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Aerospace — MJ threads — Gauging

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 10959 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 4, *Aerospace fastener systems*.

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Introduction

The purpose of this International Standard, which differs from ISO 1502, is to take into account the basic characteristics of the ISO MJ threads (restricted form variation and increased root radius of the external thread) as well as the specific tolerances and to standardize the gauging principles for ISO MJ threads, intended for products for aerospace applications.

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Aerospace — MJ threads — Gauging

1 Scope

This International Standard contains information for the gauging of ISO MJ threads in accordance with ISO 5855-1, ISO 5855-2 and ISO 5855-3.

Other methods of ensuring that the product is within the specified limits may be used provided correlation with the specified gauges is established [see 8.2 e)].

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 1:1975, *Standard reference temperature for industrial length measurements*.

ISO 1502:1996, *ISO general-purpose metric screw threads — Gauges and gauging*.

ISO 5408:1983, *Cylindrical screw threads — Vocabulary*.

ISO 5855-1:1999, *Aerospace — MJ threads — Part 1: General requirements*.

ISO 5855-2:1999, *Aerospace — MJ threads — Part 2: Limit dimensions for bolts and nuts*.

ISO 5855-3:1999, *Aerospace — MJ threads — Part 3: Limit dimensions for fittings for fluid systems*.

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 5408 and the following apply.

3.1

best wire size

cylinder or sphere which has a radius so that it will contact the thread flanks at the pitch cylinder intersection

NOTE The radius of the best wire or sphere is theoretically equal to $0,288\ 68\ P$.

3.2

indicating gauge

device having contacts which will precisely compare the size of a work piece thread to a setting standard of known dimensions

NOTE The value for the indicated characteristic thus established is the dimensional value attributed to the work piece. An indicating gauge may have contacts designed to measure any thread characteristic. This International Standard specifies the characteristics and designs for ISO MJ threads.

3.3

simple pitch diameter

diameter of an imaginary cylinder intersecting an actual thread over the width of one groove where that width is equal to one half of the basic pitch.

3.4

virtual pitch diameter

pitch diameter of the smallest (for external threads) or largest (for internal threads) perfect thread form with GO gauge profile which can engage the product threads for a distance equal to the GO gauge thread engagement

4 Types of gauges

4.1 Gauges and setting plugs for external product threads

	Gauge type	Reference
a)	GO screw ring gauges	6.1.2
b)	Setting plug for adjustable GO screw ring and indicating thread gauges	7.1
c)	Virtual pitch diameter indicating thread gauges	6.1.1
d)	Simple pitch diameter indicating thread gauges	6.1.3
e)	Flat contact gauges for major diameter	6.1.4
f)	Point contact indicating thread gauges for minor diameter	6.1.5
g)	Optical comparator for root radius and minor diameter	6.1.6

4.2 Gauges for internal product threads

	Gauge type	Reference
a)	GO screw plug gauges	6.2.1
b)	NOT GO screw plug gauges	6.2.2
c)	Plain gauges for minor diameter (plug gauge)	6.2.3
d)	GO full form screw plug gauges	6.2.3.2
e)	Virtual pitch diameter indicating thread gauges	6.2.4
f)	Simple pitch diameter indicating thread gauges	6.2.5

5 Reference temperature

In accordance with ISO 1, the dimensions of the gauge and the product shall be checked at the temperature of 20 °C.

If the product and the gauge have the same coefficients of linear expansion the temperature may deviate from 20 °C provided the temperature of the product and the gauge are the same.

If the product and the gauge have different coefficients of linear expansion the temperature of both, at the time of gauging, shall be:

- a) $20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for sizes MJ24 and smaller;
- b) $20\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$ for larger threads.

6 Function, design and use of gauges

6.1 Gauges for external threads

6.1.1 Virtual pitch diameter indicating thread gauges

6.1.1.1 It measures, on two or three segments or rolls, the maximum material virtual pitch diameter taking into account variations of form such as pitch variation, helix and flank variations, roundness and taper which produces an enlargement of the virtual pitch diameter. In addition, virtual pitch diameter control ensures the flank angle contact is sufficient to assure that the root radius does not exceed the maximum limit. Measurement of virtual pitch diameter with indicating gauges shall be obtained to calculate virtual-minus-simple pitch-diameter differential unless the simple pitch diameter limits, gauged in accordance with 6.1.3, are within the limits defined by the maximum pitch diameter and the form variation limits in ISO 5855-1.

6.1.1.2 Indicating gauges have two or three contacts at 180° or 120° respectively. Gauges with segments or rolls are designed with the length of the GO virtual maximum material gauging elements equal to the GO ring gauge length (see Table 1). For configuration and profile requirements see Figure 1.

6.1.1.3 The minor diameter of the GO virtual maximum material thread segments and the diameter of the circle surrounded by the roll cluster of GO virtual maximum material rolls shall be equal to the pitch diameter of the product minus $0,375H$, less the T_{PL} minus tolerance when assembled in the gauge frame, where T_{PL} is specified in ISO 1502. This corresponds to a flat width of $0,3125P$ on the minor crest for the thread. The crest shall be flat in an axial plane and parallel to the axis of the segments or rolls.

6.1.1.4 The major diameter of the GO virtual maximum material segments and the root of the GO virtual maximum material rolls shall be cleared beyond a $0,125P$ flat either by an extension of the flanks of the thread toward a sharp vee or by an undercut no greater than $0,125P$ maximum width and approximately central. The root clearance shall be such that the major diameter of the full form section of the thread setting plug gauge is cleared after the assembled gauge has been properly set to size. Optional clearance specifications given in ISO 1502 may be used.

6.1.1.5 The simple pitch diameter cylinder axis of threaded segments and rolls shall be straight within the diameter tolerance zone equal to T_{PL} specified in ISO 1502. The segment or roll thread profile, lead, pitch, and the half-angle variations shall be within the limits specified in ISO 1502.

