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**Erdöl- und Erdgasindustrie –
Bohr- und Förderanlagen –
Teil 2: Verschraubungen, Kalibrierung und Prüfung von drehenden
Schulteransatz-Gewindeverbindungen (ISO 10424-2:2007);
Englische Fassung EN ISO 10424-2:2007**

Petroleum and natural gas industries –
Rotary drilling equipment –
Part 2: Threading and gauging of rotary shouldered thread connections
(ISO 10424-2:2007);
English version EN ISO 10424-2:2007

Industries du pétrole et du gaz naturel –
Équipements de forage rotary –
Partie 2: Filetage et calibrage des connexions rotary filetéées à épaulement
(ISO 10424-2:2007);
Version anglaise EN ISO 10424-2:2007

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Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) im DIN

Nationales Vorwort

Dieses Dokument (EN ISO 10424-2:2007) wurde vom Technischen Komitee CEN/TC 12 „Materialien, Ausrüstungen und Offshore-Bauwerke für die Erdöl-, petrochemische und Erdgasindustrie“ erarbeitet, dessen Sekretariat von AFNOR (Frankreich) gehalten wird.

Es handelt sich dabei um die unveränderte Übernahme von ISO 10424-2:2007, erarbeitet vom ISO/TC 67 „Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries“, Subcommittee SC 4 „Drilling and production equipment“.

Für Deutschland hat hieran der Arbeitskreis AK 4 „Bohr- und Fördereinrichtungen“ des NA 109-00-01 AA „Materialien, Ausrüstung und Offshore-Bauwerke für die Erdöl-, petrochemische und Erdgasindustrie“ im Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) mitgearbeitet.

Diese Europäische Norm enthält unter Berücksichtigung des DIN-Präsidialbeschlusses 13/1983 nur die englische Originalfassung der ISO-Norm.

English Version

Petroleum and natural gas industries —
Rotary drilling equipment —
Part 2: Threading and gauging of rotary shouldered thread
connections (ISO 10424-2:2007)

Industries du pétrole et du gaz naturel —
Équipements de forage rotatif —
Partie 2: Filetage et calibrage des connexions rotatives filetées
à épaulement (ISO 10424-2:2007)

Erdöl- und Erdgasindustrie —
Bohr- und Förderanlagen —
Teil 2: Verschraubungen, Kalibrierung und Prüfung von
drehenden Schulteransatz-Gewindeverbindungen
(ISO 10424-2:2007)

This European Standard was approved by CEN on 2 November 2007.

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Foreword

This document (EN ISO 10424-2:2007) has been prepared by Technical Committee ISO/TC 67 "Materials, equipment and offshore structures for petroleum and natural gas industries" in collaboration with Technical Committee CEN/TC 12 "Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries" the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2008, and conflicting national standards shall be withdrawn at the latest by May 2008.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

The text of ISO 10424-2:2007 has been approved by CEN as a EN ISO 10424-2:2007 without any modification.

Introduction

This International Standard is based on API Spec 7, *Specification for rotary drill stem elements*.

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

1 Scope

This part of ISO 10424 specifies requirements on rotary shouldered connections for use in petroleum and natural gas industries, including dimensional requirements on threads and thread gauges, stipulations on gauging practice, gauge specifications, as well as instruments and methods for inspection of thread connections. These connections are intended primarily for use in drill-string components.

Other supplementary specifications can be agreed between interested parties for special tolerance requirements, qualification, testing, inspection and finishing.

This part of ISO 10424 is applicable to the following preferred rotary shouldered connection designs:

- a) number (NC) style;
- b) regular (REG) style;
- c) full hole (FH) style.

These are traceable to an internationally supported system of gauges and calibration

2 Conformance — Units of measurement

In this part of ISO 10424, data are expressed in both the International System (SI) of units and the United States Customary (USC) system of units. Separate tables for data expressed in SI units and USC units are given in the body of this part of ISO 10424 and Annex A, respectively. Figures express data in both SI and USC units. For a specific order item, it is intended that only one system of units be used, without combining data expressed in the other system. Annex G provides the conversion between SI and USC units used in this part of ISO 10424.

Products manufactured to specifications expressed in either of these unit systems shall be considered equivalent and totally interchangeable. Consequently, compliance with the requirements of this part of ISO 10424 as expressed in one system provides compliance with requirements expressed in the other system. For data expressed in the SI system, a comma is used as the decimal separator and a space as the thousands separator. For data expressed in the USC system, a dot (on the line) is used as the decimal separator and a space as the thousands separator.

In the text, data in SI units are followed by data in USC units in brackets.

3 Normative references

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

ISO 10424-1, *Petroleum and natural gas industries — Rotary drilling equipment — Part 1: Rotary drill stem elements*

ISO 11961¹⁾, *Petroleum and natural gas industries — Steel drill pipe*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

API Spec 7, *Specification for Rotary Drill Stem Elements*

1) To be published. (Revision of ISO 11961:1996)

4 Terms, abbreviated terms, definitions and symbols

4.1 Terms and definitions

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

4.1.1

bevel diameter

outside diameter of the contact face of the rotary shouldered connection

4.1.2

box connection

box end

threaded connection on oil country tubular goods with internal (female) threads

4.1.3

box thread

internal (female) threads of a rotary shouldered connection

4.1.4

break-in

procedure applied to newly manufactured threads to assure correct mating

4.1.5

calibration system

documented system of gauge calibration and control

4.1.6

cold working

plastic deformation of the surface of the connection at a temperature low enough to induce strain hardening

4.1.7

first perfect thread

thread furthest from the sealing face on a pin, or closest to the sealing face on a box, where both the crest and the root are fully formed

4.1.8

full-depth thread

thread in which the thread root lies on the minor cone of an external thread or lies on the major cone of an internal thread

4.1.9

gauge point

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

NOTE This plane is located 15,875 mm (0.625 0 in) from the make-up shoulder of the pin thread.

4.1.10

interchange stand-off

stand-off between each member of a gauge set and a corresponding gauge next higher in the ranking scheme: grand master or regional master, reference master, working gauge

4.1.11

lead

distance parallel to the thread axis from a point on a thread turn and the corresponding point on the next turn, i.e. the axial displacement of a point following the helix one turn around the thread axis

4.1.12

make-up shoulder

sealing shoulder on a rotary shouldered connection

4.1.13

manufacturer

firm, company or corporation that operates facilities capable of cutting the threads and is responsible for compliance with all the applicable provisions of this part of ISO 10424

4.1.14

master gauge

gauges used for calibration of other gauges

NOTE These include reference master, regional master and grand master gauges.

4.1.15

mating stand-off

stand-off between the plug and ring members of a gauge set

NOTE Interchange stand-off is the stand-off between each member and a gauge higher in the ranking scheme.

4.1.16

pin connection

pin end

threaded connection on oil country tubular goods with external (male) threads

4.1.17

pin thread

external (male) threads of a rotary shouldered connection

4.1.18

pitch

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

4.1.19

pitch cone

imaginary cone whose diameter at any point is equal to the pitch diameter of the thread at the same point

4.1.20

pitch diameter

diameter at which the distance across the threads is equal to the distance between the threads

4.1.21

product

drill string component with rotary shouldered connection in accordance with this part of ISO 10424

4.1.22

reference dimension

dimension that is a result of two or more other dimensions

4.1.23

rotary shouldered connection

thread connection used on drill stem elements which has coarse, tapered threads and sealing shoulders

4.1.24

stand-off

distance between faces of gauges, or gauge and product when mated

4.1.25

stress-relief groove

⟨feature⟩ modification performed on rotary shouldered connections that removes a certain length of the unengaged threads of the pin or box

NOTE This process reduces the likelihood of fatigue cracking in the highly stressed area both for box and pin threads due to a reduction of stress concentration.

4.1.26

taper

increase in the diameter of the pitch cone with length

NOTE The taper is expressed in millimetres per millimetre (inches per foot) of thread length.

4.1.27

thread form

thread profile in an axial plane for a length of one pitch

4.1.28

thread height

distance between the crest and root, normal to the axis of the thread

4.1.29

tolerance

amount of variation permitted

4.1.30

working gauges

gauges used for gauging rotary shouldered connections

4.2 Design types and definitions

NOTE Any style of rotary shouldered connection can be made in right-hand (RH) or left-hand (LH) versions. Right-hand is assumed unless otherwise designated as LH.

4.2.1

full-hole style

FH style

type and size of rotary shouldered connection having thread form of V-040 or V-050

NOTE The number relates to a historical drill-pipe size.

4.2.2

GOST Z style

type and size of the rotary shouldered connection, covered by a Russian standard and having the V-038R, V-040 or V-050 thread form

NOTE The number designation is the pin-base diameter, rounded to units of millimetres.

4.2.3

H90 style

type and size of rotary shouldered connection having a 90° thread form

NOTE The number relates to a historical drill-pipe size.

4.2.4

IF style

type and size of the rotary shouldered connection having the V-038R thread form

NOTE 1 The number relates to a historical drill-pipe size.

NOTE 2 The thread form was historically V-065.

