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Petroleum and natural gas industries — Aluminium alloy drill pipe thread connection gauging

Industries du pétrole et du gaz naturel — Calibrage des raccords filetés des tiges de forage en alliage d'aluminium

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*.

Introduction

Users of this International Standard need to be aware that further or differing requirements could be needed for individual applications. This International Standard is not intended to inhibit a manufacturer from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This is particularly applicable where there is innovative or developing technology. Where an alternative is offered, the manufacturer will need to identify any variations from this International Standard and provide details.

This International Standard includes requirements of various natures. These are identified by the use of certain verbal forms:

— “shall” is used to indicate that a provision is mandatory;

— “should” is used to indicate that a provision is not mandatory, but recommended as good practice;

— “may” is used to indicate that a provision is optional.

Petroleum and natural gas industries — Aluminium alloy drill pipe thread connection gauging

1 Scope

This International Standard specifies the technical delivery condition, manufacturing process, material requirements, configuration and dimensions, and verification and inspection procedures for aluminium alloy drill pipes manufactured in accordance with ISO 15546.

This International Standard also specifies the gauging procedure for taper buttress thread (right and left) and adjoining tapered stabilizing shoulders (bores) made of aluminium alloy drill pipes and related steel tool joints.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 15546, *Petroleum and natural gas industries — Aluminium alloy drill pipe*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
complete set of gauges
set of screw and plain gauges of one standard size, associated among themselves under metrological characteristics

3.1.2
gauge plane
imaginary plane perpendicular to the thread axis of rotary shouldered connections at which the pitch diameter at gauge point is measured

3.1.3
master gauge
gauge used for calibration of other gauges

3.1.4
pitch
axial distance between successive threads, which, in a single start thread, is equivalent to lead

3.1.5
plain plug gauge
gauge to control internal diameter over the basic plane of the internal taper thread or diameter in the design plane of plain tapered bore of the drill pipe tool joint

Note 1 to entry: See Reference.[1]

3.1.6
plain ring gauge
gauge to control external diameter over the basic plane of the external taper thread or diameter in the design plane of plain tapered shoulder of drill pipe

3.1.7
reference plane
imaginary plane, perpendicular to the thread axis of rotary shouldered connections used for design and inspection of the thread

3.1.8
screw plug gauge
gauge to control normalized effective and external diameters of the internal taper thread with buttress profile

3.1.9
screw ring gauge
gauge to control normalized effective and internal diameters of the external taper thread with buttress profile

3.1.10
stabilizing shoulder
taper surface adjoining drill pipe taper thread and used for increase of fatigue resistance of connection with drill pipe tool joint

Note 1 to entry: See Reference.[1]

3.1.11
working gauge
gauge used for gauging rotary shouldered connections

3.2 Symbols

The following symbols are used in this International Standard.

d_1 diameter at the plug gauge plane

d_2 external thread diameter at the plug gauge reference plane

d_3 internal thread diameter at the plug gauge reference plane

d_4 diameter of the major cone base of a plain plug gauge

d_5 diameter of the minor cone base of a plain plug gauge

d_6 diameter of the bore of a screw ring gauge

d_7 internal thread diameter at the gauge plane of a ring gauge

d_8 external thread diameter at the gauge plane of a ring gauge

L_1 length of a plain plug gauge for thread gauging

L_2 length of a plain plug gauge for the taper bore gauging

4 Technical specifications on gauges

4.1 Types of gauges

4.1.1 Gauges of the following types should be manufactured:

— R: working screw plug gauge;

— G: working plain plug gauge for thread gauging;

— G-S: working plain plug gauge for gauging of drill pipe tool joint bore;

— R-P: working screw ring-gauge with perfect profile;

— R-N: working screw ring-gauge with not perfect profile;

— K-G-R: master plain plug gauge for a screw ring-gauge R-P;

— G: working plain ring gauge for thread gauging;

— K-G-G: master plain plug gauge for a plain ring gauge G;

— G-S: working plain ring gauge for the pipe shoulder gauging;

— K-G-G-S: working plain plug gauge for the gauging of ring gauge G-S.

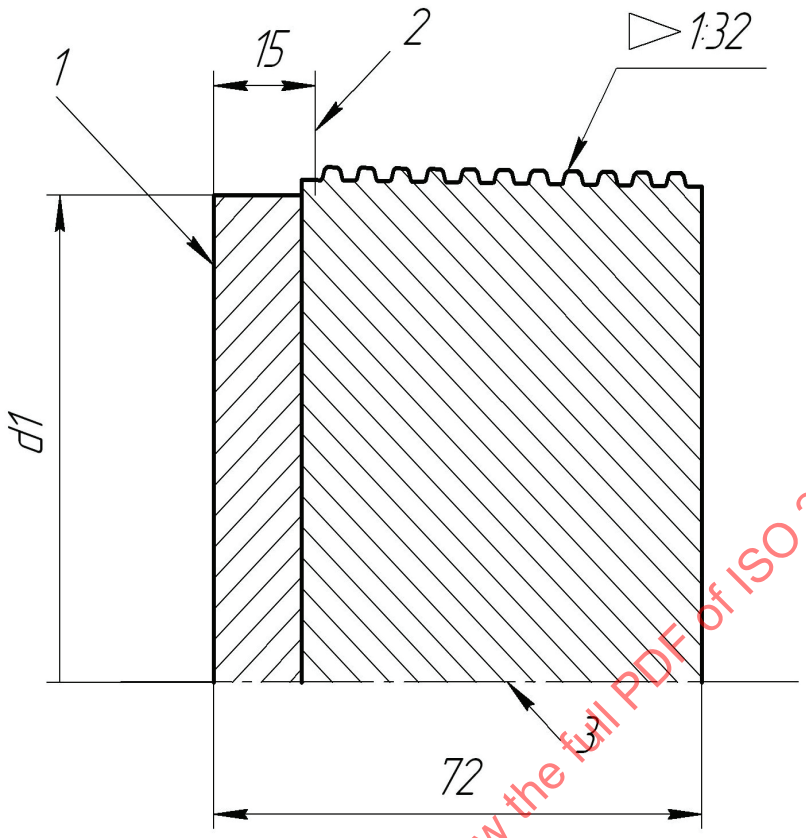
4.1.2 The scope of gauges is given in Annex A.

