

टैपिंग स्क्रू थ्रेड के साथ ड्रिलिंग स्क्रू —
यांत्रिक और कार्यात्मक गुणधर्म

**Drilling Screws with Tapping
Screw Thread — Mechanical
and Functional Properties**

ICS 21.060.10

© BIS 2024
© ISO 1999



भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002

www.bis.gov.in www.standardsbis.in

NATIONAL FOREWORD

This Indian Standard which is identical to ISO 10666 : 1999 'Drilling screws with tapping screw thread — Mechanical and functional properties' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the General Engineering and Fasteners Standards Sectional Committee and after approval of the Production and General Engineering Division Council.

The text of ISO standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

- a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'; and
- b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, references appear to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards, which are to be substituted in their respective places, are listed below along with their degree of equivalence for the editions indicated:

<i>International Standard</i>	<i>Corresponding Indian Standard</i>	<i>Degree of Equivalence</i>
ISO 1478 : 1999 Tapping screw thread	IS 5957 : 2003/ISO 1478 : 1999 Screw threads for thread forming tapping screws dimensions (<i>second revision</i>)	Identical
ISO 4042 : 1999 Fasteners — Electroplated coatings	IS 1367 (Part 11) : 2020/ISO 4042 : 2022 Technical supply conditions for threaded steel fasteners: Part 11 Electroplated coating systems (<i>fifth revision</i>)	Identical
ISO 6507-1 : 1997 Metallic materials — Vickers hardness test — Part 1: Test method	IS 1501 (Part 1) : 2020/ISO 6507-1 : 2018 Metallic materials — Vickers hardness test: Part 1 Test method (<i>fifth revision</i>)	Identical
ISO 15330 : 1999 Fasteners — Preloading test for the detection of hydrogen embrittlement — Parallel bearing surface method	IS 17445 : 2020/ISO 15330 : 1999 Fasteners — Preloading test for the detection of hydrogen embrittlement — Parallel bearing surface method	Identical

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'.

Indian Standard

**DRILLING SCREWS WITH TAPPING SCREW THREAD —
MECHANICAL AND FUNCTIONAL PROPERTIES**

1 Scope

This International Standard specifies the properties of heat treated screws with a tapping screw thread in accordance with ISO 1478, and which are designed with a drilling point which automatically drills the core hole for the screw during assembly. Such screws then automatically form the mating screw thread, either in a non-cutting or in a cutting operation, with the aid of the threaded portion of the screw adjoining the drilling point.

The purpose of this International Standard is to ensure that the screws are able to drill their core hole and form their mating screw thread without becoming distorted or fracturing in the process, provided that no overstressing has occurred. Consequently the following characteristics are regarded as representing the most important aspects for the assessment of the mechanical and operational characteristics of a drilling screw:

- surface hardness;
- capability of core hole drilling and forming of the mating female screw thread;
- torsional strength.

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 1478:1999, *Tapping screw thread*.

ISO 4042:1999, *Fasteners — Electroplated coatings*.

ISO 6507-1:1997, *Metallic materials — Vickers hardness test — Part 1: Test method*.

ISO 15330:1999, *Fasteners — Preloading test for the detection of hydrogen embrittlement — Parallel bearing surface method*.

3 Requirements

3.1 Material

Case hardening steel or heat treatable steel shall be used as the material for drilling screws.

3.2 Metallurgical properties

3.2.1 Surface hardness

The minimum surface hardness of drilling screws after heat treatment shall be 530 HV 0,3.

3.2.2 Core hardness

The core hardness after heat treatment shall be

- 320 HV 5 to 400 HV 5 for threads \leq ST 4,2 and
- 320 HV 10 to 400 HV 10 for threads $>$ ST 4,2

including a recommended minimum tempering temperature of 330 °C.

The tempering temperature range 275 °C to 315 °C shall be avoided in order to minimize the risk of tempered martensite embrittlement.

3.2.3 Case depth

The case depth shall conform to the values given in Table 1.

Table 1 — Case depth

Thread	Case depth mm	
	min.	max.
ST 2,9 and ST 3,5	0,05	0,18
ST 4,2 to ST 5,5	0,10	0,23
ST 6,3	0,15	0,28

3.2.4 Microstructure

The microstructure of drilling screws shall not exhibit any ferrite streaks between the surface zone and the core after heat treatment.