4.2.5

number style

NC style

type and size of the rotary shouldered connection having the V-038R thread form

NOTE The number in the connection number is the first two digits of the pitch diameter of the pin thread at the gauge point, expressed in units of 2,54 mm (0.1 in).

4.2.6

open-hole style

OH style

type and size of rotary shouldered connection having the V-076 thread form

NOTE The number relates to a historical drill-pipe size.

4.2.7

PAC style

type and size of rotary shouldered connection having the V-076 thread form

NOTE The number relates to a historical drill-pipe size.

4.2.8

regular style

REG style

type and size of rotary shouldered connection having thread forms of V-040, V-050 or V-055

NOTE The number relates to a historical drill-pipe size.

4.2.9

SL H90 style

type and size of rotary shouldered connection having a 90° thread form and heavy truncation

NOTE The number relates to a historical drill-pipe size.

4.3 Abbreviations and symbols

4.3.1 Abbreviations

c/bore	Counterbore
CW	Cold working
dia.	Diameter
FF	Full face
FH	Full-hole (style)
ID	Inside diameter
IF	Internal-flush (style)
LH	Left-hand
LT	Low-torque modification
max.	Maximum
min.	Minimum
NC	Numbered-connection (style)
OD	Outside diameter

OH	Open-hole (style)
ref	Reference (dimension)
REG	Regular (style)
RH	Right-hand
SRG	Stress-relief groove
thds	Threads

4.3.2 Symbols

A	Depth of the pin stress-relief groove below the thread root at the gauge point
B	Depth of box stress-relief groove, measured from the pitch cone addendum
C_{GP}	Pitch diameter at working gauge point
C	Pitch diameter of thread at gauge point
d_b	Diameter of ball for lead and taper gauges
D_{BG}	Diameter of box member at stress-relief groove
d_{bh}	Diameter of ball for thread-height gauge
D_{CB}	Diameter of cylinder of boreback stress-relief contour
D_{FG}	Diameter of face groove and box counterbore in low-torque feature
D_{FP}	Diameter of plug fitting plate
D_L	Large diameter of pin
D_{LF}	Diameter of flat on pin
D_{MP}	Major diameter of plug gauge at gauge point
D_{MR}	Minor diameter of ring gauge at gauge point
D_R	Outside diameter of ring gauge
D_S	Small diameter of pin
D_{SRG}	Diameter of pin stress-relief groove
F_c	Width of crest flat, product thread
F_r	Width of root flat, product thread
f_c	Crest truncation, product thread
f_{cg}	Crest truncation, gauge thread
f_r	Root truncation, product thread
f_{rg}	Root truncation, gauge thread
H	Reference thread height not truncated
h	Product thread height truncated
h_{bg}	Depth of box stress-relief groove, measured normal to taper cone

h_{cn}	Height of product thread, compensated for taper
h_g	Reference gauge thread height truncated
L_{BC}	Depth of box
L_{BG}	Length, shoulder face to groove of box member
L_{BT}	Depth of box threads (minimum)
L_{ct}	Length of thread lead multiple, compensated for taper
L_{CB}	Boreback length
L_{CYL}	Depth of cylinder of boreback contour
L_{fp}	Thickness of gauge fitting plate
L_{ft}	Distance from shoulder to first full-depth pin thread
L_{GP}	Distance from shoulder to gauge point
L_{pg}	Total length of plug gauge
L_{rg}	Total length of ring gauge
L_{PC}	Length of pin
L_{Qc}	Depth of box counterbore
L_{SRG}	Length of relief groove on pin
L_X	Length from shoulder to last thread scratch on boreback cylinder
n	Number of threads in 25,4 mm (1.0 in)
P	Pitch of thread (used also for lead, since all threads referenced are single-start)
Q	Diameter of ring gauge counterbore
Q_c	Diameter of product box counterbore
r_c	Radius at corners of crest flat
r_r	Radius at corners of root flat
R	Root radius, product thread
R_{bg}	Radius at corners of box stress-relief groove
R_{FG}	Radius at corners of low-torque grooves
S	Mating stand-off of gauges
S_0	Stand-off of certified reference master gauges
S_1	Stand-off of the working plug gauge on a reference master gauge
S_2	Stand-off of the working ring gauge on a reference master gauge
T	Taper, expressed as millimetres of diameter per millimetre of length or inches of diameter per foot of length
T_{FP}	Thickness of gauge fitting plate

φ	Half of the included angle of the taper cone
θ	Angle between the thread flank and the normal to the thread axis

5 Information to be supplied by purchaser

In placing orders for equipment manufactured with rotary shouldered connections in accordance with this part of ISO 10424, the purchaser shall specify the following on the purchase order:

- number of this part of ISO 10424;
- thread style and size;
- if necessary, supplementary requirements as detailed in Clause 6, which are optional with the purchaser.

6 Threading

6.1 Thread profile and dimensions

6.1.1 Overall dimensions

Rotary shouldered connections shall be furnished in the sizes and styles shown in Table 1. Dimensions of rotary shouldered connections shall conform to Tables 1 and 2, and Figures 1 and 2. The taper, T , in Tables 1 and 2, is related to the half-angle, φ , in Figures 1 and 2, by $T = 2 \tan \varphi$.

The dimensions shown in Tables 1 and 2 that have no specified tolerance and do not have tolerances defined below shall be considered reference dimensions. Deviations from these dimensions shall not be cause for rejection. The extent of the bevel of the small end of the pin is optional with the manufacturer.

Right-hand threads shall be considered standard. Left-hand threads conforming to this part of ISO 10424 shall be acceptable, if certified reference master gauges exist for these threads.

Table 1 — Product thread dimensions for preferred connections
(SI units ^a)

Dimensions in millimetres, unless otherwise specified

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Connection style and size	Thread form	Taper ^b <i>T</i> mm/mm	Threads per 25,4 mm <i>n</i>	Pitch dia. at gauge point <i>C</i>	Large dia. of pin <i>D_L</i> ref.	Pin cylinder dia. <i>D_{LF}</i> ± 0,4	Small dia. of pin <i>D_S</i> ref.	Pin length ^c <i>L_{PC}</i> 0 -3	Depth of box threads <i>L_{BT}</i> min.	Total box depth <i>L_{BC}</i> +9 0	Box c/bore dia. <i>Q_c</i> +0,8 -0,4	Depth of box c/bore <i>L_{QC}</i> +1,6 -0,8	<i>L_{ft}</i> max.
NC23	V-038R	1/6	4	59,817 0	65,10	61,90	52,40	76,20	79,38	92,08	66,68	15,88	12,70
NC26	V-038R	1/6	4	67,767 2	73,05	69,85	60,35	76,20	79,38	92,08	74,61	15,88	12,70
NC31	V-038R	1/6	4	80,848 2	86,13	82,96	71,31	88,90	92,08	104,78	87,71	15,88	12,70
NC35	V-038R	1/6	4	89,687 4	94,97	92,08	79,09	95,25	98,42	111,12	96,84	15,88	12,70
NC38	V-038R	1/6	4	96,723 2	102,00	98,83	85,07	101,60	104,78	117,48	103,58	15,88	12,70
NC40	V-038R	1/6	4	103,428 8	108,71	105,56	89,66	114,30	117,48	130,18	110,33	15,88	12,70
NC44	V-038R	1/6	4	112,191 8	117,47	114,27	98,42	114,30	117,48	130,18	119,06	15,88	12,70
NC46	V-038R	1/6	4	117,500 4	122,78	119,61	103,73	114,30	117,48	130,18	124,62	15,88	12,70
NC50	V-038R	1/6	4	128,059 2	133,34	130,43	114,29	114,30	117,48	130,18	134,94	15,88	12,70
NC56	V-038R	1/4	4	142,646 4	149,24	144,86	117,49	127,00	130,18	142,88	150,81	15,88	12,70
NC61	V-038R	1/4	4	156,921 2	163,52	159,16	128,59	139,70	142,88	155,58	165,10	15,88	12,70
NC70	V-038R	1/4	4	179,146 2	185,74	181,38	147,64	152,40	155,58	168,28	187,32	15,88	12,70
1 REG	V-055	1/8	6	29,311 6	32,54	31,32	27,78	38,10	50,80	53,98	33,04	11,13	10,16
1-1/2 REG	V-055	1/8	6	39,141 4	42,37	41,17	36,02	50,80	53,98	66,80	42,88	11,13	10,16
2-3/8 REG	V-040	1/4	5	60,080 4	66,68	63,88	47,62	76,20	79,38	92,08	68,26	15,88	12,70
2-7/8 REG	V-040	1/4	5	69,605 4	76,20	73,41	53,98	88,90	92,08	104,78	77,79	15,88	12,70
3-1/2 REG	V-040	1/4	5	82,292 7	88,89	86,11	65,07	95,25	98,42	111,12	90,49	15,88	12,70
4-1/2 REG	V-040	1/4	5	110,867 7	117,46	114,68	90,47	107,95	111,12	123,82	119,06	15,88	12,70
5-1/2 REG	V-050	1/4	4	132,944 1	140,20	137,41	110,03	120,65	123,82	136,52	141,68	15,88	12,70
6-5/8 REG	V-050	1/6	4	146,248 1	152,19	149,40	131,02	127,00	130,18	142,88	153,99	15,88	12,70
7-5/8 REG	V-050	1/4	4	170,549 1	177,80	175,01	144,46	133,35	136,52	149,22	180,18	15,88	12,70
8-5/8 REG	V-050	1/4	4	194,731 1	201,98	199,14	167,85	136,53	139,70	152,40	204,39	15,88	12,70
5 1/2 FH	V-050	1/6	4	142,011 4	147,95	145,16	126,78	127,00	130,18	142,88	150,02	15,88	12,70
6-5/8 FH	V-050	1/6	4	165,597 8	171,53	168,73	150,37	127,00	130,18	142,88	173,83	15,88	12,70

^a See Table A.1 for USC units.