6.1.2 Solid or adjustable GO screw ring gauges

To ensure the ease of assembly of product threads and conformance to the maximum material virtual pitch diameter limits, GO screw ring gauges with thread form in accordance with Figure 1 and setting gauges in accordance with 6.1 may be used. Solid GO screw ring gauges shall not be permitted to exceed the product thread dimensional limits. The gauge thickness / length shall be standardized as shown in Table 1. The gauge tolerances W_{GO} shall be in accordance with ISO 1502.

6.1.3 Simple pitch diameter indicating thread gauges

The simple pitch diameter indicating gauge with cone and vee rolls or segments or rolls with the best wire size radius allows to insure that the pitch diameter is greater than the minimum limit. The indicators are set to the GO threaded setting plug gauge. Readings indicate the position of the pitch diameter and the minimum measurement shall be no less than the minimum pitch diameter limit. The minimum measured pitch diameter shall be within the ISO 5855-1 form variation limit compared to the virtual pitch diameter measurement in accordance with 6.1.1, i.e. the differential value.

The simple pitch diameter contacts have cone and vee rolls or segments which contact the product pitch cylinder. Other designs have two or three rolls with radii on annular ribs on rolls made to best wire size. The product thread contacts is restricted to 1,5 pitch lengths. See Figures 2 and 3 for design and contact form.

6.1.4 Major diameter gauges

The maximum limit of the major diameter may be checked with a plain ring gauge, a plain GO calliper, or plain diameter measuring device, see Figure 4. The minimum limit of the major diameter shall be measured with a plain diameter measuring device set to a plain diameter plug with H_P tolerance in accordance with ISO 1502. Plain micrometer calliper may be used to measure the major diameter and may have standard gauge block settings.

6.1.5 Minor diameter gauges

It shall be set to the plain minor diameter setting plug with H_P tolerance in accordance with ISO 1502. See Figure 5 for design and contact form.

6.1.6 Optical comparator checks

The optical comparator shall be used to verify the root radius by comparing the shadow contour to the radius charts. The minor diameter may also be measured with an optical comparator using appropriate measuring techniques.

6.2 Gauging for internal threads

6.2.1 GO screw plug gauges

To ensure ease of assembly of threads and conformance to the maximum material virtual pitch and major diameter limits, GO screw plug gauges specified in ISO 1502 or the full form GO screw plug gauge in accordance with 6.2.3.2 shall be used.

6.2.2 NOT GO screw plug gauges

To check that the minimum virtual pitch diameter is not greater than the maximum limit, NOT GO screw plug gauges specified in ISO 1502 shall be used.

6.2.3 Minor diameter gauges

6.2.3.1 The minimum minor diameter may be evaluated by a plain cylindrical GO plug gauge per ISO 1502 or a GO full form screw plug gauge in accordance with 6.2.3.2. The maximum minor diameter may be checked with a plain cylindrical NOT GO plug per ISO 1502. The diameters of the plain plugs shall be based on the minimum minor diameter specified in ISO 5855-1, ISO 5855-2 or ISO 5855-3 with gauge tolerance H_1 specified in ISO 1502. Internal micrometer callipers may be used to measure the minor diameter.

6.2.3.2 The GO full form screw plug gauge shall be a modified GO screw plug gauge specified in ISO 1502 with a controlled root radius on the gauge, see Figure 6, equal to the maximum external thread root radius specified in ISO 5855-1, ISO 5855-2 or ISO 5855-3 with a radius tolerance in accordance with Table 2.

6.2.4 Virtual pitch diameter indicating thread gauges

6.2.4.1 It measures, on two or three segments or rolls, the maximum material virtual pitch diameter taking into account variations of form such as pitch variation, helix and flank variations, roundness and taper which produces a decrease in the virtual pitch diameter. The virtual pitch diameter shall be measured using indicating gauges to calculate the virtual-minus-simple pitch-diameter differential unless the simple pitch diameter limits are within the limits defined by the minimum pitch diameter and the form variation limits in ISO 5855-1, ISO 5855-2 and ISO 5855-3.

6.2.4.2 Indicating gauges have two or three contacts at 180° or 120° respectively. Gauges with segments or rolls are designed with the length of the GO virtual maximum material gauging elements equal to the GO plug gauge length equal to nine pitches (P) or the basic major diameter of the thread, whichever is the smallest. For configuration and profile requirements see Figure 7.

6.2.5 Simple pitch diameter indicating thread gauges

The simple pitch diameter indicating thread gauge with cone and vee rolls or segments or rolls with the best wire size radius allows to insure that the pitch diameter is not greater than the maximum limit. The indicators are set to the GO threaded ring gauge. Readings indicate the position of the pitch diameter and the maximum measurement shall be no greater than the maximum pitch diameter limit. The maximum measured pitch diameter shall be within the ISO 5855-1, ISO 5855-2 and ISO 5855-3 form variation limit compared to the virtual pitch diameter measurement made in accordance with 6.2.4.1.

The simple pitch diameter contacts have cone and vee rolls or segments which contact the product pitch cylinder. Other designs have two or three rolls with radii on annular ribs on rolls made to best wire size. The product thread contacts is restricted to 1,5 pitch lengths. See Figures 7, 8 and 9 for design and contact form.

7 Setting gauges

7.1 The virtual pitch diameter indicating gauge is set to the threaded setting plug whose average simple pitch diameter, see Figure 10, is below basic size by the value m specified in Table 4 of ISO 1502:1996. The m factor adjusts the size of the setting plug so as to correct for the potential diametrical equivalents of the average variation which would be expected in the pitch and flank angles of the plug for adjustable GO screw ring gauges.

7.2 Set and check the GO screw ring gauge as specified in ISO 1502. Check the GO screw plug gauge as specified in ISO 1502.