3.2.5 Hydrogen embrittlement

For electroplated drilling screws there is a risk of failure due to hydrogen embrittlement. Therefore steps shall be taken by the manufacturer and/or the electroplater to manage the risk including test detection in accordance with ISO 15330.

In this connection ISO 4042, in which measures for hydrogen embrittlement relief are described for electroplated fasteners, shall also be consulted.

3.3 Mechanical properties

3.3.1 Core hole drilling capability

The point of the drilling screw shall be shaped in such a way that it is capable of drilling the necessary core hole for forming the mating female screw thread under the test conditions specified in 4.2.1.

3.3.2 Thread forming capability

Drilling screws shall be able to form a mating thread in the core hole drilled according to 3.3.1, without deforming their own thread when driven into a test plate in accordance with 4.2.1.1.

3.3.3 Torsional strength

Drilling screws shall have a torsional strength such that the torque necessary to cause failure, when tested in accordance with 4.2.3, shall equal or exceed the minimum torque values given in Table 4 for the applicable screw threads.

4 Testing

4.1 Testing of metallurgical properties

4.1.1 Testing of surface hardness

The surface hardness shall be tested by a Vickers procedure as specified in ISO 6507-1. The indentation shall be made on a portion of the screw as flat as possible, preferably on the head of the screw.

4.1.2 Testing of the core hardness

The core hardness shall be tested on a transverse micro-section by a with Vickers method as specified in ISO 6507-1.

4.1.3 Measuring the case depth

The case depth shall be measured microscopically on a longitudinal micro-section at the thread flank mid-point between crest and root or, in the case of drilling screws up to and including ST 4,2, in the root of the thread.

For referee purposes, a micro-hardness plot shall be made using a Vickers indenter and a 300 g load on the thread profile of a properly prepared metallographic specimen. The case depth shall be the point at which the recorded hardness is 30 HV above the actual core hardness.

4.1.4 Examination of the structure

The material microstructure shall be examined by metallography.

4.2 Testing of mechanical properties

4.2.1 Drilling and screwing-in-test

4.2.1.1 Test fixture

Figure 1 illustrates an example of a suitable test fixture.

The test plate shall be made from low carbon steel with a carbon content not exceeding 0,23 %. The hardness of the plate shall be 110 HV 30 to 165 HV 30 measured in accordance with ISO 6507-1. The thickness of the test plate shall conform to the values given in Table 2.

4.2.1.2 Test procedure

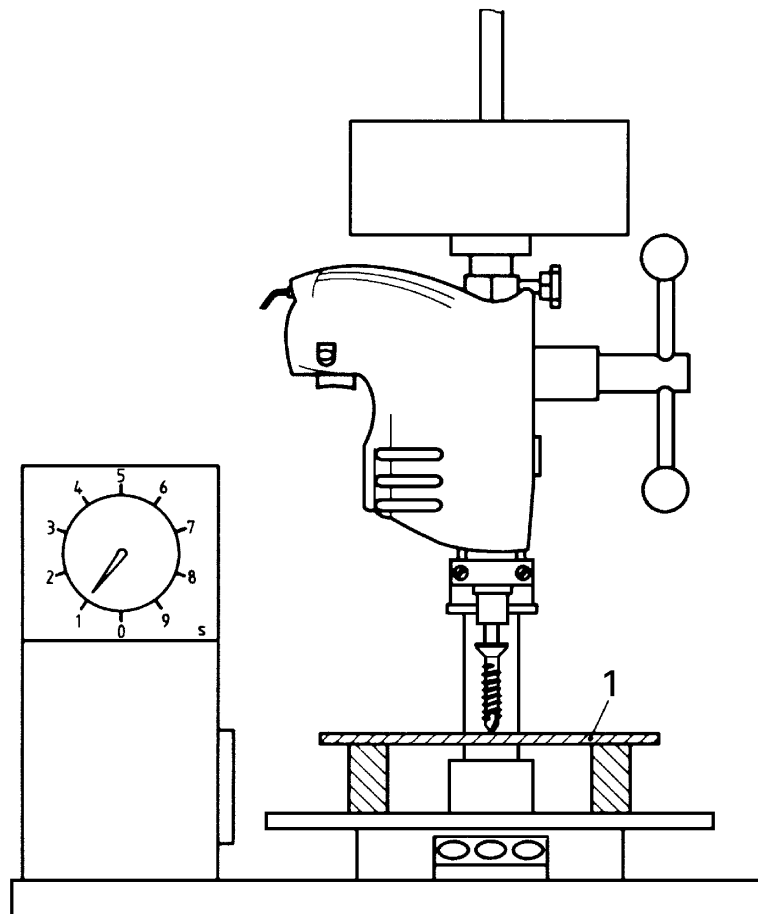
The sample screw (coated or uncoated, as received) shall be driven into the test plate until a thread of full diameter is completely through the test plate.

