August 1995

Thread rolling screws for ISO metric screw thread
Dimensions, requirements and testing

DIN 7500-1

ICS 21.040.30; 21.060.10

Supersedes December 1984 edition.

Descriptors: Thread rolling screws, metric ISO screw thread, fasteners, screws.

Gewindefurchende Schrauben für metrisches ISO-Gewinde.
Teil 1: Maße, Anforderungen, Prüfung.

In keeping with current practice in standards published by the International Organization for Standardization (ISO), a comma has been used throughout as the decimal marker.

Foreword

This standard has been prepared by the *Normenausschuß Mechanische Verbindungselemente* (Fasteners Standards Committee) and deals with screws which, when driven into a predrilled core hole, form their own mating thread by displacing material radially.

Amendments

The following amendments have been made to the December 1984 edition.

a) The references to other DIN Standards have been updated.
b) An 'E' has been added to each screw head type (except for type 'E' itself).
c) The maximum core hardness has been reduced (to 370 HV).
d) The standard has been editorially revised.

Previous editions

DIN 7500: 1978-10; DIN 7500-1: 1984-12.

Continued on pages 2 to 8

1 Scope and field of application

This standard covers heat-treated thread rolling screws with an ISO metric screw thread as specified in DIN 13-12 which allows them to form a thread capable of accommodating screws with an ISO metric thread. It specifies dimensions which are intended to ensure that the screw thread will not become deformed when the screws are driven in or when they are in service, and that screws will not fracture when subjected to normal loads.

To that end, requirements have been specified for the drilling and thread forming capability, surface hardness, torsional strength and tensile strength of thread rolling screws.

See ISO 3269 for acceptance inspection of fasteners.

2 Normative references

This standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

DIN 13-12
: ISO metric screw threads; coarse and fine pitch threads with diameters from 1 to 300 mm; selected diameters and pitches

DIN 13-15
: ISO metric screw threads; fundamental deviations and tolerances for screw threads of 1 mm diameter and larger

DIN 912
: Hexagon socket head cap screws (modified version of ISO 4762)

DIN 962
: Designation system for fasteners

DIN 1654-1
: Cold heading and cold extruding steels; technical delivery conditions; general

DIN 1654-2
: Cold heading and cold extruding steels; technical delivery conditions for steels for killed unalloyed steels not intended for heat treatment

DIN 1654-3
: Cold heading and cold extruding steels; technical delivery conditions for case harding steels

DIN 1654-4
: Cold heading and cold extruding steels; technical delivery conditions for steels for quenching and tempering

DIN 1654-5
: Cold heading and cold extruding steels; technical delivery conditions for stainless steels

DIN 4000-2
: Tabular layouts of article characteristics for bolts, screws and nuts

DIN 17 210
: Case hardening steel, technical delivery conditions

DIN 50 133
: Vickers hardness testing of metallic materials; HV 0,2 to HV 100

DIN 50 190-1
: Determination of effective case depth of heat treated parts after carburizing

DIN EN 10 083-2
: Quenched and tempered steels; technical delivery conditions for unalloyed quality steels

DIN EN 24 017
: Hexagon head screws; product grades A and B (ISO 4017 : 1988)

DIN EN ISO 1207
: Slotted cheese head screws; product grade A (ISO 1207 : 1992)

DIN EN ISO 1580
: Slotted pan head screws; product grade A (ISO 1580 : 1994)

DIN EN ISO 2009
: Slotted countersunk flat head screws (common head style); product grade A (ISO 2009 : 1994)

DIN EN ISO 2010
: Countersunk slotted raised head screws (common head style); product grade A (ISO 2010 : 1994)

DIN EN ISO 7045
: Pan head screws with type H or type Z cross recess; product grade A (ISO 7045 : 1994)

DIN EN ISO 7046-2
: Cross recessed countersunk flat head screws (common head style) (grade A); steel of property class 8.8, stainless steel and non-ferrous metals (ISO 7046-2 : 1990)

DIN EN ISO 7047
: Countersunk raised head screws (common head style) with type H or type Z cross recess; product grade A (ISO 7047 : 1994)

ISO 3269 : 1988
: Fasteners; acceptance inspection

ISO 4042 : 1989
: Threaded components; electroplated coatings

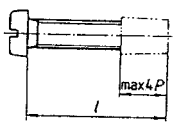
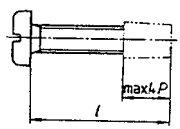
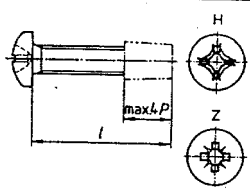
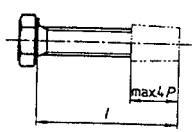
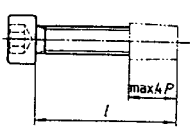
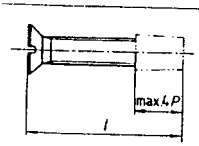
ISO 4759-1 : 1978
: Tolerances for fasteners; bolts, screws and nuts with thread diameters between 1,6 (inclusive) and 150 mm (inclusive) and product grades A, B and C