7.3 Set the simple pitch diameter indicating gauge to the calibrated or marked pitch diameter setting plug gauge. These gauges are the same setting gauges as described in 7.1 to permit differential measurement calculations.

7.4 Set the major and minor diameter indicating gauges to their respective plain setting plugs. The diameter of these plain setting plugs shall be made to the maximum dimension with a negative tolerance of H_P in accordance with ISO 1502, see Figures 11 and 12. The micrometer callipers may have standard gauge block settings.

8 Gauging of threads

8.1 Gauges with a wear allowance, such as permitted in ISO 1502, which allows gauges to exceed the maximum or minimum limits of the product thread, are not permitted for MJ threads.

A product thread characteristic is acceptable when any appropriate standardized gauge can be assembled. The manufacturer is responsible for ensuring that, whatever the case, the means ultimately assures characteristics in accordance with the envelope requirements (see annex A, normative).

8.2 External threads shall be as follows:

- a) check the virtual pitch diameter by measurement using either an indicating gauge or an assembly with a GO threaded ring gauge;
- b) measure the simple pitch diameter with an indicating gauge;
- c) compare the difference between the virtual and simple pitch diameter measurements to evaluate the cumulative effect of variations defined in ISO 5855-1;
- d) evaluate the thread minor and major diameters and root contour;
- e) normally, the use of more than one gauge option is not required. A product thread characteristic is accepted if it satisfies any one appropriate standard gauge. However, if there is a conflict between gauges for the product external thread maximum material limit, the product thread shall be accepted as long as the thread satisfies the GO thread ring gauge. Wear check plugs shall not exceed the basic profile.

8.3 Internal threads shall be evaluated as follows:

- check the maximum material limit of the virtual pitch diameter as well as the minimum major diameter with a GO screw plug gauge in accordance with ISO 1502. A full form screw plug gauge may be used for this check;
- measure the virtual pitch diameter with an indicating gauge. This requirement is optional for thread sizes less than 5 mm;
- check the minimum material pitch diameter with a NOT GO screw plug gauge. Measuring the simple pitch diameter with an indicating gauge is, except for thread sizes less than 5 mm, also required;
- check the minimum minor diameter with either a GO plain plug gauge or GO full form screw plug gauge. Use a NOT GO plain plug gauge to check the maximum minor diameter.

Table 1 — GO gauge thickness (length)

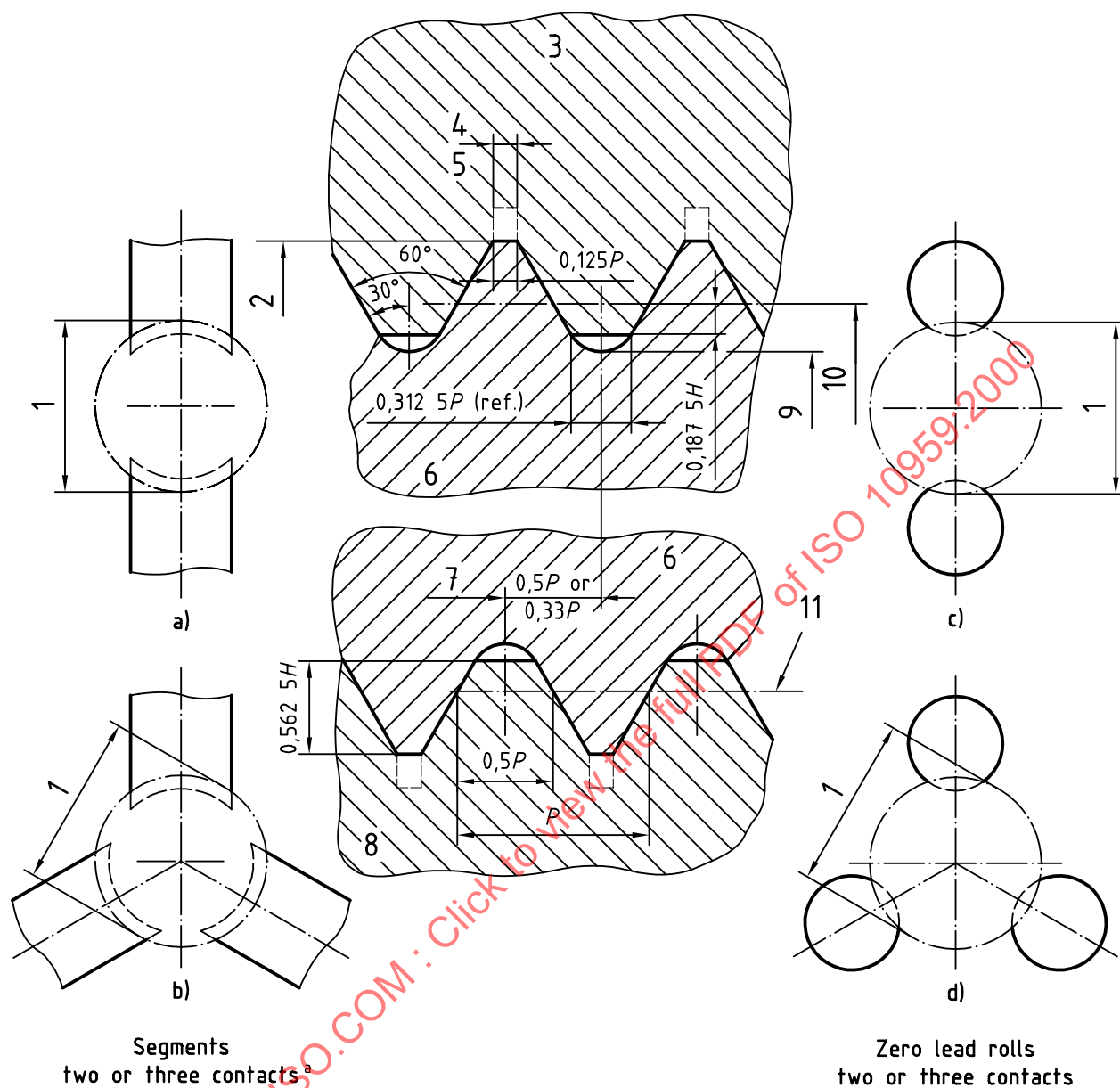
Thread size	Gauge length ^a mm	Thread size	Gauge length ^a mm
MJ1,6 × 0,35	1,6	MJ14 × 1,5	13,5
MJ2 × 0,4	2	MJ16 × 1,5	13,5
MJ2,5 × 0,45	2,5	MJ18 × 1,5	
MJ3 × 0,5	3	MJ20 × 1,5	
MJ3,5 × 0,6	3,5	MJ22 × 1,5	
MJ4 × 0,7	4	MJ24 × 2	18
MJ5 × 0,8	5	MJ27 × 2	
MJ6 × 1	6	MJ30 × 2	
MJ7 × 1	7	MJ33 × 2	
MJ8 × 1	8	MJ36 × 2	
MJ10 × 1,25	10	MJ39 × 2	
MJ12 × 1,25	11,25		