Axial forces and rotational speeds as specified in Table 2 shall be applied for the drilling and screwing-in-test.

4.2.2 Inspection of the drilled hole

Subject to mutual agreement, an inspection of the drilled hole may also be carried out. For this purpose, test plates in accordance with 4.2.1.1 but with thicknesses as given in Table 3 shall be used. The test plate shall be centered with a light punch mark at the spot to be drilled. After the test plate has been drilled through, the maximum size of the drilled hole shall not exceed the limits specified in Table 3.

Figure 2 illustrates a suitable testing arrangement as an addition to the test fixture illustrated in Figure 1. The inside diameter of the bush shall be approximately 0,25 mm larger than the outside diameter of the screw thread. The length of the bush shall be selected in such a way that the drilling point protrudes out of the bush.



Key

1 Test plate

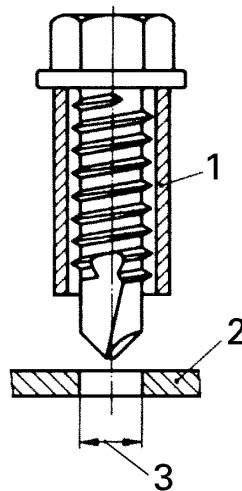
Figure 1 — Test fixture for the drilling and screwing-in-test

Table 2 — Test data for the drilling and screwing-in-test

Thread	Thickness of test plate ^a mm	Axial force N	Test duration max. s	Rotational speed of screw under load
				min ⁻¹
ST 2,9	0,7 + 0,7 = 1,4	150	3	1 800 to 2 500
ST 3,5	1 + 1 = 2	150	4	1 800 to 2 500
ST 4,2	1,5 + 1,5 = 3	250	5	1 800 to 2 500
ST 4,8	2 + 2 = 4	250	7	1 800 to 2 500
ST 5,5	2 + 3 = 5	350	11	1 000 to 1 800
ST 6,3	2 + 3 = 5	350	13	1 000 to 1 800

^a The thickness of the test plate may be achieved by placing two steel sheets on top of one another. These values apply to the acceptance test only.

The axial forces specified in Table 2 can also be regarded as guideline values for the application of drilling screws. If these values are substantially exceeded, the drilling points may be partially destroyed by fracture or burning up.



Key

- 1 bush
- 2 test plate
- 3 drilled hole

Figure 2 — Test arrangement for the drilling test

Table 3 — Test data for the drilled hole

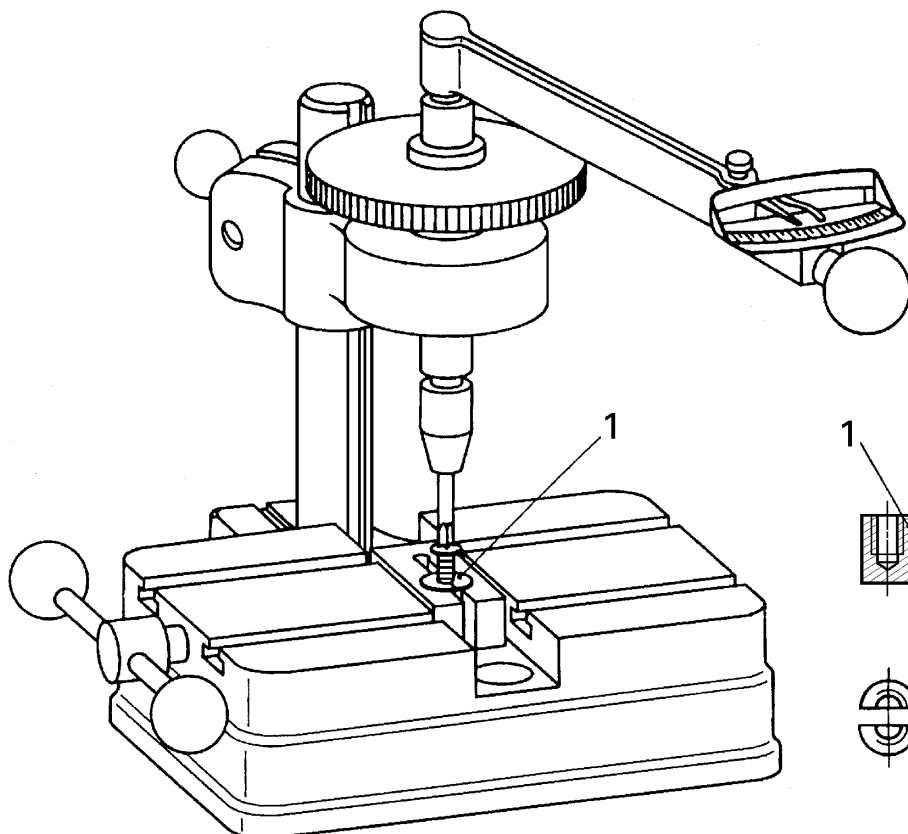
Thread	Plate thickness mm	Hole diameter mm	
		min.	max.
ST 2,9	1	2,2	2,5
ST 3,5	1	2,7	3,0
ST 4,2	2	3,2	3,6
ST 4,8	2	3,7	4,2
ST 5,5	2	4,2	4,8
ST 6,3	2	4,8	5,4