4.2 Thread profile, basic dimensions and tolerance

4.2.1 The basic dimensions of working and master gauges, thread profile and their limit deviation are specified in Figures 1 to 8 and in Tables 1 to 5.

NOTE For symbols, see 3.2.

Dimensions in millimetres

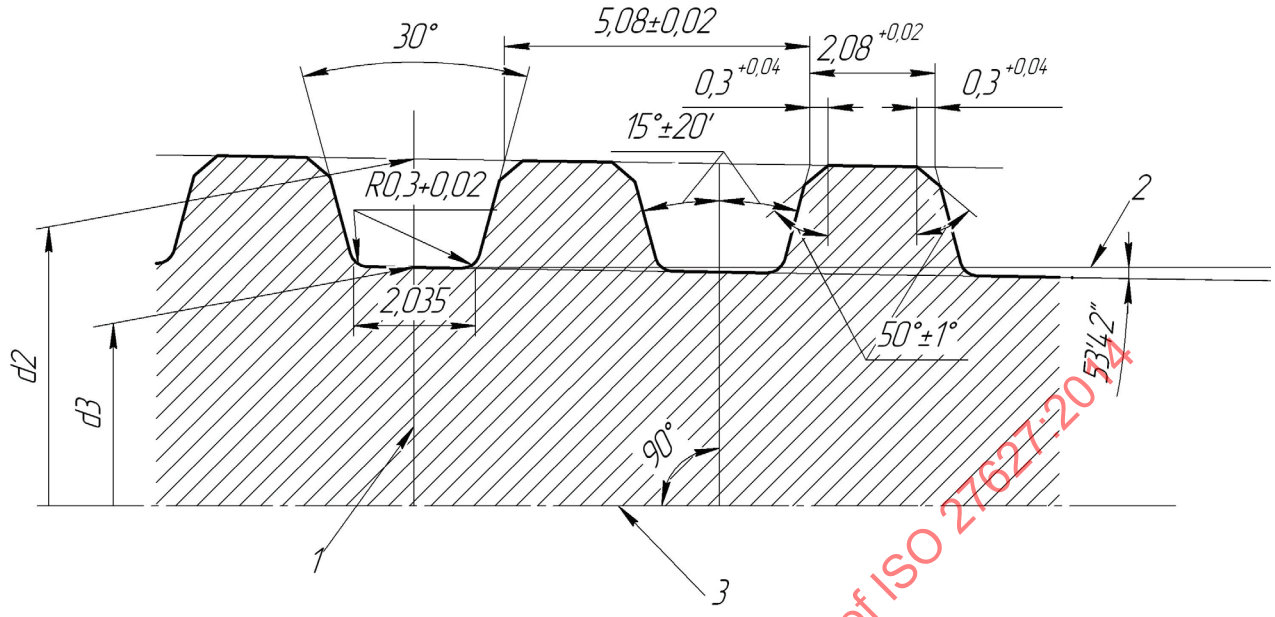


Key

1 gauge plane
2 reference plane
3 thread axis

Figure 1 — Plug gauge characteristics (R type)

Dimensions in millimetres



Key

1 reference plane

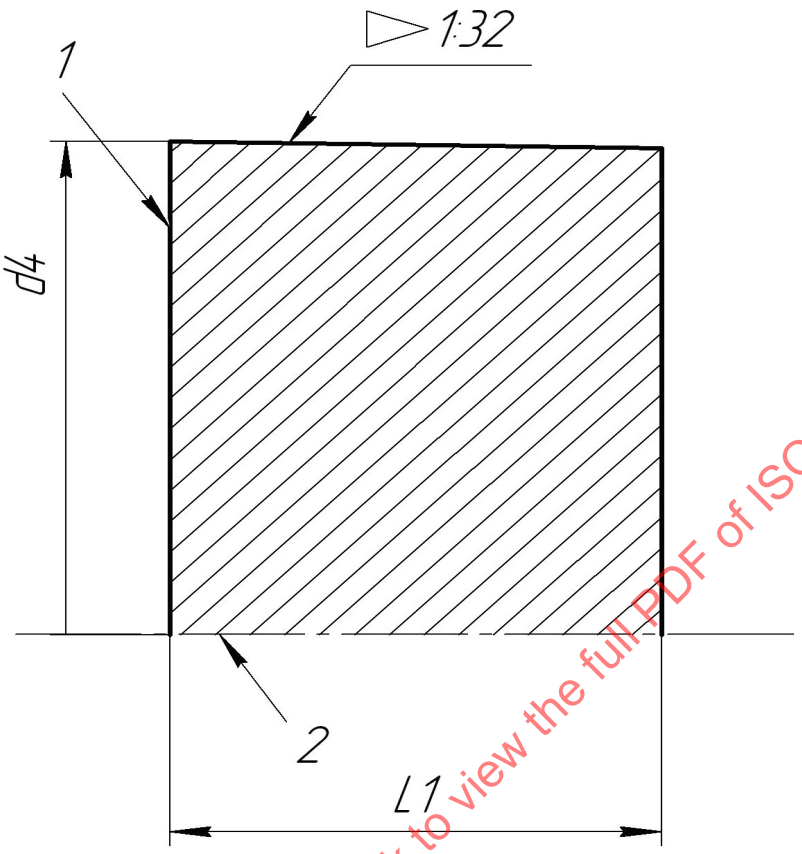
2 line parallel to the gauge thread axis

3 thread axis

NOTE Numbers with an asterisk (*) are reference dimensions.

