INTERNATIONAL STANDARD ISO 2702

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Heat-treated steel tapping screws — Mechanical properties

Vis à tôle en acier traité thermiquement — Caractéristiques mécaniques

First edition — 1974-08-15

UDC 621.882.21.082.8 : 531.789 **Ref. No. ISO 2702-1974 (E)**

Descriptors : fasteners, screws, tapping screws, mechanical properties.

Price based on 3 pages

FOREWORD

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Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2702 was drawn up by Technical Committee ISO/TC 2, *Bolts, nuts and accessories,* and circulated to the Member Bodies in March 1972.

It has been approved by the Member Bodies of the following countries :

Belgium	Italy	Spain
Denmark	Japan	Sweden
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The Member Bodies of the following countries expressed disapproval of the document on technical grounds :

Canada
France
United Kingdom
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Printed in Switzerland

Heat-treated steel tapping screws — Mechanical properties

0 INTRODUCTION

The primary objective of this International Standard is to ensure that tapping screws will form mating threads in materials into which they are normally driven without deforming their own thread and without breaking during assembly or service.

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the characteristics of heat-treated steel tapping screws conforming to the dimensions given in ISO/R 1479 to ISO/R 1483, together with the corresponding test methods.

2 REFERENCES

ISO/R 80, *Rockwell hardness test (B and C scales) for steel.*

ISO/R 81, *Vickers hardness test for steel (Load 5 to 100 kgf).*

ISO/R 1024, *Rockwell superficial hardness test (N and T scales) for steel.*

ISO/R 1479, *Hexagon head tapping srews —Metric series.*

ISO/R 1480, *Hexagon head tapping screws — Inch series.*

ISO/R 1481, *Slotted pan head tapping screws — Dimensions in millimetres and inches.*

ISO/R 1482, *Slotted countersunk (flat) head tapping screws — Dimensions in millimetres and inches.*

ISO/R 1483, *Slotted raised countersunk (oval) head tapping screws — Dimensions in millimetres and inches.*

3 MATERIALS

Tapping screws shall be made from cold heading, case hardening quality steel.

4 METALLURGICAL REQUIREMENTS

4.1 Surface hardness

The surface hardness after heat treatment shall be

— Rockwell 15 N 83 (C 45) minimum, or

— Vickers 450 HV 0,3 minimum.

4.2 Case depth

The case depth shall be as given in table 1.

TABLE 1 — **Case depth**

Tapping screws No.	Case depth			
	mm		in	
	min.	max.	min.	max.
2 and 3	0,04	0,1	0.001 6	0.004
4 to 6	0,05	0,18	0.002	0.007
7 to 12	0,10	0,23	0.004	0.009
14 and 16	0,15	0,28	0.006	0.011

4.3 Core hardness

The core hardness after heat treatment shall be between

— Rockwell C 26 and Rockwell C 40, or

— Vickers 270 and 390 HV 0,3.

4.4 Microstructure

The microstructure shall show no band of free ferrite between case and core.

5 MECHANICAL REQUIREMENTS

5.1 Thread-forming capability

Tapping screws shall form a mating thread without deforming their own thread when driven into a test plate in accordance with 7.1.

5.2 Torsional strength

Tapping screws shall have a torsional strength such that the torque necessary to cause failure, when tested in accordance with 7.2, shall equal or exceed the minimum torque values given in table 3 for the applicable sizes of screw.

6 TEST METHODS FOR THE METALLURGICAL REQUIREMENTS

6.1 Surface hardness test

6.1.1 *Rockwell hardness test*

The Rockwell hardness test shall be carried out in accordance with the provisions of ISO/R 80.

The impression of the cone shall be made on a flat face, for preference on the screw head.

6.1.2 *Vickers hardness test*

The Vickers hardness test shall be carried out in accordance with the provisions of ISO/R 81.

The impression of the pyramid shall be made on a flat face, for preference on the screw head.

6.2 Case depth test (microscopic test)

The microscopic test shall be carried out at the thread flank midpoint between crest and root or, in the case of smaller tapping screws up to No.7, in the root of the thread.

6.3 Core hardness test

The core hardness test (either Rockwell or Vickers) shall be carried out at the midradius of a transverse section through the screw taken at a distance sufficiently behind the point of the screw to be through the full minor diameter.

6.4 Microstructure test

The microstructure test shall be carried out by metallographic examination.

7 TEST METHODS FOR THE MECHANICAL REQUIREMENTS

7.1 Drive test

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

The test plate shall be made from low carbon steel with a carbon content not exceeding 0,23 %. Hardness of the plate shall be Rockwell B 70 to 85 (HB 125 to 165). Thickness of the plate shall be as given in table 2.

The test hole shall be drilled, or punched and redrilled, or reamed, to the hole diameter specified in table 2 for the size of screw being tested.