^b Taper, *T*: 1/6 mm/mm corresponds to a half-angle of $\varphi = 4,764^\circ$.
1/4 mm/mm corresponds to a half-angle of $\varphi = 7,125^\circ$.
1/8 mm/mm corresponds to a half-angle of $\varphi = 3,576^\circ$.

^c For roller cone drill bits only, the pin length may vary by -5 mm.

6.1.2 Shoulder contact face

Shoulder contact faces of rotary shouldered connections shall be plane, and square with the thread axis, within 0,05 mm (0.002 in).

6.1.3 Stand-off

Rotary shouldered connections shall be produced with stand-off tolerances as specified in Clause 8.

6.1.4 Thread axis

Thread axes of rotary shouldered connections, except on bits, shall not deviate from the design axes of the product by an angle greater than $0,057^\circ$ [$0,001 \text{ mm/mm}$ (0.001 in/in) of projected axis]. The design axis shall be assumed to intersect the thread axis at the plane of the joint shoulder.

6.1.5 Lead tolerance

The lead tolerance of rotary shouldered connections shall be as follows:

- a) $\pm 0,038 \text{ mm}$ per $25,4 \text{ mm}$ (0.0015 in per in) for any $25,4 \text{ mm}$ (1.0 in) between first and last full depth threads;
- b) $\pm 0,114 \text{ mm}$ (0.0045 in) between first and last full depth threads, or the sum of $0,0254 \text{ mm}$ (0.001 in) for each $25,4 \text{ mm}$ (1 in) between first and last full depth threads, whichever is greater.

Clause 8 describes the method for determining lead.

6.1.6 Taper tolerance

The taper tolerance of rotary shouldered connections shall be as follows:

- a) pin thread: $+0,0025 \text{ mm/mm}$ to 0 mm/mm (0.030 in/ft to 0 in/ft) average taper between first and last full depth threads;
- b) box thread: 0 mm/mm to $-0,0025 \text{ mm/mm}$ (0 in/ft to -0.030 in/ft) average taper between first and last full depth threads.

Methods for determining taper are described in 8.5.

6.1.7 Thread form

The thread form shall be as defined in Table 2, and shown in Figures 3 and 4.

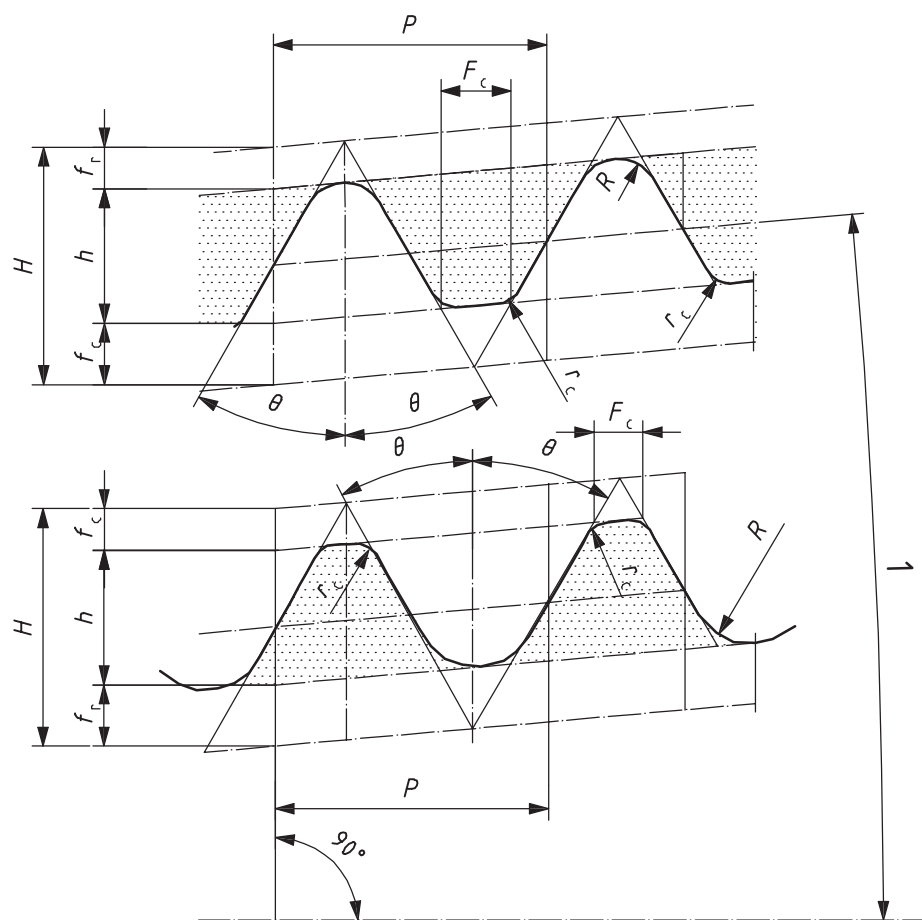
Table 2 — Product thread form dimensions
(SI units ^a)

Dimensions in millimetres, unless otherwise specified

1	2	3	4	5	6	7	8
Thread form		V-038R	V-038R	V-040	V-050	V-050	V-055
Threads per 25,4 mm	n	4	4	5	4	4	6
Lead, ref		6,35	6,35	5,08	6,35	6,35	4,233 33
Half angle	θ , deg $\pm 0,75$	30	30	30	30	30	30
Taper	T , mm/mm	1/6	1/4	1/4	1/6	1/4	1/8
Crest flat width	F_c , ref.	1,65	1,65	1,02	1,27	1,27	1,40
Root radius	R	0,97	0,97	0,51	0,64	0,64	N/A
Root flat width	F_r , ref.	N/A	N/A	N/A	N/A	N/A	1,19
Root flat corner radius	$r_r \pm 0,2$	N/A	N/A	N/A	N/A	N/A	0,38
Thread height, not truncated	H , ref.	5,486 53	5,470 62	4,376 50	5,486 53	5,470 62	3,661 40
Crest truncation	f_c	1,426 50	1,422 36	0,875 31	1,097 31	1,094 12	1,208 26
Root truncation	f_r	0,965 20	0,965 20	0,508 00	0,635 00	0,635 00	1,032 51
Thread height truncated	$h \begin{smallmatrix} +0,025 \\ -0,076 \end{smallmatrix}$	3,094 83	3,083 06	2,993 19	3,754 22	3,741 50	1,420 63
Crest flat corner radius	$r_c \pm 0,2$	0,38	0,38	0,38	0,38	0,38	0,38

NOTE See Figures 4 and 5 for meaning of dimensions.

^a See Table A.2 for values in USC units.