Figure 2 — Thread form for a plug gauge (R type)

Dimensions in millimetres



Key

1	gauge plane
2	axis gauge

Figure 3 — Gauges of G and G-S types

Table 1 — TT gauge thread characteristics (see Figures 1 and 2)

Dimensions in millimetres

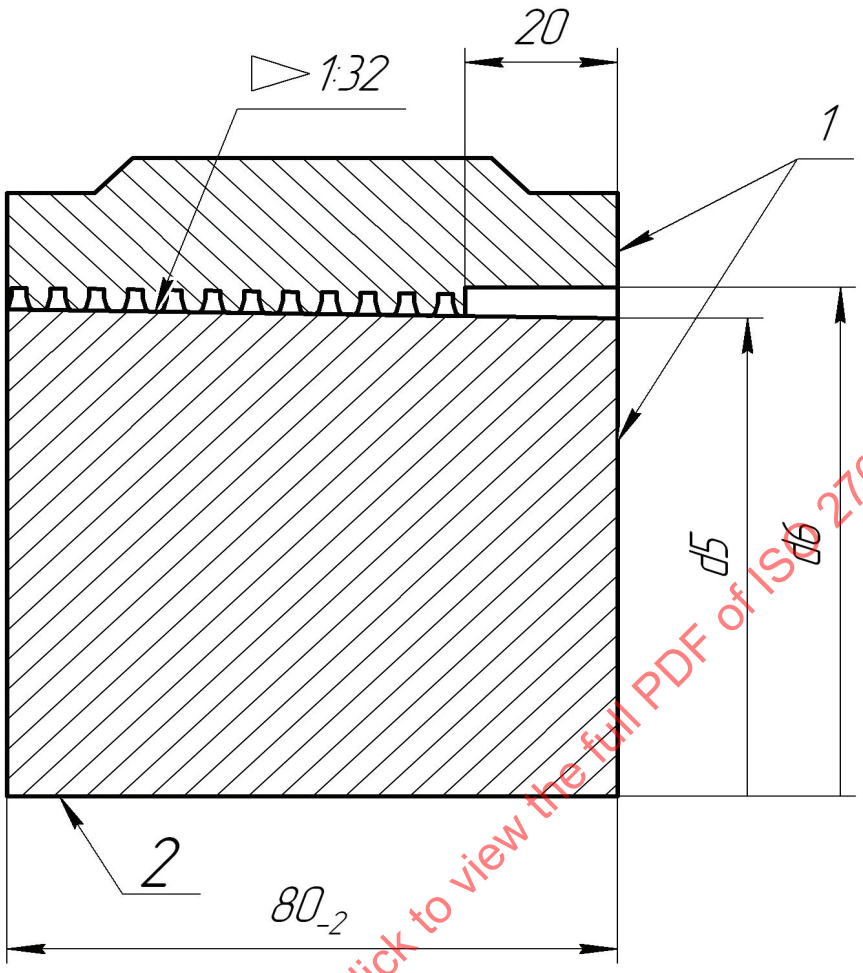
Thread type	d_1 0 -0,4	Thread diameter in the plane of reference	
		d_2 0 -0,05	d_3 +0,01 0
TT53 × 5,08 × 1:32	50	57,00	53,40
TT63 × 5,08 × 1:32	60	66,98	63,38
TT82 × 5,08 × 1:32	80	85,94	82,34
TT90 × 5,08 × 1:32	86	93,92	90,32
TT94 × 5,08 × 1:32	91	97,91	94,31
TT104 × 5,08 × 1:32	100	107,90	104,30
TT106 × 5,08 × 1:32	102	109,89	106,29
TT120 × 5,08 × 1:32	116	123,85	120,25
TT122 × 5,08 × 1:32	118	125,85	122,25
TT136 × 5,08 × 1:32	132	139,82	136,22
TT138 × 5,08 × 1:32	134	141,82	138,22
TT158 × 5,08 × 1:32	154	161,79	158,19
TT172 × 5,08 × 1:32	168	175,72	172,12

Table 2 — Gauge characteristics (G and G-S types) (see Figure 3)