TABLE 2 — **Standard test plate thickness and hole sizes for drive test**

Tapping screw No.	Major thread diameter max.		Plate thickness mm		Plate thickness in		Hole diameter mm		Hole diameter in	
	mm	in	min.	max.	min.	max.	min.	max.	min.	max.
2	2,24	0.088	1,17	1,30	0.046	0.051	1,905	1,955	0.0750	0.0770
3	2,57	0.101	1,17	1,30	0.046	0.051	2,185	2,235	0.0860	0.0880
4	2,90	0.114	1,17	1,30	0.046	0.051	2,415	2,465	0.0950	0.0970
5	3,30	0.130	1,17	1,30	0.046	0.051	2,680	2,730	0.1055	0.1075
6	3,53	0.139	1,85	2,06	0.073	0.081	2,920	2,970	0.1150	0.1170
7	3,91	0.154	1,85	2,06	0.073	0.081	3,240	3,290	0.1275	0.1295
8	4,22	0.166	1,85	2,06	0.073	0.081	3,430	3,480	0.1350	0.1370
10	4,80	0.189	3,10	3,23	0.122	0.127	4,015	4,065	0.1580	0.1600
12	5,46	0.215	3,10	3,23	0.122	0.127	4,735	4,785	0.1865	0.1885
14 (1/4)	6,25	0.246	4,67	5,05	0.184	0.199	5,475	5,525	0.2155	0.2175
16 (5/16)	8,00	0.315	4,67	5,05	0.184	0.199	6,885	6,935	0.2710	0.2730

In cases where screws are plated subsequent to delivery to the purchaser (or where plating of screws is otherwise under the control of the purchaser), the producer is not responsible for failure due to plating. In such cases, the bolt manufacturer can only be held responsible if it is proved that the failure is not due to any post-treatment. Screws from which the plating has been stripped off cannot be considered as samples.

7.2 Torsional strength test

The shank of the sample screw (coated or uncoated, as received) shall be clamped in a mating, split, blind-hole die (see figure) or other device so that the clamped portion of the screw is not damaged and at least two full threads project above the clamping device and at least two full-form threads exclusive of point are held within the clamping device. (A blind hole may be used in place of the clamping device, provided that the hole depth is such as to ensure that breakage will occur beyond the point.)

By means of a suitable calibrated torque-measuring device, torque shall be applied to the screw until failure occurs. The screw shall meet the minimum torsional strength requirement given in table 3.

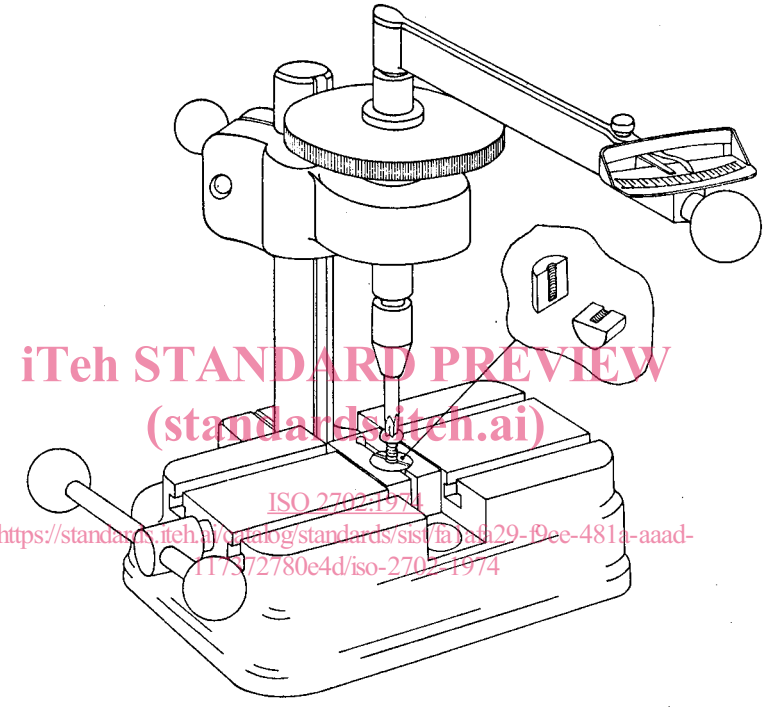

FIGURE – **Torsion test apparatus**

TABLE 3 – **Torsional strength**

Tapping screw No.	Major thread diameter		Minimum torsional strength	
	mm	in	N·m	lbf·in
2	2,24	0.088	0,45	4
3	2,57	0.101	0,90	8
4	2,90	0.114	1,5	13
5	3,30	0.130	2,0	18
6	3,53	0.139	2,7	24
7	3,91	0.154	3,4	30
8	4,22	0.166	4,4	39
10	4,80	0.189	6,3	56
12	5,46	0.215	10,0	88
14 (1/4)	6,25	0.246	13,6	120
16 (5/16)	8,00	0.315	30,5	270