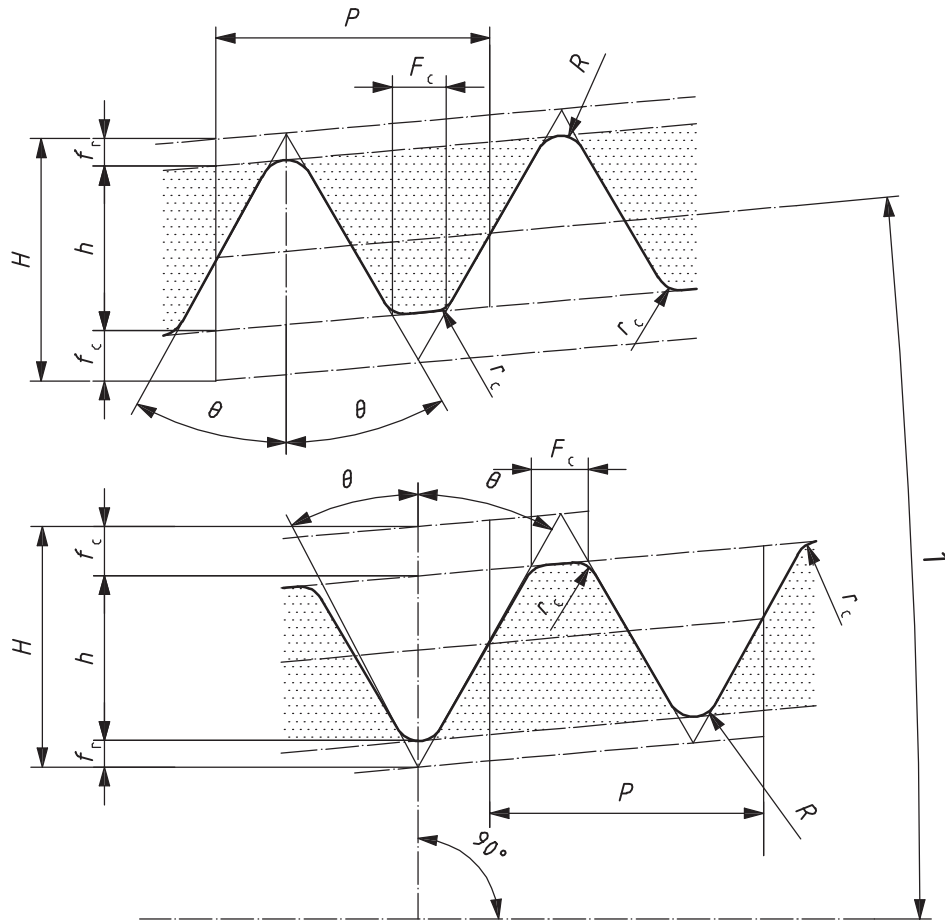


a) V-038R

Key

- 1 taper half-angle, φ

Figure 3 — Product thread forms

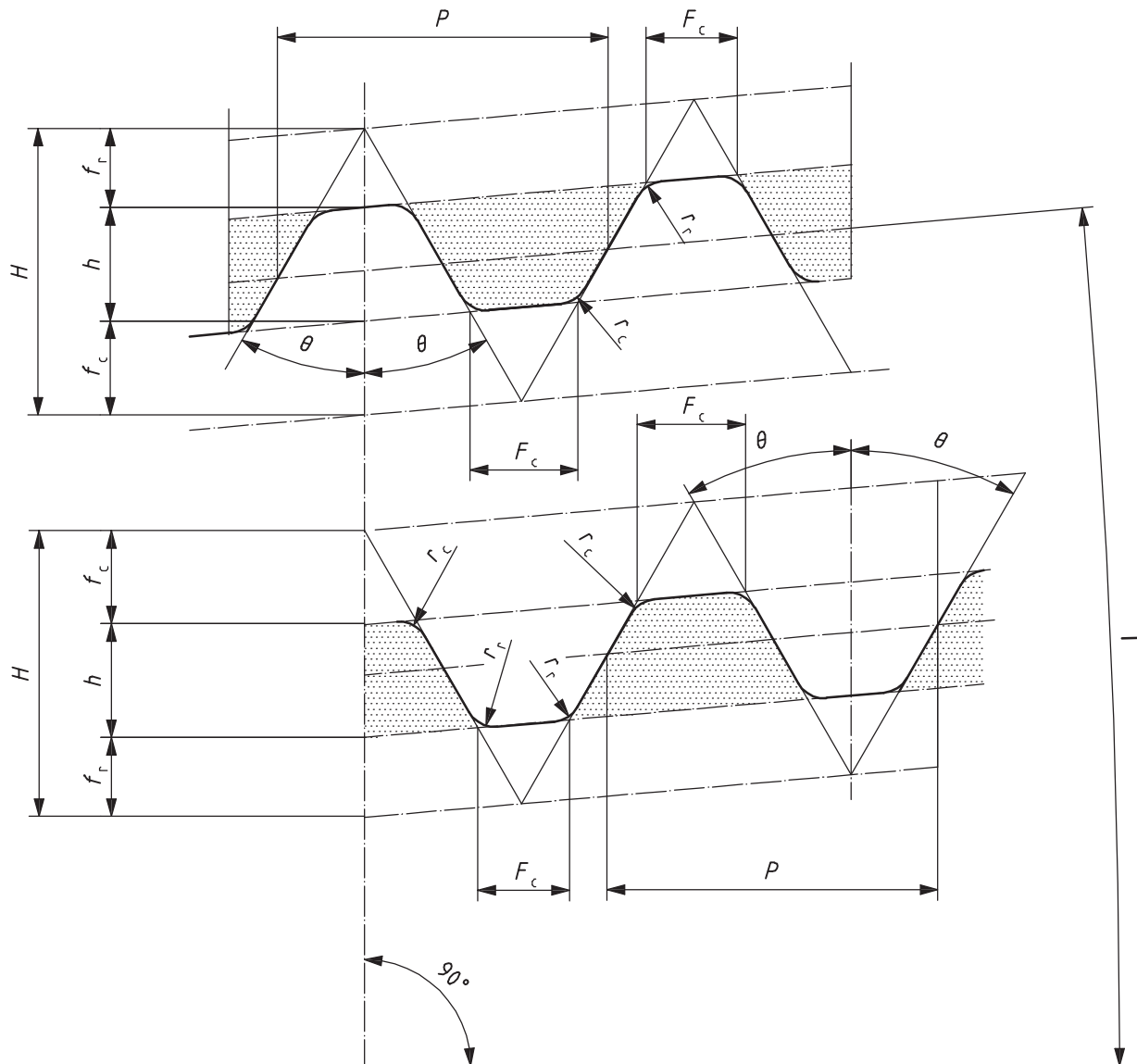


b) V-050, V-040

Key

1 taper half-angle, φ

Figure 3 (continued)



Key

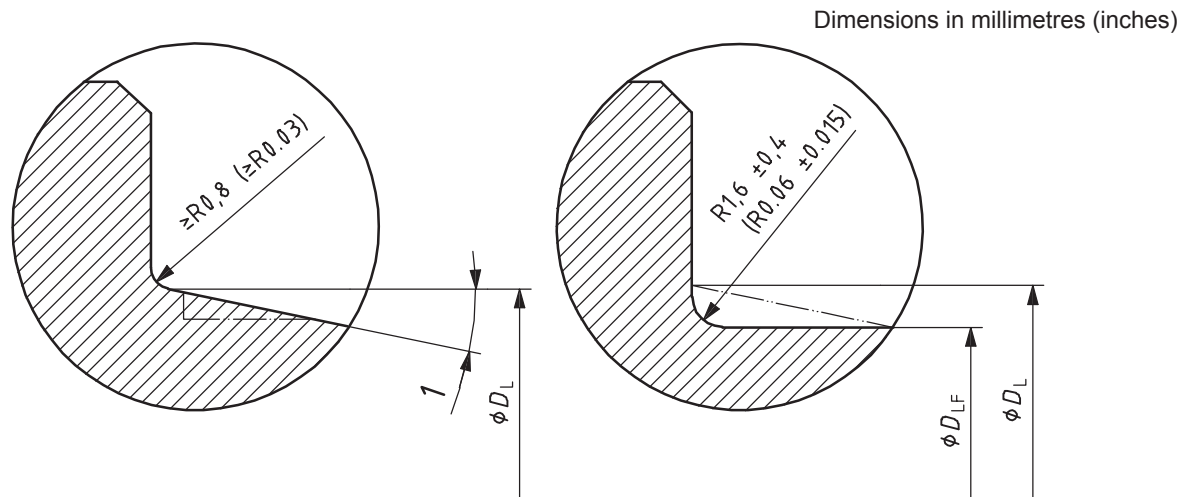
- 1 taper half-angle, φ

Figure 4 — Product thread form V-055

6.1.8 Pin base diameter

Pin base diameter dimensional requirements shall be as follows.

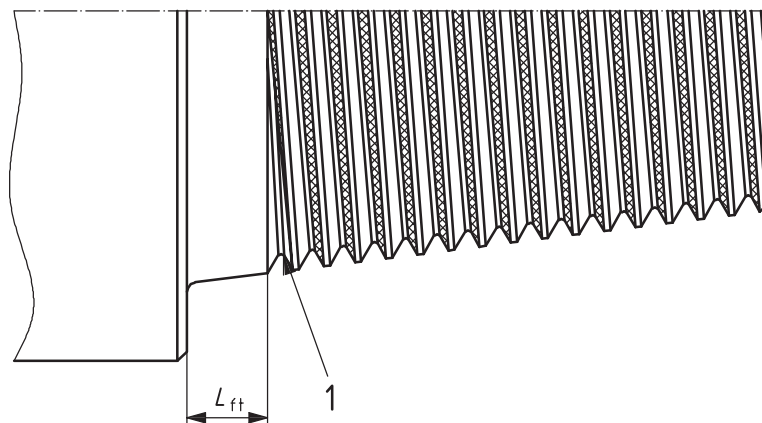
- Rotary shouldered connections on drill collars shall have a cylindrical region at the base conforming to the dimension D_{LF} of Table 1, and shall have a $1,6 \text{ mm} \pm 0,4 \text{ mm}$ ($0.062 \text{ in} \pm 0.015 \text{ in}$) radius at the pin base as shown in Figure 5, except when a stress-relief groove is used.
- Rotary shouldered connections on products other than drill collars may have a tapered region at the pin base rather than a cylindrical region. When the tapered base is used, the radius at the intersection of the taper and the sealing face shall be equal to or greater than $0,8 \text{ mm}$ (0.03 in), as shown in Figure 5.
- The distance between the pin shoulder and the intersection of the pin base diameter with the thread flank at the first point of full thread depth shall not exceed L_{ft} (see Figure 6 and Table 1).