Dimensions in millimetres

Thread type	Gauge type				Pipe body outside diameter	Tool joint
	G		G-S			
	d_4 ± 0,01	L_1 0 – 2,0	d_4 ± 0,01	L_1 0 – 2,0		
TT53 × 5,08 × 1:32	53,493	60	60,425	42	64	NC 23
TT63 × 5,08 × 1:32	63,474		70,405		73	NC 26
TT82 × 5,08 × 1:32	82,434		89,365	42	90	NC 38
TT90 × 5,08 × 1:32	90,414		97,345	50	90; 103	NC 38
TT94 × 5,08 × 1:32	94,404		101,335		103	NC 38
TT104 × 5,08 × 1:32	104,394		111,575		114	NC 44
TT106 × 5,08 × 1:32	106,383		110,352		114	NC 46
TT120 × 5,08 × 1:32	120,344		127,175		129	NC 50
TT122 × 5,08 × 1:32	122,344		129,525		114	NC 50
TT136 × 5,08 × 1:32	136,314		143,495		147	5–1/2FH
TT138 × 5,08 × 1:32	138,314		145,495		129; 131; 133;140;147	5–1/2 FH
TT158 × 5,08 × 1:32	158,284		165,465		147; 151; 155; 168	6-5/8 FH
TT172 × 5,08 × 1:32	172,214		179,395		164; 168	6-5/8 FH

