. The major diameter of the external thread is not checked by this gauge.

Checking with the GO screw ring gauge is essentially in accordance with the Taylor principle.

- (b) The solid GO screw ring gauge manufactured according to the prescribed sizes is checked by the GO and NOT GO screw check plugs and should regularly be controlled with the wear check plug.

If the NOT GO check plug is not used, other provisions must be made so as to ensure that the maximum size of the pitch diameter of the GO screw ring gauge is not exceeded.

The adjustable GO screw ring gauge is set to its setting plug and should regularly be controlled with the wear check plug.

- (c) The GO screw ring gauge screwed by hand, without using excessive force, should pass over the whole length of the workpiece thread. If this is not possible, the workpiece thread does not comply with the specifications.

6.1.2 *Screw check plugs for new solid GO screw ring gauge*

- (a) These screw check plugs (GO and NOT GO) are used to check the limits of the pitch diameter of the new solid GO screw ring gauge. The GO screw check plug checks the GO limit of the total profile of the appropriate new solid GO screw ring gauge.

- (c) The GO screw check plug screwed by hand, without using excessive force, should pass through the new solid GO screw ring gauge.

The NOT GO screw check plug screwed by hand, without using excessive force, may enter into both ends of the new solid GO screw ring gauge, but not more than one turn of thread*.

6.1.3 *Setting plug for adjustable GO screw ring gauge*

- (a) The setting plug which contains two successive portions, one with complete flanks and the other with truncated flanks, is used to set the adjustable GO screw ring gauge to the specified pitch diameter.

It is not essential to use a double length setting plug if the GO screw ring gauge is checked with a NOT GO screw check plug (clause 6.1.2) after it has been adjusted.

- (b) The GO screw ring gauge is set on the portion of the setting plug with complete flanks.

- (c) The portion with complete flanks screwed by hand, without using excessive force, should pass through the GO screw ring gauge.

When the portion with truncated flanks of the setting plug is screwed through the screw ring gauge, no perceptible clearance is permissible between the plug and the ring. If there is a clearance, the ring gauge should be lapped and adjusted to correct form and size.

* The one turn of thread is determined when withdrawing the check plug.

6.1.4 Wear check plug for solid or adjustable GO screw ring gauge

- (a) The wear check plug is used to ascertain that the pitch diameter of the GO screw ring gauges has not exceeded the wear limit. It embodies the pitch diameter of the GO screw ring gauge at the prescribed limit of wear.

- (c) The wear check plug screwed by hand, without using excessive force, may enter into both ends of the GO screw ring gauge, but not more than one turn of thread*.

If it can be screwed in more than one turn of thread, the GO screw ring gauge no longer meets the specifications.

6.1.5 GO screw calliper gauge

- (a) This gauge checks the maximum limit of the pitch diameter in an axial plane, as apparently increased by errors of pitch and flank angle in the workpiece. Furthermore it checks whether the length of the straight flank is adequate, for example that the rounding of the root of the profile does not encroach too far upon the flank of the thread. The major diameter of the external thread, however, is not checked.

With regard to the embodiment of the virtual pitch diameter, the GO screw calliper gauge seriously violates the Taylor principle (periodic errors of pitch and deviations of form, such as departures from roundness are not detected).

- (b) The GO screw calliper gauge should be set with the setting plug specified.

- (c) Workpiece threads are generally checked by the GO screw calliper gauge under its own weight or in accordance with a fixed working load to correspond with the method of adjustment of the gauge.

The GO screw calliper gauge should accept the workpiece thread at least at three positions, evenly distributed over the whole circumference of the thread. If this is not possible, the workpiece thread does not comply with the specification.

When put on the workpiece the GO screw calliper gauge may be moved slightly to and fro in a circumferential direction in order to minimise the effects of friction.

In cases of dispute, gauging with the GO screw ring gauge, preferably solid type, is decisive.

6.1.6 Setting plug for GO screw calliper gauge

- (a) With this setting plug the anvils of the GO calliper gauge are set.

- (c) The GO screw calliper gauge should pass over the setting plug under its own weight or under a fixed working load. If this is not possible or if there is a clearance, the anvils of the GO screw calliper must be adjusted.