^a Gauge thickness: for diameter / pitch combinations not listed in this table, the gauge thickness is equal to nine pitches (*P*) or the basic major diameter (*D*, *d*) of the thread, whichever is the smallest.

Table 2 — Tolerance for GO full form screw plug gauge

Nominal thread pitch	Radius tolerance ^a + μm	Nominal thread pitch	Radius tolerance ^a + μm
0,35	6	0,7	13
0,4	7	0,8	14
0,45	8	1	18
0,5	9	1,25	23
0,6	11	1,5 to 2	25

^a Gauge thickness: for thread pitches not listed in this table, the radius tolerance shall be based on 0,5 of the root radius (*R*) tolerance for the external thread.

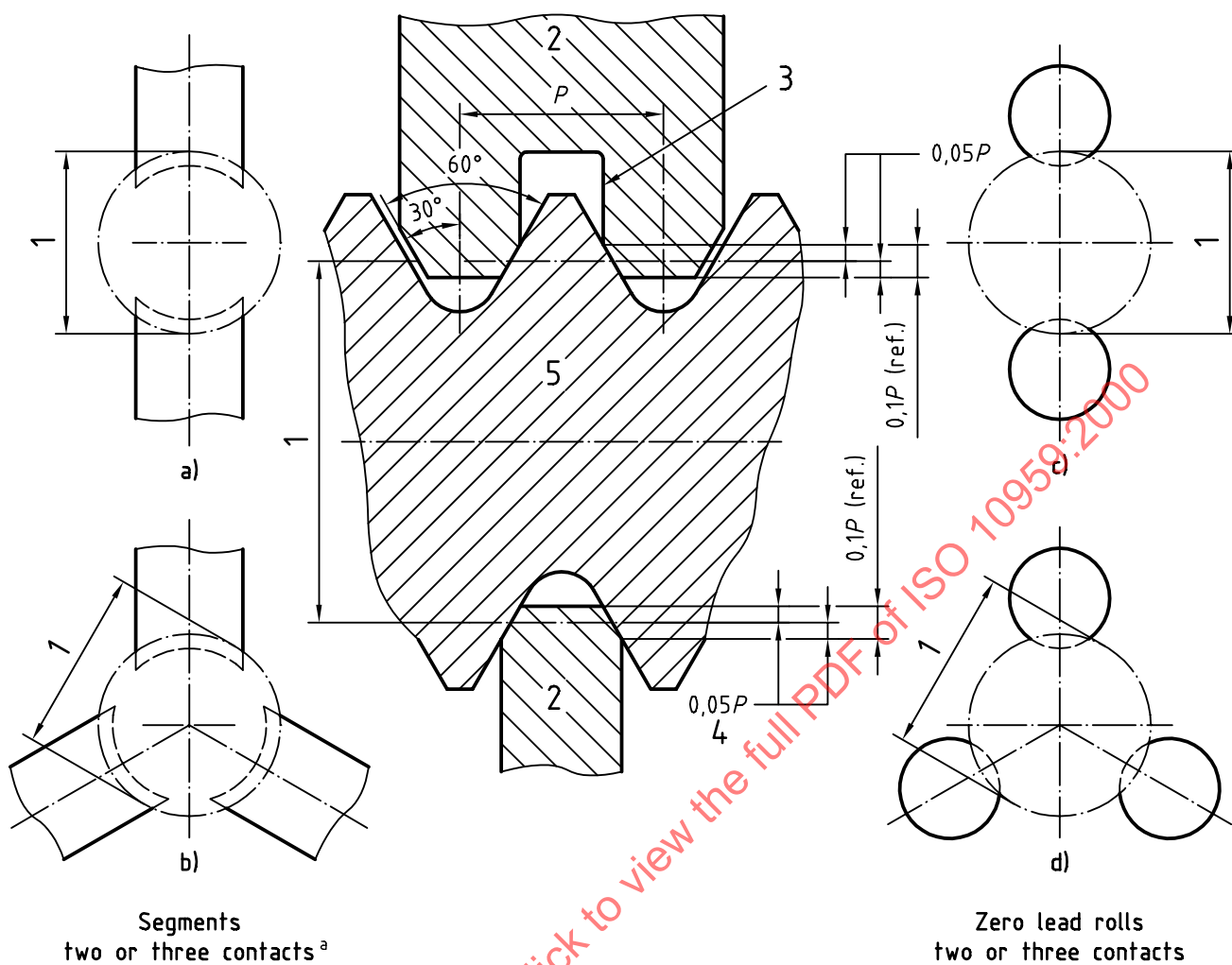


Key

- | | |
|---|--|
| 1 Pitch diameter | 6 Maximum product external thread |
| 2 Maximum major diameter of product external thread | 7 For two or three contacts respectively |
| 3 Gauge thread form | 8 Form of segment or roll |
| 4 Clear 0,125P when not undercut | 9 Maximum minor diameter of product external thread |
| 5 Form of relief optional — Width approximately central when undercut | 10 Maximum pitch diameter of product external thread |
| | 11 Pitch cylinder |

^a The total segment contact to be a minimum of 25 % of circumference.