4.2.3 Torsional test

The drilling screw to be tested shall be clamped in a split clamping device with a female screw thread, or in an equivalent testing device in such a way that the clamped portion of the drilling screw is not damaged.

Figure 3 illustrates an example of a testing appliance. After clamping, at least two pitches of the screw thread must protrude above the clamping device, and at least two pitches of the screw thread (without the drilling point) must be firmly clamped in the device or testing appliance. In the case of short drilling screws, the complete screw thread shall be firmly clamped, but the screw head shall not rest on the face of the clamping device.

By means of a suitably calibrated torque-measuring device, torque shall be applied to the screw until failure occurs. The screw shall meet the minimum torsional strengths given in Table 4.



Key

1 Insert with tapered blind hole

Figure 3 — Testing appliance for torsional test

Table 4 — Minimum torsional strength

Thread	Minimum torsional strength N·m
ST 2,9	1,5
ST 3,5	2,8
ST 4,2	4,7
ST 4,8	6,9
ST 5,5	10,4
ST 6,3	16,9

5 Torque wrenches

Torque wrenches used in torsional test shall be accurate within $\pm 3\%$ of the specified torques.

Alternatively, a torque sensing power device of equivalent accuracy may be used.

For referee purposes a manually-operated torque wrench shall be used.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 2016* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Head (Publication & Sales), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the website-www.bis.gov.in or www.standardsbis.in.

This Indian Standard has been developed from Doc No.: PGD 37 (25507).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002

Telephones: 2323 0131, 2323 3375, 2323 9402

Website: www.bis.gov.in

Regional Offices:

Central : 601/A, Konnectus Tower -1, 6th Floor,
DMRC Building, Bhavbhuti Marg, New
Delhi 110002

Telephones

{ 2323 7617

Eastern : 8th Floor, Plot No 7/7 & 7/8, CP Block, Sector V,
Salt Lake, Kolkata, West Bengal 700091

{ 2367 0012
{ 2320 9474

Northern : Plot No. 4-A, Sector 27-B, Madhya Marg,
Chandigarh 160019

{ 265 9930

Southern : C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113

{ 2254 1442
{ 2254 1216

Western : 5th Floor/MTNL CETTM, Technology Street, Hiranandani Gardens,
Powai, Mumbai 400076

{ 2570 0030
{ 2570 2715

Branches : AHMEDABAD, BENGALURU, BHOPAL, BHUBANESHWAR, CHANDIGARH, CHENNAI, COIMBATORE, DEHRADUN, DELHI, FARIDABAD, GHAZIABAD, GUWAHATI, HARYANA (CHANDIGARH), HUBLI, HYDERABAD, JAIPUR, JAMMU, JAMSHEDPUR, KOCHI, KOLKATA, LUCKNOW, MADURAI, MUMBAI, NAGPUR, NOIDA, PARWANOO, PATNA, PUNE, RAIPUR, RAJKOT, SURAT, VIJAYAWADA.