Key

- 1 taper half-angle, φ

Figure 5 — Pin base cylinder



Key

- 1 first point of full thread depth

Figure 6 — First point of full thread depth

6.1.9 Box counterbore

The box counterbore shall have the diameter, Q_C , specified in Table 1, and taper, T , as described in 6.1.1 and shown in the detail of Figure 2. The depth of the counterbore shall be L_{QC} , as specified in Table 1. The angle of the bevel at the intersection of the counterbore and the first threads is optional to the manufacturer and is typically 25° to 45° .

6.2 Bevels for drill collars and tools that mate directly with drill collars

Bevel diameters on drill collars and tools that mate with them are based on a computation described in detail in Annex I, which depends on the outside diameter at the connection. The bevel diameter for the smallest diameter commonly used, the reference diameter, is listed in Table 3. The bevel diameter is re-calculated for every 6,4 mm (0.25 in) increase in outside diameter of the drill collar. For every 6,4 mm (0.25 in) increase (or decrease) in outside diameter, the bevel diameter is also increased (or decreased) by 4,8 mm (0.19 in).

Bevel diameters for low-torque features have been arbitrarily set and shall not increase with diameter changes.

Unless otherwise specified, bevel tolerances shall be $\pm 0,4$ mm (± 0.015 in).

These bevel diameters shall not apply to products that have specific requirements in API Spec 7 and ISO 10424-1, tool joints, bits or boxes that mate with bits.

**Table 3 — Reference bevel diameters for 60° included thread angle connections
when used on drill collars**
(SI units ^a)

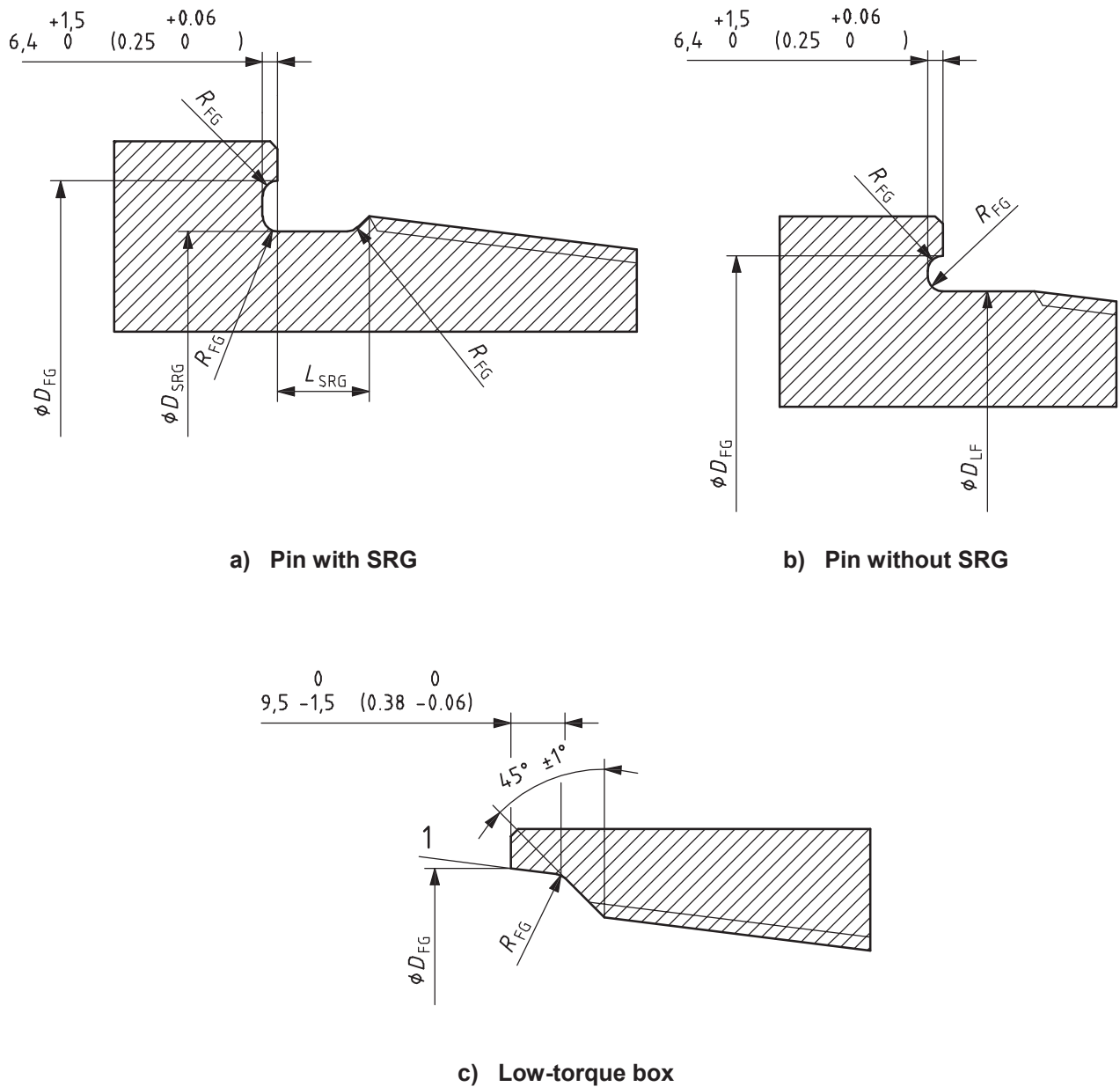
Dimensions in millimetres

1	2	3	4	5	6	7	8	9
Connection size and style	Reference OD ^b	Reference bevel diameter	Connection size and style	Reference OD ^b	Reference bevel diameter	Connection size and style	Reference OD ^b	Reference bevel diameter
NC23	79,38	76,20	NC50	161,92	155,18	51/2 REG	165,10	159,54
NC26	85,72	82,95	NC56	190,50	180,58	65/8 REG	190,50	181,37
NC31	104,78	100,41	NC61	209,55	198,44	75/8 REG	219,08	209,55
NC35	120,65	114,70	NC70	241,30	227,81	75/8 REG LT	244,48	234,95
NC38	120,65	116,28	23/8 REG	79,38	76,60	85/8 REG FF	241,30	232,17
NC40	133,35	127,40	27/8 REG	98,42	90,88	85/8 REG LT	269,88	266,70
NC44	146,05	139,70	31/2 REG	107,95	103,58	51/2 FH	171,45	165,89
NC46	152,40	145,26	41/2 REG	139,70	134,54	65/8 FH	203,20	195,66
NOTE These bevel diameters do not apply to tool joints, bits or boxes that mate with bits.								
^a See Table A.3 for USC units.								
^b See 6.2 for OD larger than the reference OD.								

6.3 Low-torque feature

Several connections in larger sizes shall have modified bevel diameters and enlarged face counterbores when used on products with a large outside diameter. This allows the make-up torque to achieve adequate compressive stress on the sealing face while maintaining bending stiffness. These features are shown in Figure 7, and dimensions in Table 4. These features shall be mandatory above the product diameter indicated.

Dimensions in millimetres (inches), unless otherwise specified



Key

1 taper

Figure 7 — Low-torque feature for certain connections with ODs larger than 241 mm (9.5 in)

Table 4 — Low-torque feature
(SI units ^a)

Dimensions in millimetres

1	2	3	4
Connection size and style	Required above OD	Face groove diameter $D_{FG} \begin{smallmatrix} +0,8 \\ -0,4 \end{smallmatrix}$	Face groove radius $R_{FG} \begin{smallmatrix} 0 \\ -0,4 \end{smallmatrix}$
7-5/8 REG	241,3	196,9	6,35
8-5/8 REG	266,7	228,6	6,35
NOTE See Figure 7.			
^a See Table A.4 for USC units.			

7 Product optional features

7.1 General

The requirements given in 7.2 to 7.6 apply only if stated on the purchase order.

7.2 Stress-relief features

If fatigue failures in connections can be a problem, stress-relief features may be specified. Stress-relief features are of two basic designs: a groove on the pin and a boreback contour for boxes or a groove on both the pins and boxes. The boreback stress-relief contour is the recommended design for the box connection. However, the box relief groove also has been shown to provide beneficial effects.

These features are shown in Figures 8 through 10. The dimensions for connections not listed here may be calculated according to the equations in Annex I. Stress-relief grooves at the pin shoulder and stress-relief grooves or borebacks at the base of the box thread shall conform to the dimensions shown in Table 5.

Stress-relief grooves are not recommended for use on pin threads with pitch diameter, C , at gauge point smaller than 89 mm (3.5 in).

The boreback contour is not recommended for use on threads with pin length, L_{PC} , smaller than 89 mm (3.5 in).