When put on the setting plug, the GO screw calliper gauge may be moved slightly to and fro in a circumferential direction.

6.1.7 NOT GO screw calliper gauge

- (a) The NOT GO screw calliper gauge checks the minimum limit of the pitch diameter. It operates very largely in accordance with the Taylor principle.

- (b) The NOT GO screw calliper gauge should be set with the setting plug specified.

- (c) The NOT GO screw calliper gauge should not pass over the workpiece, except for the first two threads of the workpiece thread. The checking should be carried out under the same conditions as the adjustment by means of the setting plug; it should take place in at least three positions, evenly distributed over the circumference.

If the gauge corresponds to Figure 10 (b) each gauging should be repeated by displacing the gauge from one pitch to the other.

* The one turn of thread is determined when withdrawing the check plug.

6.1.8 *Setting plug for NOT GO screw calliper gauge*

- (a) With this setting plug the anvils of the NOT GO calliper gauge are set.
- (c) The NOT GO screw calliper gauge should pass over the setting plug under its own weight or under a fixed load. If it is not possible or if there is a clearance, the NOT GO screw calliper gauge anvils must be adjusted.

When put on the setting plug, the NOT GO screw calliper gauge may be moved slightly to and fro in a circumferential direction.

6.1.9 *Solid or adjustable NOT GO screw ring gauge*

- (a) The NOT GO screw ring gauge is intended to check whether the actual pitch diameter exceeds the specified minimum size. The checking with the NOT GO screw ring gauge does not correspond to the Taylor principle when checking rigid workpieces. In cases of non-rigid workpieces, the departure from the Taylor principle is of less importance because of the flexibility of the workpieces.

- (b) The solid NOT GO screw ring gauge manufactured according to the prescribed sizes will be checked by the GO and NOT GO screw check plugs and should regularly be controlled with the wear check plug.

If the NOT GO check plug is not used, other provisions must be made to ensure that the maximum limit of the pitch diameter of the new NOT GO screw ring gauge is not exceeded.

The adjustable NOT GO screw ring gauge should be set with the setting plug specified and regularly controlled with the wear check plug.

- (c) The NOT GO screw ring gauge, screwed by hand without using excessive force on the workpiece thread, may enter on both sides but not more than two turns of thread*. If the gauge can be screwed on the workpiece more than two turns of thread, the thread does not comply with the specifications. The NOT GO screw ring gauge should not pass completely over a workpiece having a length of thread of three threads or less.

6.1.10 *Screw check plugs for new solid NOT GO screw ring gauge*

- (a) The check plugs (GO and NOT GO) are used to check the pitch diameter limits of the new solid NOT GO screw ring gauge. The GO screw check plug makes sure that the clearing diameter of the new NOT GO solid screw ring gauge is not too small.

If a wear check plug for the NOT GO screw ring gauge is provided, the NOT GO check plug may be cancelled.

- (c) The GO screw check plug screwed by hand, without using excessive force, should pass through the corresponding new solid NOT GO screw ring gauge.

The NOT GO check plug gauge screwed by hand, without using excessive force, may enter the new solid NOT GO screw ring gauge at both ends but not more than one turn of thread**.

6.1.11 *Setting plug for adjustable NOT GO screw ring gauge*

- (a) The setting plug which contains two successive portions, one with complete flanks and the other with truncated flanks, is used to set the adjustable NOT GO screw ring gauge to the specified pitch diameter.

It is not essential to use a double length setting plug if the NOT GO screw ring gauge is checked with a NOT GO screw check plug described in clause 6.1.10 after it has been adjusted.

- (b) The NOT GO screw ring gauge is set on the portion of the setting plug with complete flanks.

- (c) The portion with complete flanks screwed by hand without using excessive force, should pass through the screw ring gauge.

When the portion with truncated flanks of the setting plug is screwed through the ring gauge, no perceptible clearance is permissible between the plug and the ring. If there is a clearance the ring gauge should be lapped and adjusted to correct form and size.

* The two turns of thread are determined when withdrawing the gauge.

** The one turn of thread is determined when withdrawing the check plug.