ISO 8992 : 1986
: Fasteners; general requirements for bolts, screws, studs and nuts

3 Dimensions and designation

Table 1: Screw types and designations

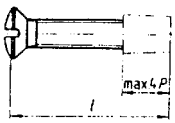
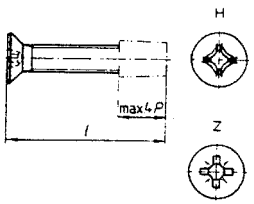
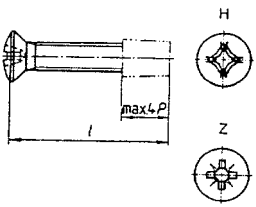
The section of the screw enclosed within chain thin double dashed lines shall be designed at the manufacturer's discretion (see 4.3).

Type	Illustration	Other dimensions as in	Range of sizes suitable for rolling	Example of designation
AE		DIN EN ISO 1207	M3,5 to M10	Screw DIN 7500 – AE M6 × 20 – St
BE		DIN EN ISO 1580	M2 to M6	Screw DIN 7500 – BE M6 × 20 – St
CE		DIN EN ISO 7045	M2 to M10	Screw DIN 7500 – CE M6 × 20 – St – Z[1]
DE		DIN EN 24017	M2 to M10	Screw DIN 7500 – DE M6 × 20 – St
E		DIN 912	M2 to M10	Screw DIN 7500 – E M6 × 20 – St
KE		DIN EN ISO 2009	M2 to M10	Screw DIN 7500 – KE M6 × 20 – St

[1] If previous designations do not include the symbol H or Z (to identify the cross recess), recess type H shall apply.

(continued)

Table 1 (concluded)

Type	Illustration	Other dimensions as in	Range of sizes suitable for rolling	Example of designation
LE		DIN EN ISO 2010	M2 to M10	Screw DIN 7500 – LE M6 × 20 – St
ME		DIN EN ISO 7046-2	M2 to M10	Screw DIN 7500 – ME M6 × 20 – St – Z[1]
NE		DIN EN ISO 7047	M2 to M10	Screw DIN 7500 – NE M6 × 20 – St – Z[1]

For [1], see page 3.

The DIN 4000 – 2 – 1 tabular layout of article characteristics shall apply to screws as covered in this standard.

Table 2: Range of commercial sizes

Thread size	M2	M2,5	M3	M3,5	M4	M5	M6	M8	M10
l'	0,4	0,45	0,5	0,6	0,7	0,8	1	1,25	1,5
*)	1,6	1,8	2	2,4	2,8	3,2	4	5	6
l [1])	Range of commercial sizes [2])								
3	[3])								
4		[3])	[3])						
5			[3])	[3])					
6				[3])	[3])				
8						[3])	[3])		
10								[3])	
12								[3])	[3])
(14)									[3])
16									[3])
(18)									
20									
(22)									
25									
(29)									
30									
35									
40									
45									
50									
55									
60									
70									
80									

*) Maximum length of screw section used for thread rolling
1) Bracketed sizes should be avoided if possible
2) The zone between the continuous thick lines indicates the range of commercial sizes. These screws only are covered by this standard
3) Not for types KE to NE

4 Requirements

4.1 General requirements

Thread rolling screws shall meet the general requirements specified in ISO 8992.

4.2 Design and dimensional accuracy

The design and dimensional accuracy of thread rolling screws shall comply with ISO 4759-1, product grade A, unless otherwise specified in the relevant dimensional standards.

As a departure from ISO 4759-1, the nominal length of thread rolling screws shall be subject to tolerance js16.

If thread rolling screws are to have an unthreaded portion of shank, the thread length shall be included in the designation, e.g.

Screw DIN 7500 – AE M6 × 50 × 28 – St

4.3 Material

Thread rolling screws may be made of case hardening steel as specified in DIN 17 210 or quenched and tempered steel as specified in DIN EN 10 083-2 or of steels as specified in DIN 1654-1 to DIN 1654-5, use of other materials being subject to agreement.

4.4 Thread

The thread of thread rolling screws shall be such that the thread formed is capable of accommodating a screw with an ISO metric coarse screw thread complying with DIN 13-15 and produced to tolerance 6h.

The section of the screws used for forming the mating thread shall be designed at the manufacturer's discretion. Nevertheless, the length of this section shall not be greater than 4 *P*.

4.5 Surface protection

ISO 4042 shall apply with regard to electroplating.

4.6 Metallurgical properties

4.6.1 Surface hardness

The surface hardness of screws after heat treatment shall be at least 450 HV 0,3.

4.6.2 Case depth

The case depth of screws shall comply with the values given in table 3.

4.6.3 Core hardness

The core hardness of screws shall, after heat treatment, be between 240 HV 5 and 370 HV 5.