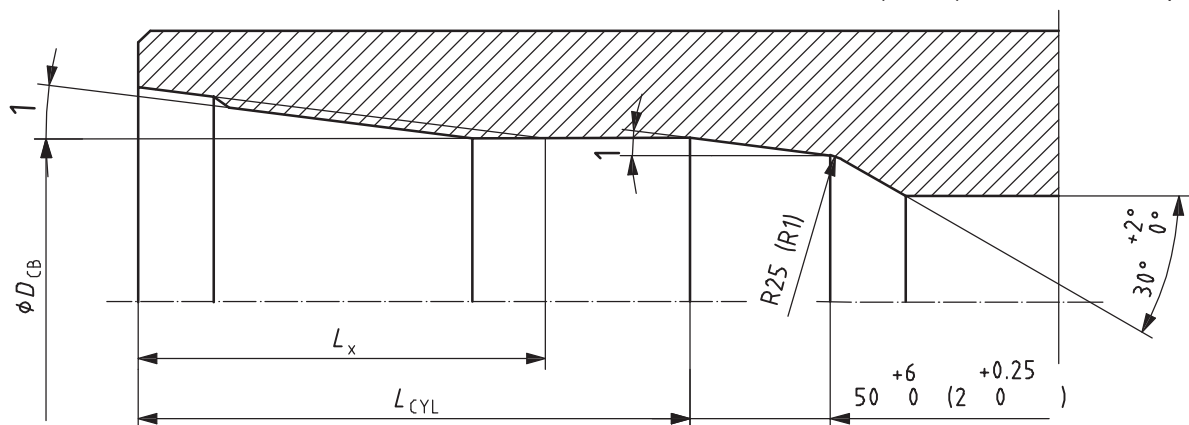
Stress-relief grooves on pins cause a slight reduction in the tensile strength and section modulus of the connection. However, under most conditions this reduction in cross-sectional area is more than offset by the reduction in fatigue failures. If unusually high loads are expected, calculations of the effect should be made.

Table 5 — Stress-relief groove and boreback contour dimensions for preferred connections
(SI units ^a)

Dimensions in millimetres

1	2	3	4	5	6	7	8
Connection size and style	Box boreback contour			Box groove		Pin groove	
	Cylinder diameter	Depth to last thread scratch	Depth to end of cylinder	Diameter of box groove	Depth to start of box groove	Diameter of pin groove	Length of pin groove
	D_{CB} $+0,38$ 0	L_X reference	L_{CYL} $\pm 7,9$	D_{BG} $+0,79$ 0	L_{BG} 0 $-3,1$	D_{SRG} 0 $-0,79$	L_{SRG} $\pm 0,79$
NC35	82,15	82,55	133,35	84,53	85,72	82,07	25,40
NC38	88,11	88,90	139,70	90,49	92,08	89,10	25,40
NC40	92,87	101,60	152,40	94,85	104,78	95,81	25,40
NC 44	101,60	101,60	152,40	103,58	104,78	104,57	25,40
NC46	106,76	101,60	152,40	109,14	104,78	109,88	25,40
NC50	117,48	101,60	152,40	119,46	104,78	120,45	25,40
NC56	121,84	114,30	165,10	123,03	117,48	134,04	25,40
NC61	132,95	127,00	177,80	134,14	130,18	148,31	25,40
NC70	152,00	139,70	190,50	153,19	142,88	170,54	25,40
4-1/2 REG	94,46	95,25	146,05	96,04	98,42	101,93	25,40
5-1/2 REG	114,30	107,95	158,75	114,30	111,12	123,67	25,40
6-5/8 REG	134,14	114,30	165,10	134,94	117,48	137,59	25,40
7-5/8 REG	148,83	120,65	171,45	148,83	123,82	161,26	25,40
8-5/8 REG	172,24	123,82	174,63	172,24	127,00	185,45	25,40
5 1/2 FH	129,78	114,30	165,10	130,97	117,48	133,35	25,40
6-5/8 FH	153,59	114,30	165,10	154,38	117,48	156,95	25,40
NOTE See Figures 8 to 10.							
^a See Table A.5 for USC units.							

Dimensions in millimetres (inches) unless otherwise specified



Key

1 taper half-angle, ϕ

Figure 8 — Box boreback feature

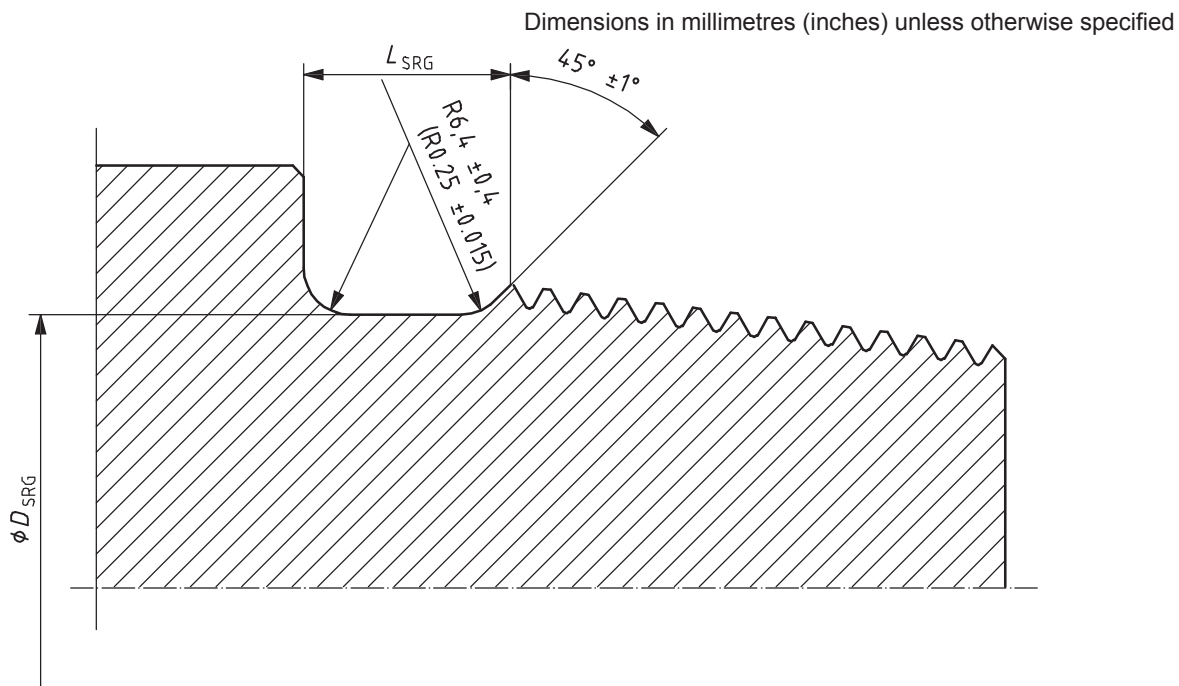
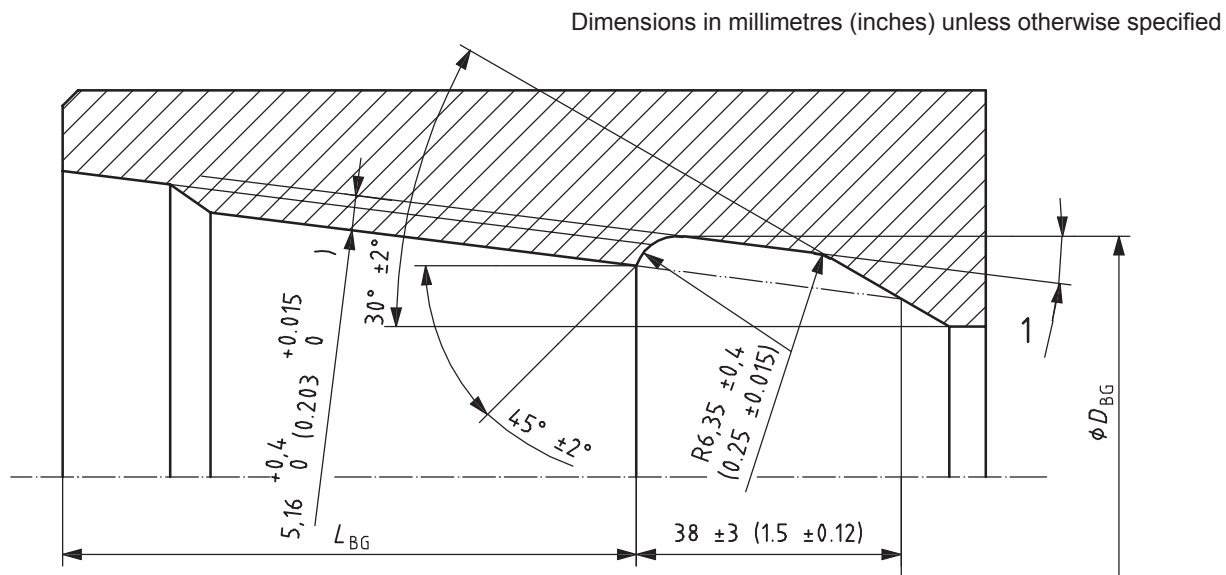


Figure 9 — Pin stress-relief groove



Key

- 1 taper half-angle, φ

Figure 10 — Box stress-relief groove

7.3 Benchmarks

7.3.1 General

If so specified, a benchmark may be used on both box and pin to serve as a witness of the original dimensions. This permits the evaluation of any rework of the shoulder face to repair damage in service. The benchmark should be applied 3,18 mm (0.125 in) from the face, on the pin base or on the box counterbore.