Dimensions in millimetres



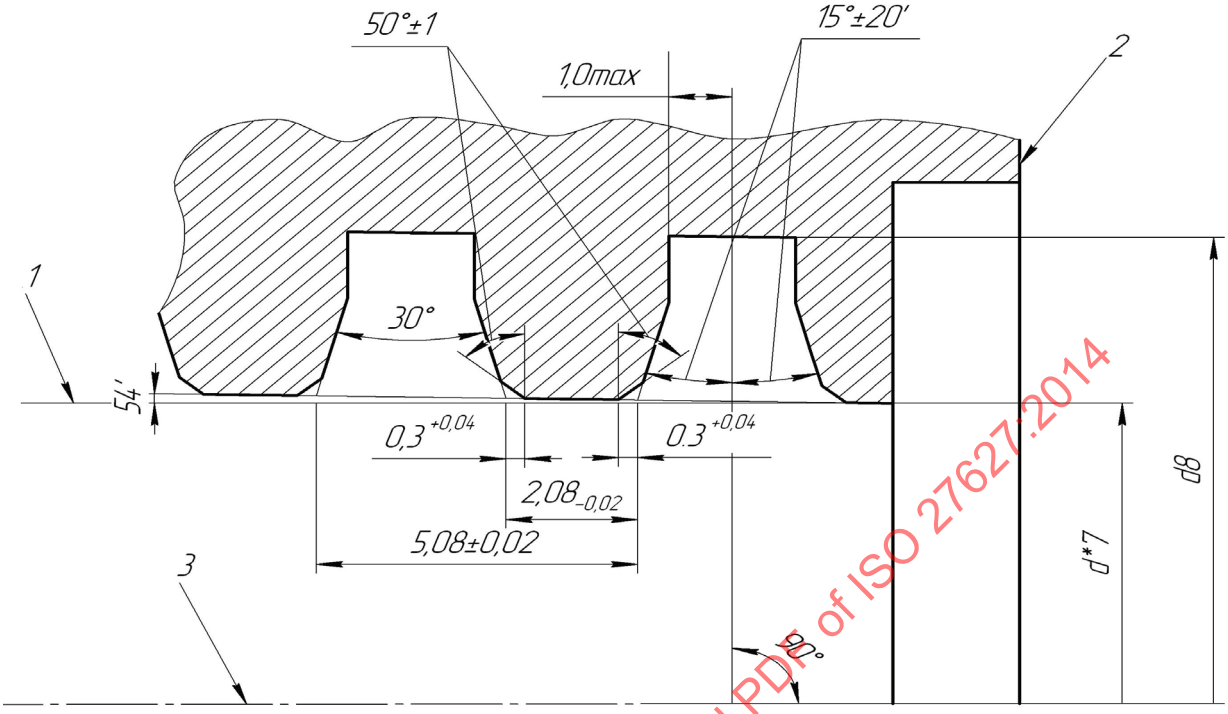
Key

1 gauge planes

2 gauge axis

Figure 4 — Diagram of fitting of R-P and R-N ring gauges to K-G-R plug gauge

Dimensions in millimetres



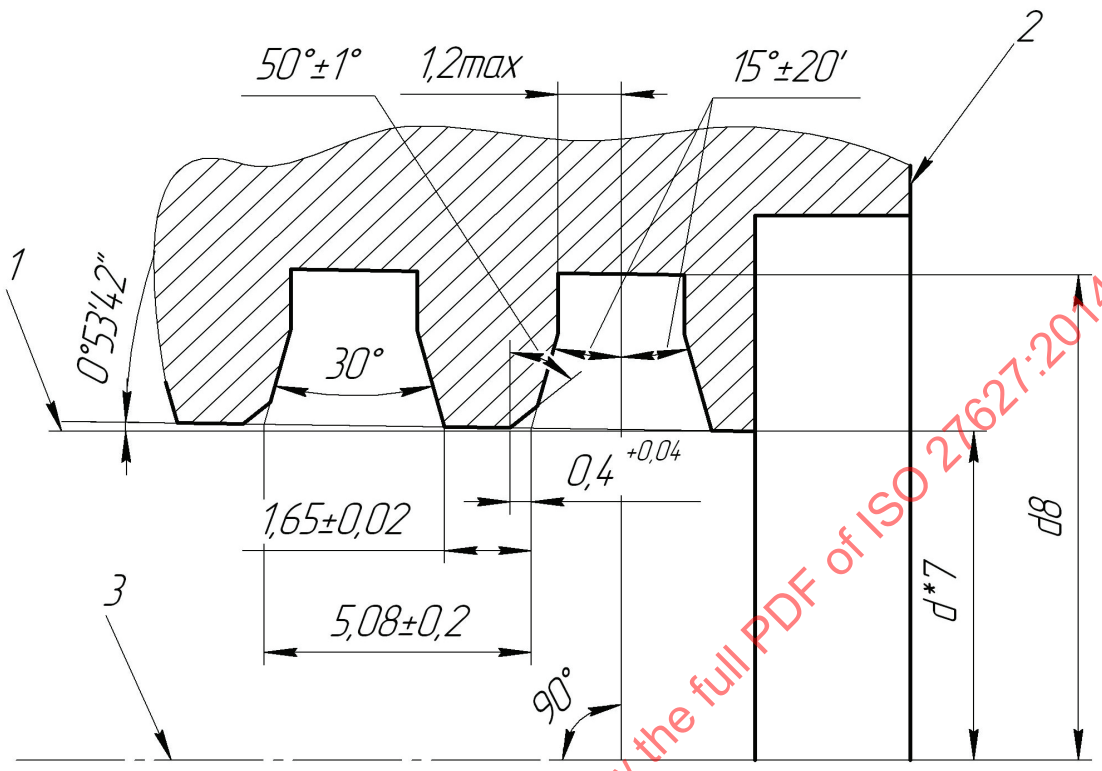
Key

1 line parallel to the gauge thread axis
2 gauge plane
3 thread axis

NOTE Numbers with an asterisk (*) are reference dimensions.

Figure 5 — Ring gauge thread with R-P perfect profile

Dimensions in millimetres



Key

1 line parallel to the gauge thread axis
2 gauge plane
3 thread axis

NOTE Numbers with an asterisk (*) are reference dimensions.

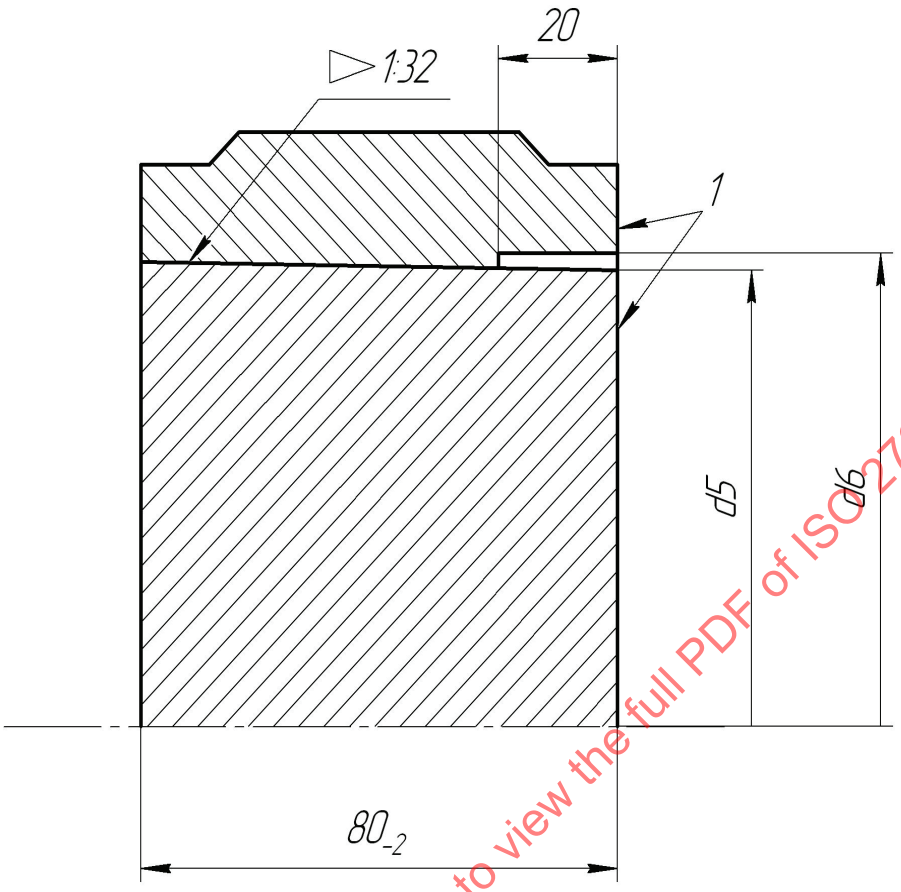
Figure 6 — Ring gauge thread profile with R-N not perfect profile

Table 3 — Ring gauge characteristics (R-P, R-N and K-G-R types) (see Figures 4, 5 and 6)

Dimensions in millimetres

Thread type	Gauge type			
	K-G-R	R-P and R-N		
	d_5 ± 0,01	d_6	Thread diameter in the gauge plane	
			d_7	d_8 min
TT53 × 5,08 × 1:32	51,256	60	51,256	56,5
TT63 × 5,08 × 1:32	61,256	70	61,256	67,5
TT82 × 5,08 × 1:32	80,256	88	80,256	86,5
TT90 × 5,08 × 1:32	88,256	96	88,256	94,5
TT94 × 5,08 × 1:32	92,256	100	92,256	98,5
TT104 × 5,08 × 1:32	102,256	110	102,256	108,5
TT106 × 5,08 × 1:32	104,256	112	104,256	110,5
TT120 × 5,08 × 1:32	118,256	126	118,256	124,5
TT122 × 5,08 × 1:32	120,256	128	120,256	126,5
TT136 × 5,08 × 1:32	134,256	142	134,256	140,5
TT138 × 5,08 × 1:32	136,256	145	136,256	142,5
TT158 × 5,08 × 1:32	156,256	165	156,256	162,5
TT172 × 5,08 × 1:32	170,256	178	170,256	176,5