Table 3: Case depth

Dimensions in mm

Thread size	Case depth (Eht 450)	
	Minimum	Maximum
M2 and M2,5	0,04	0,12
M3 and M3,5	0,05	0,18
M4 and M5	0,10	0,25
M6 and M8	0,15	0,28
M10	0,15	0,32

4.6.4 Microstructure

The microstructure of screws shall, after heat treatment, show no band of ferrite between the core and case.

4.7 Mechanical properties

4.7.1 Thread forming capability

In the test described in subclause 5.2.1, thread rolling screws shall be capable of forming a mating thread without their own thread being deformed.

4.7.2 Torsional strength

The torsional strength of self-drilling screws shall be such that, when tested in accordance with subclause 5.2.2, the torque necessary to cause failure (breaking torque) is equal to or greater than the values specified in table 5.

4.7.3 Tensile strength

The tensile strength of thread rolling screws shall be such that, when tested in accordance with subclause 5.2.3, the force necessary to cause failure (breaking load) is equal to or greater than the values specified in table 6.

5 Testing

5.1 Metallurgical properties

5.1.1 Determination of surface hardness

The surface hardness shall be determined in accordance with DIN 50 133, the impression being made on a flat section of the screw, preferably on the screw head.

5.1.2 Determination of case depth

The case depth may be determined by examining a microsection made at the thread flank mid-point (i.e. between crest and root) with a microscope.

Determination of the case depth using hardness tests is covered by DIN 50 190-1.

5.1.3 Determination of core hardness

The core hardness shall be determined in accordance with DIN 50 133, using a transverse microsection.

5.1.4 Examination of microstructure

The microstructure of the screw material shall be examined metallographically.

5.2 Mechanical properties

5.2.1 Drive test

The drive test shall be carried out using the test assembly shown in figure 1 by way of example.

The screw to be tested shall be driven into a test plate until one full-form thread projects above the surface of the plate.

The test plate material shall have a carbon content not exceeding 0,23 %, its hardness being from 110 HB to 130 HB. The thickness of the test plate shall be as specified in table 4.

The core hole in the test plate may be produced by drilling, punching and redrilling, or by reaming or piercing.

The force used to drive the screw into the test plate shall not exceed 50 N for sizes up to M5, and 100 N for size M6 or more. The driving speed shall not exceed 30 revolutions per minute.

Where necessary, the lubricant to be used during the drive test shall be agreed upon.

NOTE: If thread rolling screws are plated by the purchaser, any complaints made to the screw manufacturer need be accepted only if driving tests carried out on screws of the same lot not subsequently plated do not provide satisfactory results.

Table 4: Test plate details

Thread size	Plate thickness, in mm	Hole diameter, in mm
M2	2	1,8
M2,5	2,5	2,3
M3	3	2,75
M3,5	3,5	3,2
M4	4	3,6
M5	5	4,6
M6	6	5,5
M8	8	7,4
M10	10	9,3

5.2.2 Torsional strength test

The shank of the screw shall be clamped in a split threaded die with mating thread, as shown in figure 1 by way of example, or in an equivalent device so that the clamped portion of the screw is not damaged. At least two full-form threads shall project above the device, and at least two full-form threads (without screw end) shall be held in the clamping device. In the case of short screws, the complete thread shall be held in the die, the screw head not resting on the device.

The screw shall be tightened until fracture occurs, and the minimum breaking torque shall be established.

Table 5: Minimum breaking torques

Thread size	Minimum breaking torque, in Nm
M2	0,5
M2,5	1
M3	1,5
M3,5	2,3
M4	3,4
M5	7,1
M6	12
M8	29
M10	59

5.2.3 Tensile test

The screw (to be tested as a finished component) shall be clamped in a tensile testing machine and subjected to tensile stress. The force at which the screw fractures shall be established.

5.2.4 Rolling torque test

A screw shall be driven into a test plate as specified in table 4 and the rolling torque measured.

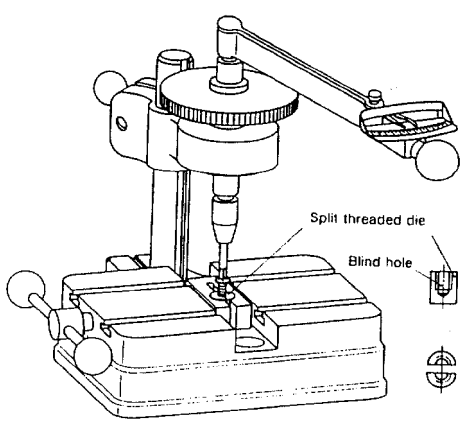


Figure 1

Table 6: Minimum breaking forces

Thread size	Minimum breaking force, in N
M2	1 650
M2,5	2 700
M3	4 000
M3,5	5 400
M4	7 000
M5	11 400
M6	16 000
M8	29 000
M10	46 000

Table 7: Maximum rolling torques

Thread size	Maximum rolling torque, in Nm
M2	0,3
M2,5	0,6
M3	1
M3,5	1,6
M4	2,4
M5	4,7
M6	8
M8	20
M10	39