
International Standard



898/5

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**Mechanical properties of fasteners —
Part 5 : Set screws and similar threaded fasteners not
under tensile stresses**

Propriétés mécaniques des éléments de fixation — Partie 5 : Vis sans tête et éléments de fixation filetés similaires non soumis à des contraintes de traction

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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 898/5 was developed by Technical Committee ISO/TC 2, *Fasteners*, and was circulated to the member bodies in April 1979.

It has been approved by the member bodies of the following countries:

Australia	Germany, F. R.	Poland
Austria	Hungary	Romania
Belgium	India	South Africa, Rep. of
Bulgaria	Ireland	Spain
Canada	Italy	Sweden
Chile	Japan	Switzerland
Czechoslovakia	Korea, Rep. of	United Kingdom
Denmark	Netherlands	USA
Finland	New Zealand	USSR
France	Norway	Yugoslavia

No member body expressed disapproval of the document.

Mechanical properties of fasteners — Part 5 : Set screws and similar threaded fasteners not under tensile stresses

1 Scope and field of application

This International Standard specifies the mechanical properties of set screws and similar fasteners not under tensile stresses in the range from 1,6 up to and including 39 mm thread diameter which are made of carbon steel or alloy steel.

It does not apply to screws requiring special properties such as

- specified tensile stresses (see ISO 898/1);
- weldability;
- corrosion resistance (see ISO 3506);
- ability to withstand temperatures above + 300 °C or below – 50 °C.

NOTE — Screws made from free-cutting steel should not be used above + 250 °C.

2 References

ISO/R 79, *Brinell hardness test for steel*.

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

ISO/R 81, *Vickers hardness test for steel*.

ISO 6157/1, *Surface discontinuities on bolts, screws and studs*¹⁾.

3 Designation system

The property classes are designated by the symbols shown in table 1.

The numerical part of the symbol represents 1/10 of the minimum Vickers hardness.

The letter H in the symbol refers to hardness.

Table 1 — Designations of property classes in relation to Vickers hardness

Property class	14H	22H	33H	45H
Vickers hardness, HV min.	140	220	330	450

1) At present at the stage of draft.

4 Raw materials

Set screws shall be made of steel conforming to the requirements specified in table 2.

For property class 45H, other materials may be used provided that the torque test requirements in 6.4 are met.

5 Mechanical properties

When tested by the methods specified in clause 6, the set screws shall have, at ambient temperature, the mechanical properties specified in table 3.

Table 2 — Steel specifications

Property class	Material	Heat treatment	Chemical composition, %			
			C		P	S
			max.	min.	max.	max.
14H	Carbon steel ¹⁾²⁾	—	0,50	—	0,11	0,15
22H	Carbon steel ³⁾	Quenched and tempered	0,50	—	0,05	0,05
33H	Carbon steel ³⁾	Quenched and tempered	0,50	—	0,05	0,05
45H	Alloy steel ³⁾⁴⁾	Quenched and tempered	0,50	0,19	0,05	0,05

1) Free-cutting steel may be used, with lead content 0,35 % max., phosphorus content 0,11 % max. and sulphur content 0,34 % max.

2) Case hardening is allowed in the case of square-head set screws.

3) Steel with lead content 0,35 % max. may be used.

4) Shall contain one or more of alloying elements chromium, nickel, molybdenum, vanadium or boron.

Table 3 — Mechanical properties

Mechanical properties		Property class*				
		14H	22H	33H	45H	
Vickers hardness HV	min.	140	220	330	450	
	max.	290	300	440	560	
Brinell hardness HB, $F = 30 D^2$	min.	133	209	314	428	
	max.	276	285	418	532	
Rockwell hardness	HRB	min.	75	95	—	
		max.	105	—	—	
	HRC	min.	—	—	33	45
		max.	—	30	44	53
Torque strength		—	—	—	see table 5	
Minimum height of non-decarburized thread zone, E		—	$\frac{1}{2}H_1$	$\frac{2}{3}H_1$	$\frac{3}{4}H_1$	
Maximum depth of complete decarburization, G	mm	—	0,015	0,015	**	
Surface-hardness HV 0,3	max.	—	320	450	580	

* Classes 14H, 22H and 33H are not for hexagon socket set screws.

** No complete decarburization permitted in property class 45H.

6 Test methods for determination of mechanical properties

6.1 Hardness tests

Hardness tests shall be conducted as near as practicable to the centre position of the point ends of the screw. If the maximum hardness is exceeded, a retest shall be conducted on a cross-section 0,5 mm back from the point end. In case of doubt, the Vickers hardness test is decisive for acceptance.

Hardness readings for the surface hardness shall be taken on the end of the screw, which will be prepared by slightly grinding or polishing to ensure reproducible readings.

6.1.1 Vickers hardness test

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

6.1.2 Brinell hardness test

The Brinell hardness test shall be carried out in accordance with the provisions of ISO/R 79.

6.1.3 Rockwell hardness test

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

6.2 Decarburization test

Using the appropriate measuring method (6.2.2.1 or 6.2.2.2 as applicable), the longitudinal section of the thread shall be examined to determine that the height of the zone of base metal (E) and the depth of the zone with complete decarburization (G) are within specified limits, (see figure 1).

The minimum values for E and the maximum values for G are specified in table 3.