Dimensions in millimetres



Key

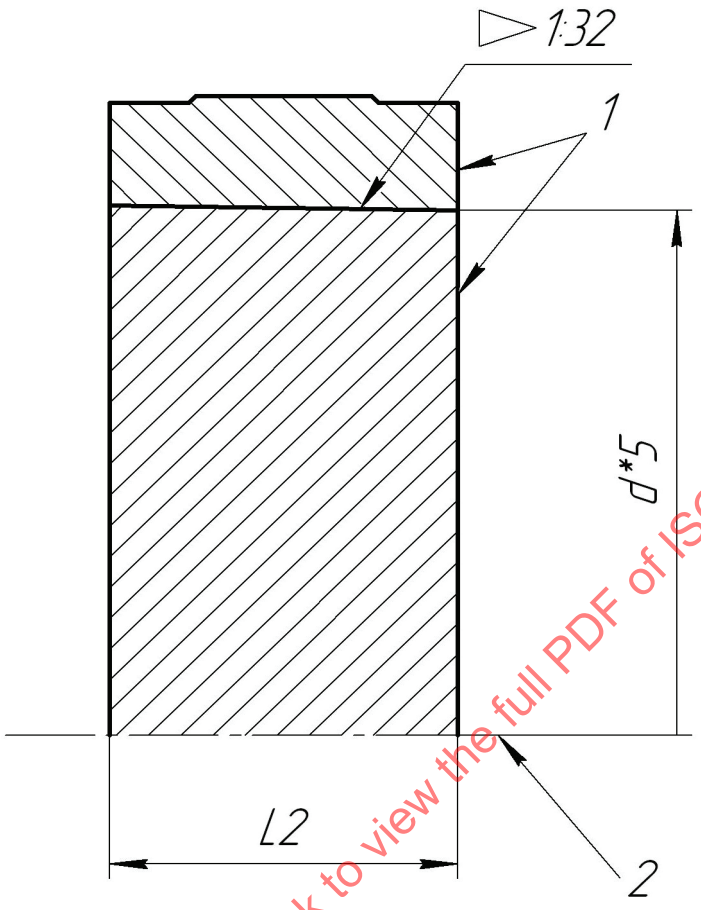
1 gauge planes

Figure 7 — Diagram of fitting of G ring gauge to K-G-G plug gauge

Table 4 — Characteristics of G ring gauge and K-G-G plug gauge (see Figure 7)

Dimensions in millimetres

Thread type	Gauge type	
	K-G-G	G
	d_5 ± 0,01	d_6
TT53 × 5,08 × 1:32	54,656	60
TT63 × 5,08 × 1:32	64,656	70
TT82 × 5,08 × 1:32	83,656	88
TT90 × 5,08 × 1:32	91,656	96
TT94 × 5,08 × 1:32	95,656	100
TT104 × 5,08 × 1:32	105,656	110
TT106 × 5,08 × 1:32	107,656	112
TT120 × 5,08 × 1:32	121,656	126
TT122 × 5,08 × 1:32	123,656	128
TT136 × 5,08 × 1:32	137,656	142
TT138 × 5,08 × 1:32	139,656	145
TT158 × 5,08 × 1:32	159,656	165
TT172 × 5,08 × 1:32	173,656	178



Key

1 gauge planes

2 gauge axis

NOTE Numbers with an asterisk (*) are reference dimensions.

Figure 8 — Diagram of fitting of G-S ring gauge to K-G-G-S plug gauge

Table 5 — Characteristics of G-S ring gauge and K-G-G-S plug gauge (see Figure 8)

Dimensions in millimetres

Thread type	Gauge type			
	G-S		K-G-S-S	
	d_5	L_2 0 − 2,0	d_5 ± 0,01	L_2 0 − 2,0
TT53 × 5,08 × 1:32	56,500	38	56,500	38
TT63 × 5,08 × 1:32	69,500		69,500	
TT82 × 5,08 × 1:32	88,500		88,500	
TT90 × 5,08 × 1:32	96,500		96,500	
TT94 × 5,08 × 1:32	100,500	38	100,500	38
TT104 × 5,08 × 1:32	110,500	46	110,500	46
TT106 × 5,08 × 1:32	112,500		112,500	
TT120 × 5,08 × 1:32	126,500		126,500	
TT122 × 5,08 × 1:32	128,500		128,500	
TT136 × 5,08 × 1:32	142,500		142,500	
TT138 × 5,08 × 1:32	144,500		144,500	
TT158 × 5,08 × 1:32	164,500		164,500	
TT172 × 5,08 × 1:32	178,500		178,500	

4.2.2 Limits for taper deviations (differences of thread diameters at the length of 100 mm) shall be:

— for R plug gauge: 0 / + 0,020 mm;

— for R-P and R-N ring gauges: − 0,010 mm / − 0,035 mm.

Limits for taper deviations (differences of thread diameters at the length of 100 mm) shall be:

— for K-G-R, K-G-G and K-G-G-S plug gauge: 0 mm / + 0,020 mm;

— for G and G-S plug gauge: 0 mm / + 0,025 mm;

— for G and G-S ring gauges: − 0,010 mm / − 0,035 mm.

When gauging the difference between screw and plain gauges' diameters at a length other than 100 mm, limit deviations shall be proportionally changed.

4.2.3 Limit deviations of the difference between the R plug gauges' diameters refer to the external and internal diameters, as of R-P and R-N ring gauges to the internal diameter.