Figure 1 — Virtual pitch diameter indicating thread gauges for external threads



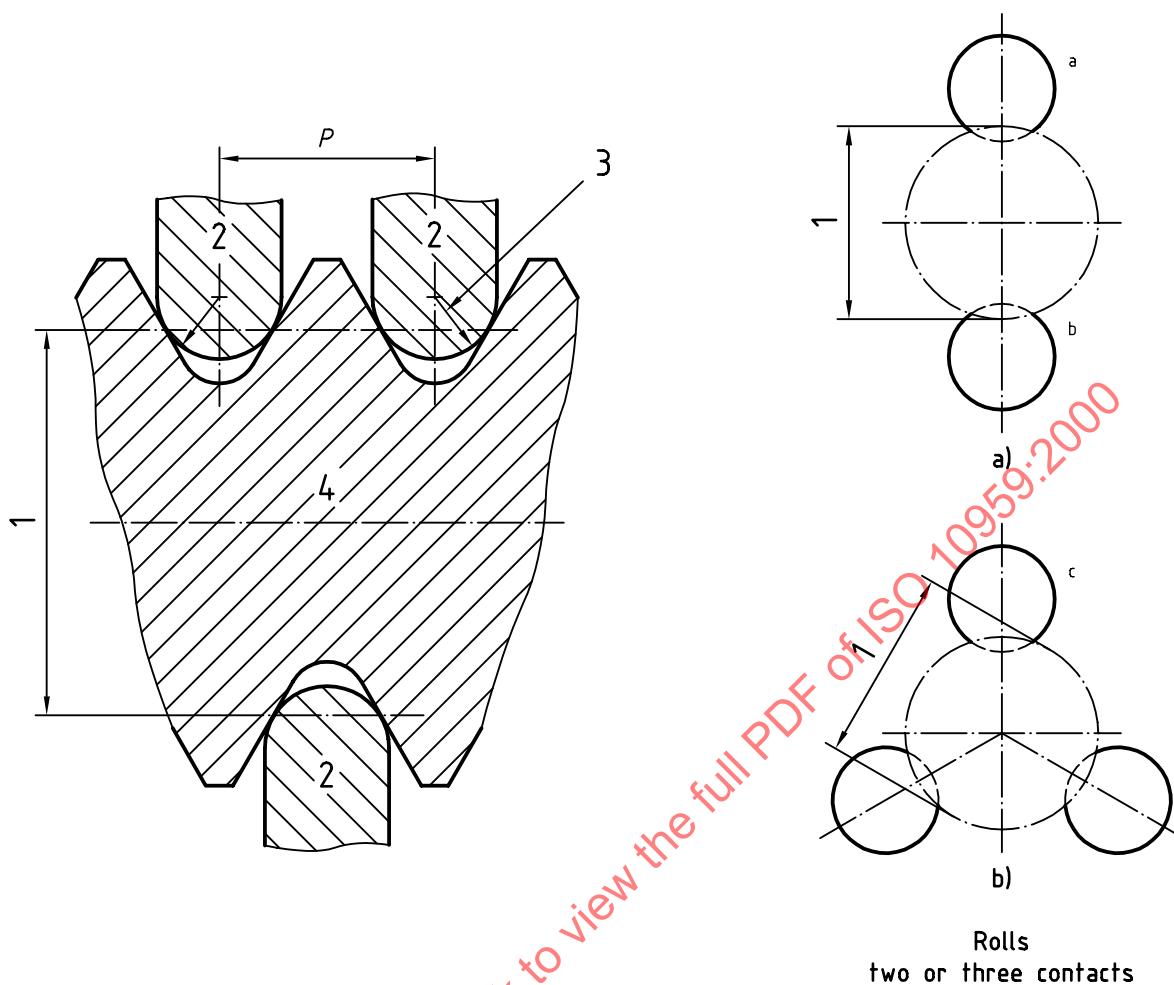
Key

- 1 Pitch diameter
- 2 Gauging element

- 3 Form of relief optional
- 4 Contact central on pitch line
- 5 External thread

a The total segment contact to be a minimum of 25 % of circumference.

Figure 2 — Simple pitch diameter indicating thread gauges with cone and vee for external threads