Benchmarks are commonly used on drill-pipe tool joints. They shall not be used on pin connections with stress-relief grooves.

Two types of benchmarks are used.

7.3.2 Cylinder benchmark

The cylinder benchmark consists of a turned flat in the box counterbore or on the pin base, 3,18 mm (0.125 in) long, as shown in Figures 11 and 12.

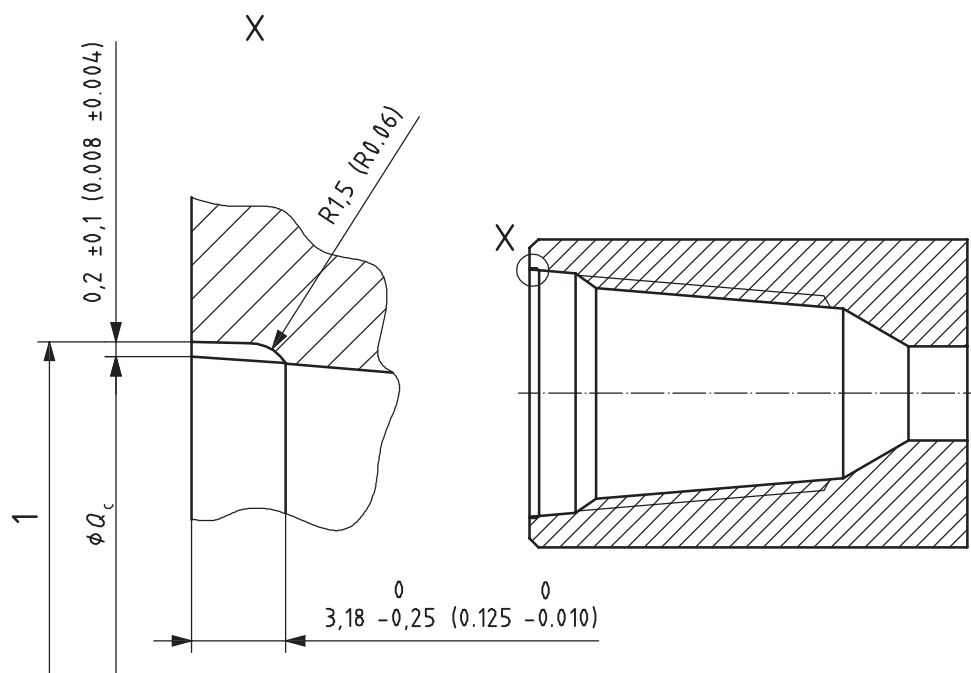
The diameter of the cylinder benchmark feature in the box is the counterbore diameter, Q_C , plus 0,4 mm (0.016 in).

The diameter of the cylinder benchmark feature on the pin is the pin base cylinder diameter, D_{LF} , plus 0,8 mm (0.032 in).

7.3.3 Stamped benchmark

The stamped benchmark consists of a 4,7 mm (0.19 in) diameter circle with a bar tangent to the circle. The bar is located to the side of the circle nearest the make-up shoulder. The benchmark is stamped on the product so that the bar is parallel to the make-up shoulder and positioned 3,18 mm (0.125 in) from the shoulder face, as shown in Figure 13.

Dimensions in millimetres (inches)



Key

1 benchmark diameter; see 7.3.2

Figure 11 — Cylinder benchmark — Box

Dimensions in millimetres (inches)

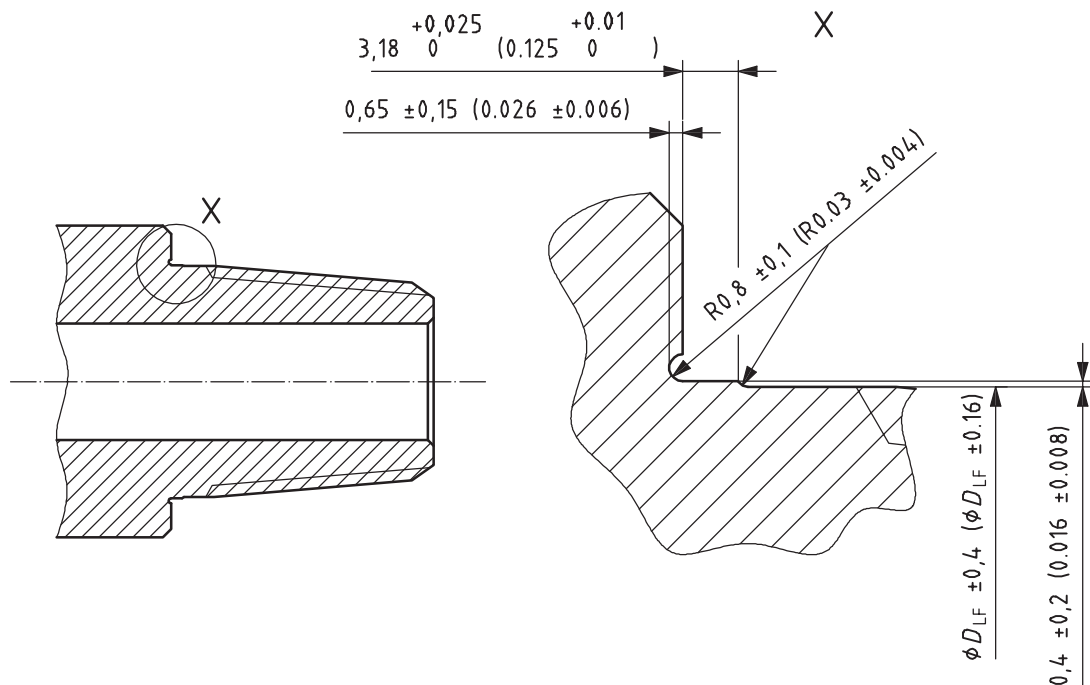


Figure 12 — Cylinder benchmark — Pin

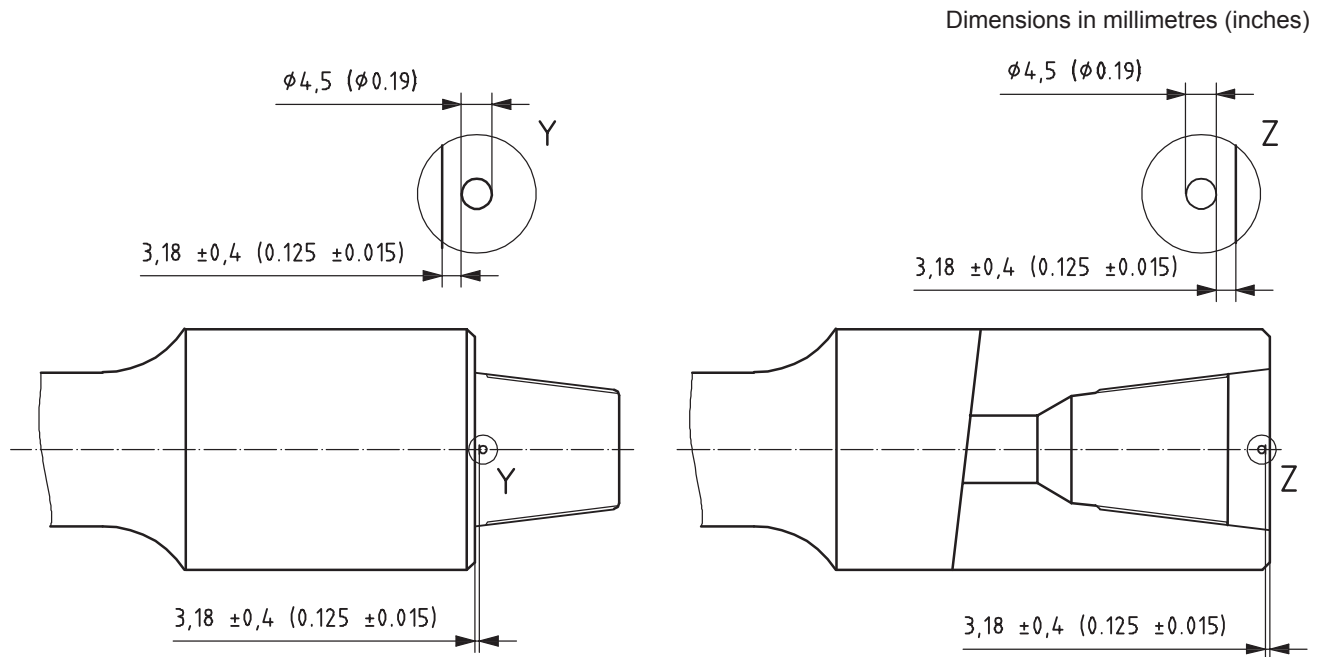


Figure 13 — Stamped benchmark

7.4 Surface treatment

All gauging shall be done before surface treatment.