4.2.4 Limit deviations of thread pitch refer to the distance between any two screw gauge thread turns.

4.2.5 Thread pitch and width of crest flat shall be measured in parallel to the gauge thread axis.

4.2.6 The form of grooves along thread roots of ring gauges is arbitrary.

4.2.7 Discrepancies of gauge planes when fitting the screw and plain ring gauges to corresponding plain control plug gauges shall be no more than ± 0,15 mm.

Tolerances of gauge planes' parallel alignment when fitting ring gauges to control plug gauges shall be 0,05 mm.

4.2.8 Control and certification of gauges shall be made by corresponding techniques on the special high-precision equipment intended for measurement of details with taper thread and plain taper surfaces. Certification of gauges shall be carried out in accredited metrological laboratories (centres) [[2]].

4.3 Technical requirements for manufacturing

4.3.1 Gauges shall be manufactured according to the requirements of this International Standard to the design drawings, which are authorized in due course.

4.3.2 Measuring parts of gauges shall be manufactured from alloyed steel of 100 Cr 6 or 100 Cr Mn 6 grades (see EN 10027-2).

4.3.3 Hardness of the thread surface, flanks of plain gauges and gauge planes of all gauges shall be HRC 58...62 (see ASTM A370).

4.3.4 Gauges shall be subjected to aging treatment and demagnetized.

4.3.5 The first thread turns from each side of a gauge shall be cut to full width and blunted.

4.3.6 There should be mud grooves on screw gauges, which cross screw fillets along the generating line of the thread cone and are located in regular intervals along a circle. One of the mud flutes should pass through the origin of the first overall fillet.

4.3.7 Characteristic of the surface roughness Ra shall be not more than:

— for threads (except for grooves on roots of R-P and R-N ring gauges) and flanks of plain gauges, 0,32 µm;

— for gauge planes, 0,63 µm.

4.3.8 The tolerance of profile flank straightness shall be no more than 0,003 mm.

4.3.9 The tolerance of perpendicularity of gauges' control planes to the thread axis shall be no more than 0,025 mm.

4.3.10 There shall not be scuffs, scribes, fractures, visible corrosion and other defects on gauge flanks.

4.3.11 The complete set of gauges should consist of master and working screw gauges and plain gauges (see 4.1).

If a customer so wishes, separate manufacturing of working screw and plain plug gauges or ring gauges may be admitted.

Ring gauges (up to 10 pieces) should be completed with one plain master plug gauge to which they should be fitted.

4.3.12 A certificate shall be enclosed with each gauge, which specifies:

a) thread mark signs;

b) gauge type mark signs;

c) gauge serial number;

d) date of production;

e) trade mark of the enterprise or manufacturer;

f) reference to ISO 27627.

4.4 Marking, packing, transportation and storage

4.4.1 The following specifications shall be plotted on plug gauges and ring gauges:

a) thread mark signs;

b) gauge type mark signs;

c) gauge serial number;

d) reference to ISO 27627;

e) date of production;

f) trade mark of the enterprise or manufacturer.

The letter "L" shall be added on a screw gauge with the left-hand thread.

When fitting one or several screw or plain ring gauges to one plain control plug gauge, numbers on these gauges are plotted as fractions, the numerator of which is the number of a plug gauge and the denominator is the serial number of a fitted ring gauge.

EXAMPLE Examples of gauge marks:

— working plain plug gauge for gauging of internal diameter and taper of TT122 × 5.08 × 1:32 thread: *TT 122 G 35. IV.07 (trade mark)*;

— working screw ring gauge with not perfect profile for gauging of internal diameter of TT 132 × 5.08 × 1:32 thread: *TT 132 R-N 5/2 VII.07 (trade mark)*.

4.4.2 Gauges shall be subjected to conservation. The conservation validity period shall be one year.

4.4.3 Conserved gauges should be wrapped up in condenser paper and packed into the wooden boxes, which are lined on the inside with water-proof material.

4.4.4 A label shall be pasted on each box, which specifies:

a) name of a product;

b) thread and gauge type mark signs;

c) number of gauges;

d) date of production;

e) trade mark of the enterprise or manufacturer;

f) reference to ISO 27627.

4.4.5 At transportation, boxes with gauges should be put in such way that they cannot be move around.

4.4.6 Packed gauges should be kept in a ventilated room at a temperature of between 10 °C and 35 °C; air humidity should be no more than 80 %. Acid and alkali fumes should not be present in the air of this room.

4.4.7 Plug gauges and ring gauges should be kept separately.

5 Gauging of threaded connections

5.1 Gauging of threaded connections of TT type shall be made by measuring tightness by means of plain and screw gauges.

5.2 Gauging of external thread (of pipe) shall be made using plain and screw (with perfect and not perfect profile) ring gauges, and of taper stabilizing shoulders, using plain ring gauges according to Figure 9.[1]

The gauge plane of a screw ring gauge with a perfect or imperfect profile shall not reach or overpass the pipe end face and shall be in a range between 0 mm and 2 mm [Figure 9 a)]; the gauge plane of a plain ring gauge shall not reach or overpass the pipe end face and shall be in a range between 0 mm and 3,2 mm [Figure 9 b)].