6.2.1 Definitions

base metal hardness : The hardness closest to the surface (when traversing from core to outside diameter) just before an increase or decrease occurs denoting carburization or decarburization.

decarburization : Generally, the loss of carbon at the surface of commercial ferrous materials (steels).

partial decarburization : Decarburization with loss of carbon sufficient to cause a lighter shade of tempered martensite and significantly lower hardness than that of the adjacent base metal.

complete decarburization : Decarburization with sufficient carbon loss to show only clearly defined ferrite grains under metallographic examination.

carbon restoration : A process of restoring surface carbon loss by heat treating in a furnace atmosphere of properly controlled carbon potential.

carburization : A process of increasing surface carbon to a content above that of the base metal.

6.2.2 Measurement methods

6.2.2.1 Microscopic method

This method allows the determination of both E and G .

The specimens to be used are longitudinal sections taken through the thread axis approximately half a nominal diameter from the end of the screw, after all heat treatment operations have been performed on the product. The specimen shall be mounted for grinding and polishing in a clamp or plastic mount, the latter being the preferred method.

After mounting, grind and polish the surface in accordance with good metallographic practice.

Etching in a 3 % nital (concentrated nitric acid in ethanol) solution is usually suitable for showing changes in microstructure caused by decarburization.

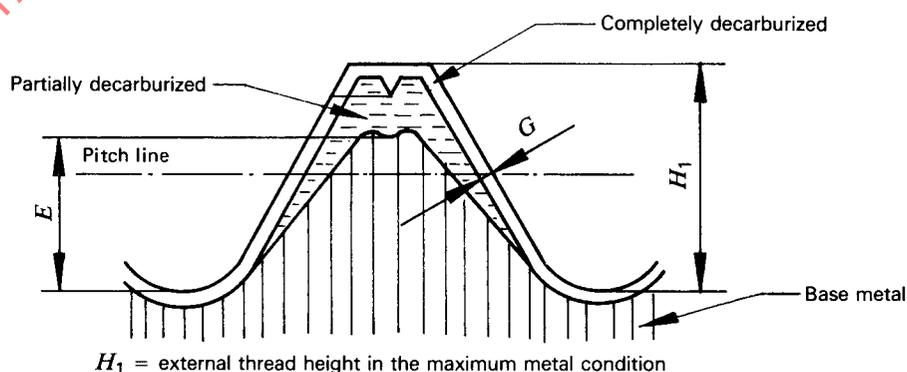


Figure 1

Unless otherwise agreed between the interested parties, 100 X magnification shall be used for examination.

If the microscope is of a type with a ground glass screen, the extent of decarburization can be measured directly with a scale. If an eyepiece is used for measurement, it should be of an appropriate type, containing a cross-hair or a scale.

6.2.2.2 Hardness method (Referee method for partial decarburization and carburization)

The hardness measurement method is applicable only for threads with pitches of 1,25 mm and larger, except for property class 45H, where it is applicable for all sizes.

The hardness measurements are made at three points in accordance with figure 2. Values for *E* are given in table 3.

Hardness determination for point 3 shall be made on the pitch line of the thread adjacent to the thread on which determinations at points 1 and 2 are made.

The Vickers hardness value at point 2 shall be equal to or greater than that at point 1 minus 30 Vickers units. In this case the height of the non-decarburized zone *E* is at least as specified in table 4.

The Vickers hardness value at point 3 shall be equal to or less than that at point 1 plus 30 Vickers units. An increase of more than 30 Vickers units indicates carburization.

Complete decarburization up to the maximum specified in table 3 cannot be detected by the hardness measurement method.

NOTE — Careful differentiation should be made between an increase in hardness caused by carburization and that due to heat treatment or cold working of the surface.

6.3 Surface integrity test

The surface integrity test shall be carried out in accordance with the provisions of ISO 6157/1.

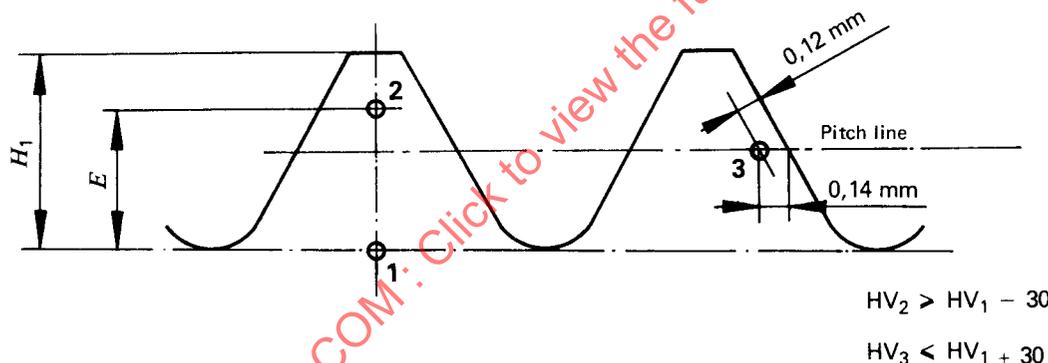


Figure 2

Table 4 — Values for *H*₁ and *E*

Pitch of the thread	<i>P</i> mm	0,5	0,6	0,7	0,8	1	1,25	1,5	1,75	2	2,5	3	3,5	4	
<i>H</i> ₁	mm	0,307	0,368	0,429	0,491	0,613	0,767	0,920	1,074	1,227	1,534	1,840	2,147	2,454	
<i>E</i> min. mm	Prop- erty class	22H	0,154	0,184	0,215	0,245	0,307	0,384	0,460	0,537	0,614	0,767	0,920	1,074	1,227
		33H	0,205	0,245	0,286	0,327	0,409	0,511	0,613	0,716	0,818	1,023	1,227	1,431	1,636
		45H	0,230	0,276	0,322	0,368	0,460	0,575	0,690	0,806	0,920	1,151	1,380	1,610	1,841