7.5 Cold working

If so specified, the roots of threads may be cold worked after gauging. A connection shall be considered to conform to this specification if it meets the requirements of this part of ISO 10424 before cold working. In such event, the connection shall also be stamped with the mark "CW" to indicate cold working after gauging. A pin connection shall be so marked on the end of the pin. A box connection shall be marked in the box counterbore.

NOTE 1 Gauge stand-off changes after cold working of threads. Cold working of gauged connections can, therefore, result in connections that do not fall within the gauge stand-off of this part of ISO 10424. This does not affect the interchangeability of connections and improves the performance of connections in fatigue.

NOTE 2 Cold working procedures are outside the scope of this document. Improper cold working can be damaging to the connection.

7.6 Break-in

If so specified, the connection may be "broken-in" by repeated make and break of the connection before being placed in service. All gauging shall be done before break-in.

8 Product gauging

8.1 Gauging

8.1.1 General

Any manufacturer who desires to produce drill-stem members utilizing rotary shouldered connections conforming to this part of ISO 10424 shall own or have access to calibrated reference master gauges, consisting of individual reference master plug(s) and reference master ring gauge(s) conforming to the requirements in 9.2.2.

All threads of rotary shouldered connections shall comply with the gauging requirements specified herein. These requirements are not intended in any way to restrict the use of any other instruments or methods to control manufacturing operations. In case of dispute, acceptance and rejection of the product shall be governed by the use of instruments for determining stand-off, lead, taper and thread form described in this part of ISO 10424. The intent of this part of ISO 10424 is that any thread element of the product shall be acceptable if any measurement of that element, measured as defined in 8.1.2 to 8.6, is found to be in conformance. That is, the variation of gauges, within tolerances, shall not be a reason for rejection.

8.1.2 Precautions

8.1.2.1 Temperature

All instruments shall be exposed to the same temperature conditions as the product for inspection, for a time sufficient to eliminate any temperature difference.

Some materials used to make rotary shouldered connections, notably on non-magnetic drill collars, have thermal expansion coefficients significantly different from the steel used to make gauges. This effect can impact the measurement of stand-off if the temperature is far from 20 °C (68 °F), and should be taken into account.

8.1.2.2 Care of instruments

The instruments described herein are precision instruments and shall be handled in a careful and intelligent manner, commensurate with the maintenance of the high accuracy and precision required for inspection under the requirements of this gauging practice, as described in Annexes B, C and D. If any instrument is damaged, for instance, inadvertently dropped or severely shocked, it should not be used for inspection purposes until its accuracy has been re-established.

8.1.2.3 Cleaning the threads

All threads shall be cleaned thoroughly before gauging. If the gauging is made after shipment, the thread compound shall be removed with a brush having stiff bristles, using a suitable solvent.

8.2 Stand-off measurement

8.2.1 Stand-off

The stand-off of the working gauge is intended as a method to locate the plane of the pitch diameter in relation to the sealing shoulder of the connection. It is dependent on the other elements of the thread, notably lead and taper, but this effect is small when they are in conformance with the specification.

8.2.2 Working gauges

The manufacturer shall have available working gauges, as defined in Clause 9, to gauge product threads and shall maintain all working gauges in such condition as to ensure that product threads, gauged as required herein, are acceptable (see Annex D for recommended practice for care and use of working gauges). The

working gauges shall comply with all the stipulations on calibration and retest as specified in Clause 10. The use of reference master gauges in checking product threads should be minimized. Such use should be confined to cases of dispute that cannot be settled by rechecking the working gauges against the reference master. Good care should be exercised when the reference master gauge is assembled on a product thread. The purchaser of reference master gauges shall comply with all the stipulations on calibration and retest as given in Clause 10.

8.2.3 Stand-off tolerances

Tolerances on stand-off values shall be as specified in Figure 14. The stand-offs, S_1 and S_2 , to the working gauges are defined in 9.1. These tolerances shall apply after the connection is finish-machined and before any anti-galling or cold-working surface treatment is applied to the pin or box connection. Gauge stand-off may change after the application of surface treatment and may cause the stand-off to exceed the limits specified for the connection and shall not constitute a cause for rejection. It is, therefore, permissible for a connection to be referenced to this part of ISO 10424 if it meets its requirements before the application of the surface treatment.

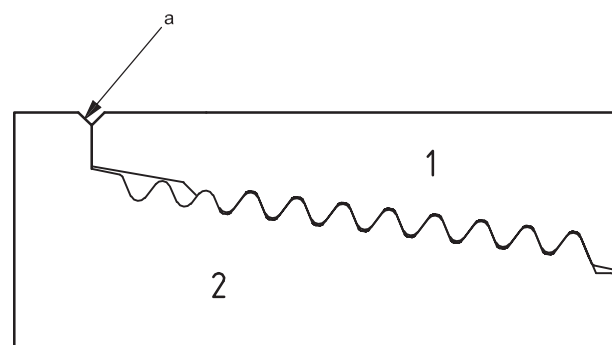
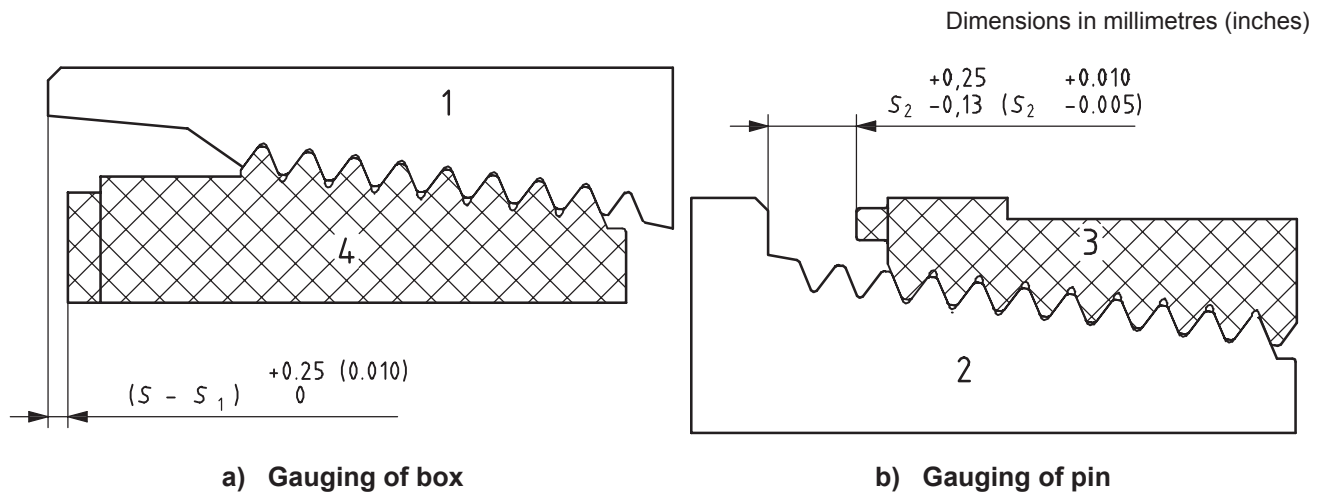
8.3 Gauge contact points

The measurement of lead and taper should preferably be made as close as practical to the pitch cone of the thread. Contact points of lead and taper gauges shall, therefore, be of the ball-point type and should preferably be made of tungsten carbide or tantalum carbide. The dimensions of the ball-point contacts shall be such that they contact the thread flanks rather than the thread root. The ball-points meeting flank contact requirements are specified in Table 6, column 5. The contact points for thread height gauges should be ball type with a diameter as specified in Table 6, column 7 and shall not contact the thread flank.

8.4 Lead measurement

8.4.1 Lead tolerances

Lead tolerances shall be expressed in terms of millimetres per 25,4 mm (inches per 1 in) of threads and cumulative error and lead errors shall be determined accordingly. For interval measurements over lengths other than 25,4 mm (1 in), the observed errors should be calculated to the basis of millimetres per 25,4 mm (inches per 1 in). For cumulative measurements, observed errors represent the cumulative errors.



c) Mating of product threads

Key

- 1 product box
- 2 product pin
- 3 working ring gauge
- 4 working plug gauge
- a Hand tight.

Figure 14 — Gauging practice

8.4.2 Lead gauges

The lead of threads shall be gauged with a lead gauge. The accuracy of the measuring mechanism shall be 0,005 mm (0.000 2 in) or better.

8.4.3 Lead gauge setting standard

Lead gauge setting standards, similar to Figure 15, shall be so constructed as to compensate for the error in measuring lead parallel to the taper cone instead of parallel to the thread axis, according to the values shown in Table 6. The distance between any two adjacent notches of the template shall be accurate within a tolerance of $\pm 0,003$ mm (± 0.000 1 in), and between any two non-adjacent notches within a tolerance of $\pm 0,005$ mm (± 0.000 2 in).