**Key**

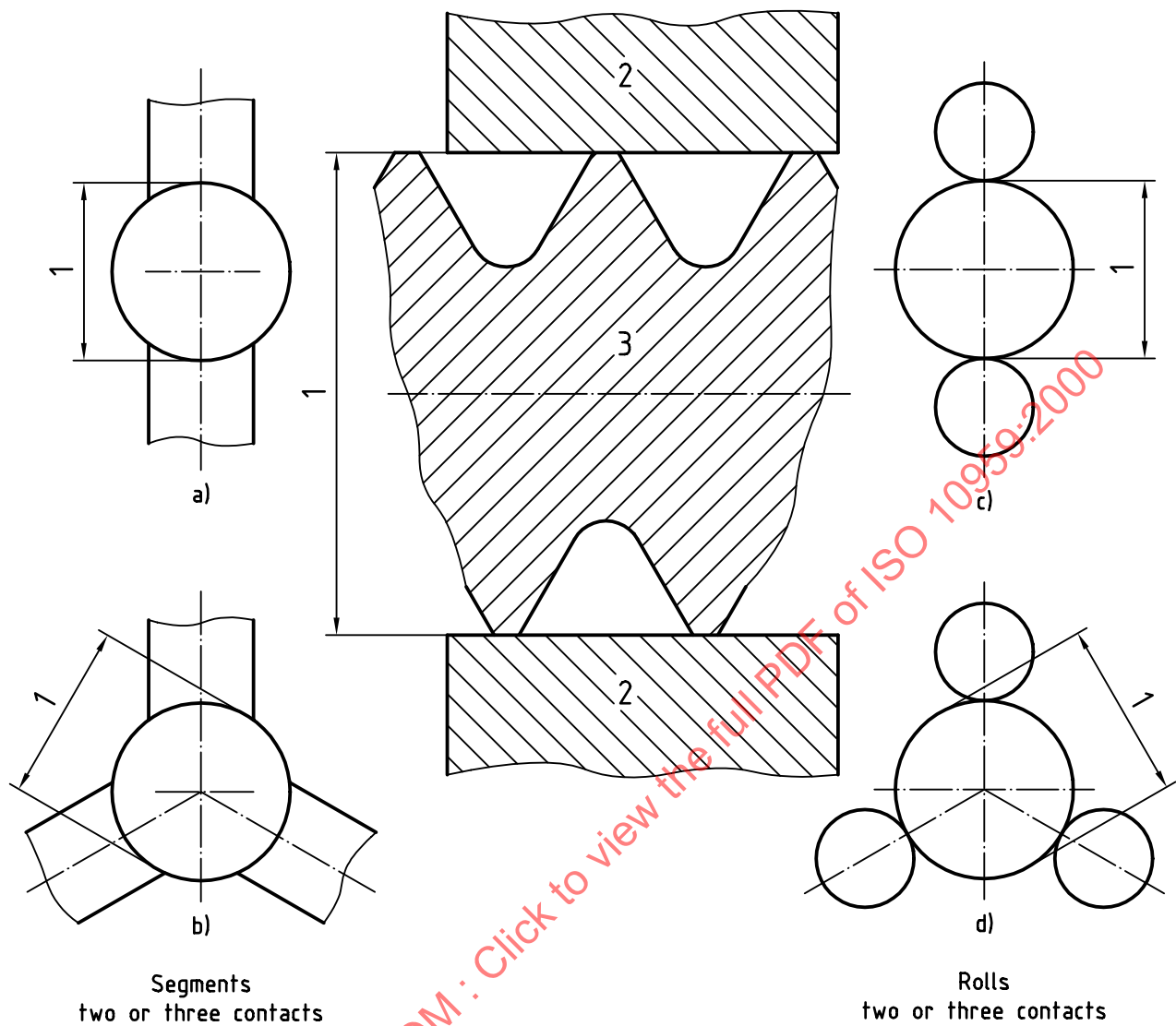
- 1 Pitch diameter
- 2 Roll

- 3 Rolls — Gauging contacts — $R = 0,288\ 68P$
- 4 External thread

NOTE Best wire size radius = $0,288\ 68P$.

- a Two ribs on top roll.
- b One rib on bottom roll.
- c One rib on each roll, one-third pitch apart.

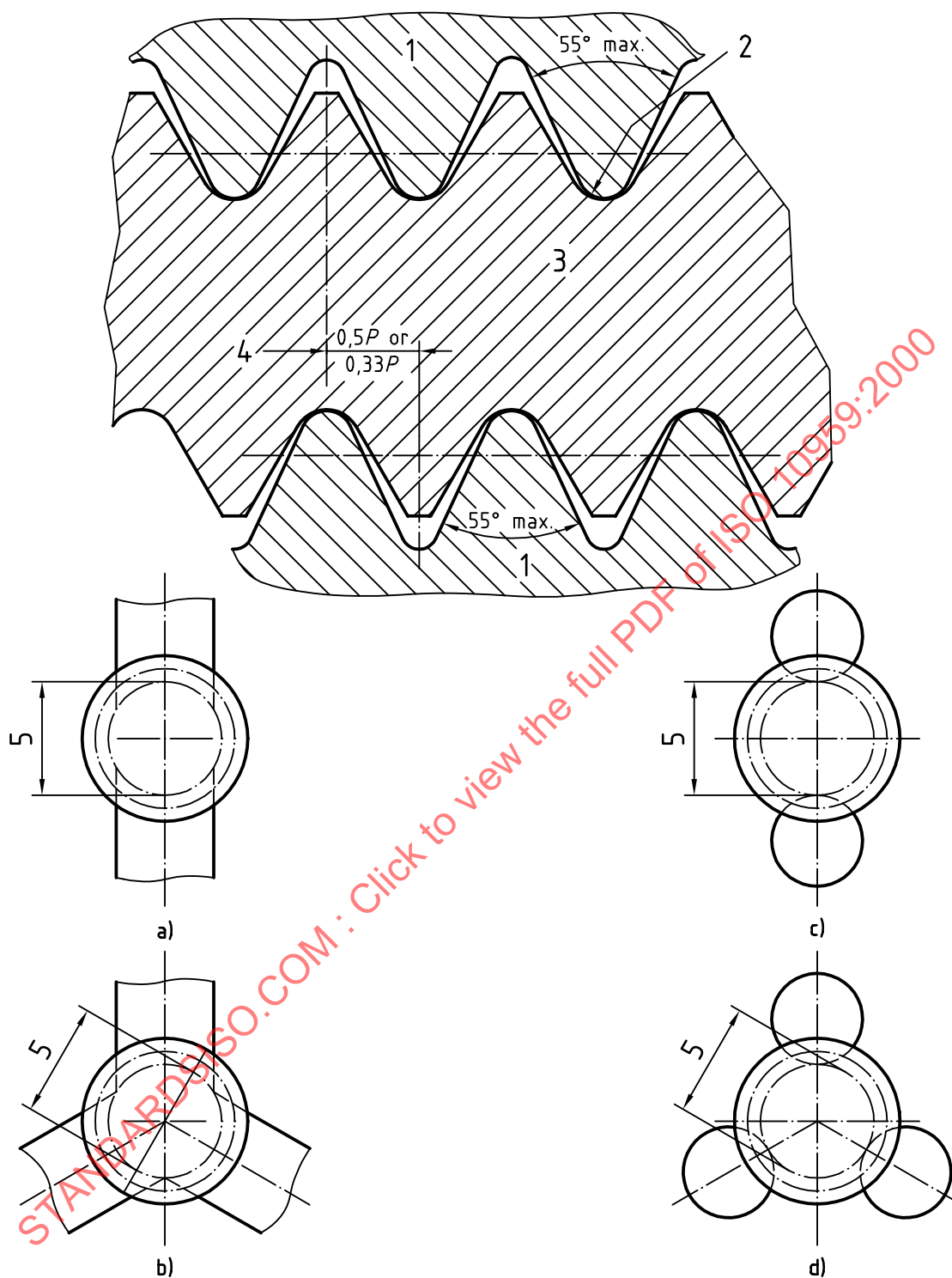
Figure 3 — Simple pitch diameter indicating thread gauges with radius roll for external threads