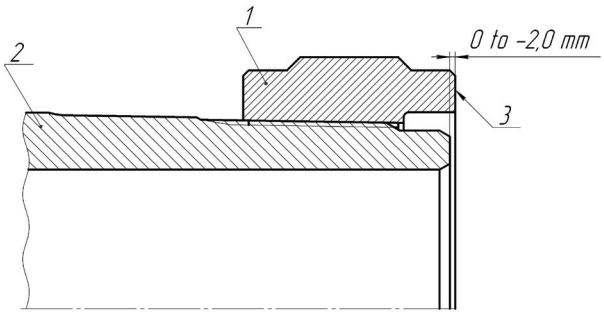
The diameter in the design plane of a taper stabilizing shoulder shall be controlled by the position of the gauge plane of the corresponding plain ring gauge against the pipe end face. The gauge plane of a plain ring gauge shall be at a distance of 96 mm from the pipe end face with a maximum deviation of ± 2 mm [Figure 9 c)].

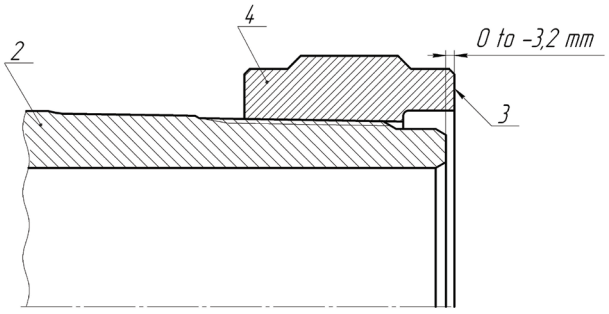
5.3 Gauging of internal threads (in a tool joint) shall be made using plain and screw plug gauges. Gauging of a taper bore shall be made using a plain plug gauge (Figures 10 and 11).

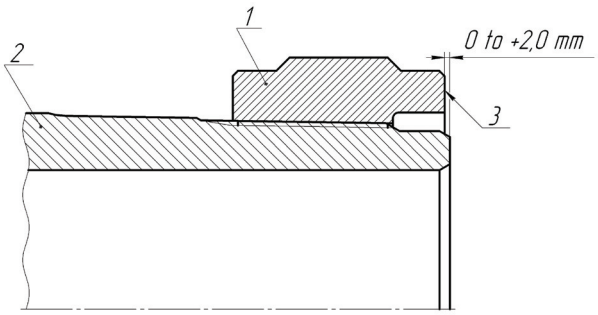
Therewith the gauge plane of a screw plug gauge shall be at the distance of 50 mm from the end face of a tool joint with a tolerance of ± 1,6 mm [Figure 10 a)], and the gauge plane of a plain plug gauge at a distance of 62 mm with a tolerance of 1,6 mm [Figure 10 b)].

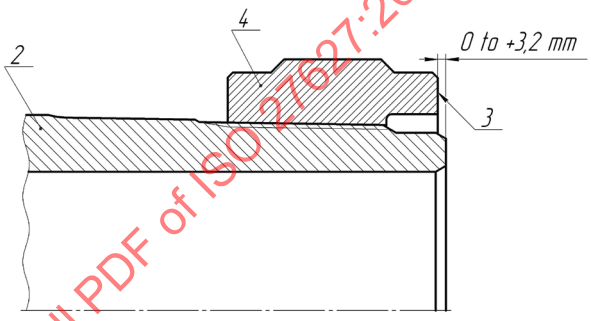
5.4 The diameter in the design plane of a taper bore shall be controlled by the position of the gauge plane of a plain plug gauge. The gauge plane of a plug gauge shall stand out from the end face of the tool joint by a distance of between 0 mm and 3,2 mm (Figure 11).

Dimensions in millimetres



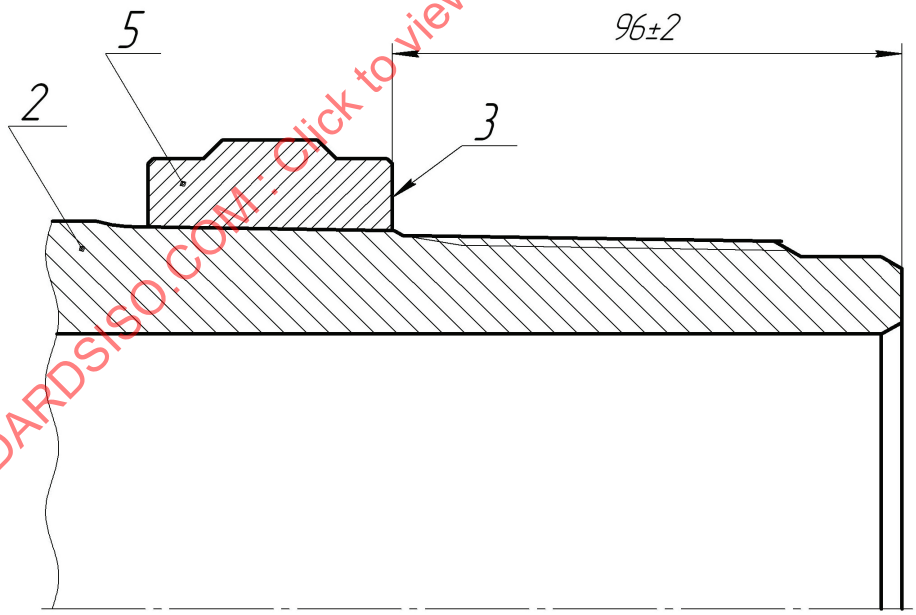






a) Gauging of thread by screw ring gauges with perfect and not perfect profiles

b) Gauging of thread by a plain ring gauge



c) Gauging of a taper stabilizing shoulder by a plain ring gauge