Key

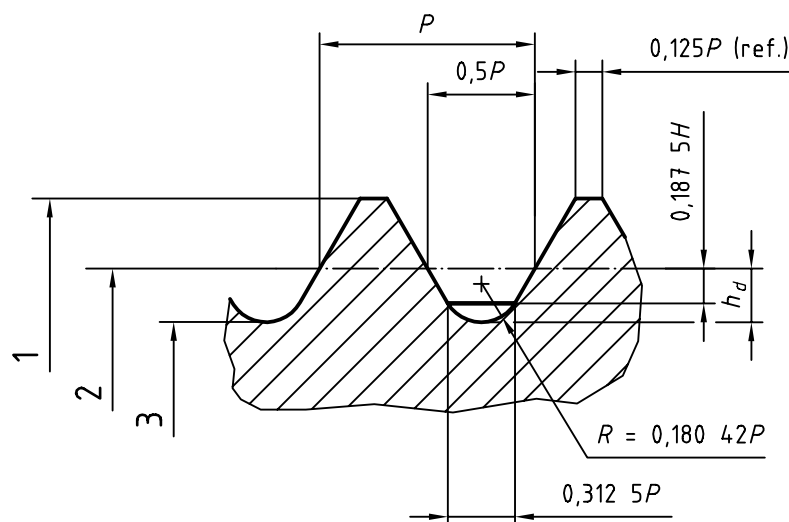
- 1 Major diameter
- 2 Plain gauge contact
- 3 External thread

Figure 4 — Major diameter indicating plain gauges for external threads

**Key**

- | | | | |
|---|--|---|--|
| 1 | Three thread segments or rolls | 3 | External thread |
| 2 | Radius not to exceed root radius of part | 4 | For two or three contacts respectively |
| | | 5 | Minor diameter |

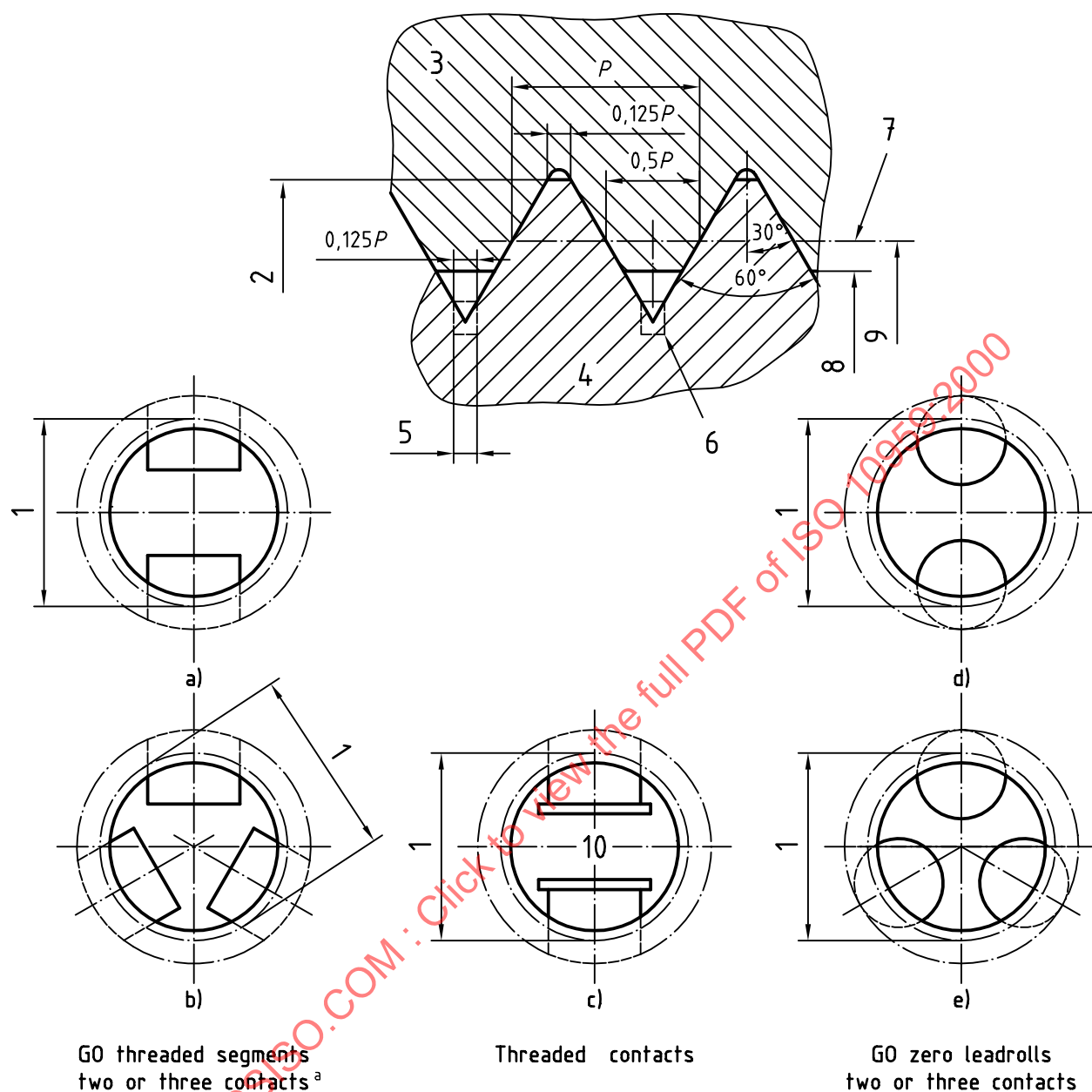
Figure 5 — Minor diameter indicating thread gauges for external threads



Key

- 1 Major diameter
- 2 Pitch diameter
- 3 Minor diameter

Figure 6 — GO full form screw plug gauges for internal maximum material threads

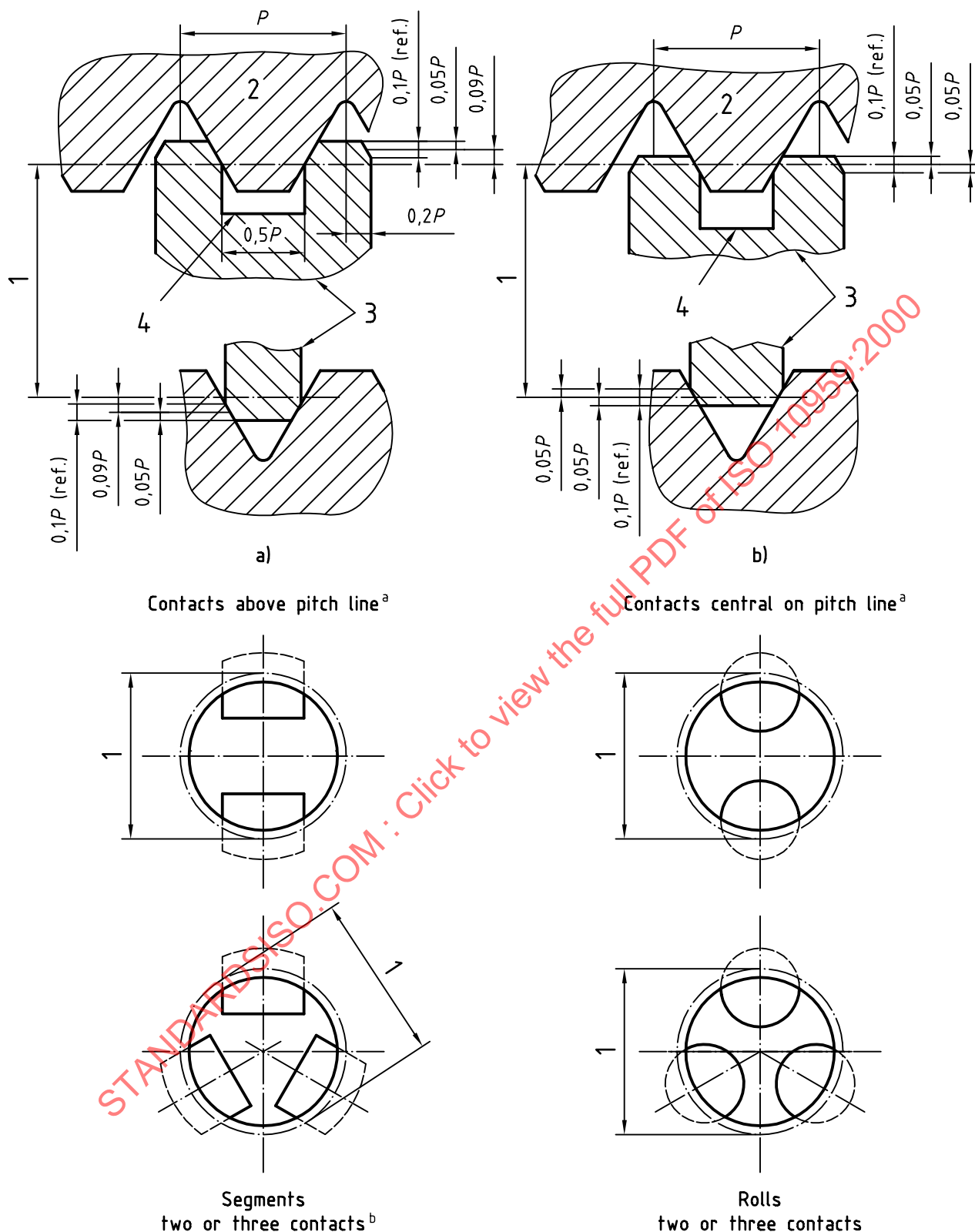
**Key**

- 1 Pitch diameter
- 2 Minimum major diameter of product internal thread
- 3 Minimum product internal thread
- 4 Gauge thread form
- 5 Clear $0,125P$ when undercut

- 6 Form of relief optional — Width approximately central when undercut
- 7 Pitch cylinder
- 8 Minimum minor diameter of product internal thread
- 9 Minimum pitch diameter of product internal thread
- 10 Fingers

^a The total segment contact to be a minimum of 25 % of circumference.

Figure 7 — Virtual pitch diameter indicating thread gauges for internal threads



Key

- | | |
|-------------------|---------------------------|
| 1 Pitch diameter | 3 Gauging elements |
| 2 Internal thread | 4 Form of relief optional |

^a Alternate designs: Contacts in other positions near the pitch cylinder may also be applied.

^b The total segment contact to be a minimum of 25 % of circumference.

Figure 8 — Simple pitch diameter indicating thread gauges with cone and vee for internal threads