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Road vehicles — Wheels — Nut seat strength tests

Véhicules routiers — Roues — Essai de résistance des sièges d'écrou

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Foreword

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ISO 15172 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 19, *Wheels*.

Road vehicles — Wheels — Nut seat strength tests

1 Scope

This International Standard specifies a test method to evaluate the strength of the nut seat of wheels intended for use on passenger cars, light trucks and multi-purpose vehicles. While this test ensures the minimum strength of the nut seat, the wheel must also have a degree of flexibility to allow torque retention. This test evaluates the axial strength of the nut seat. In addition, the informative annex provides recommended bearing area to ensure enough strength for the rotational force in tightening a nut against the nut seat.

2 Test procedures

2.1 General

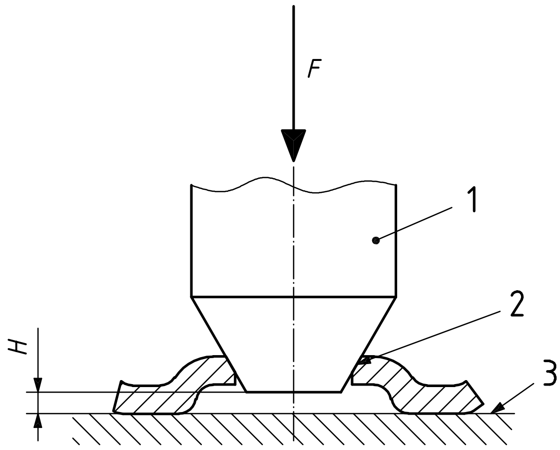
The principle of this test is to apply an axial load to the nut seat and determine permanent deformation of the nut seat. An additional test to measure yield strength is also specified.

2.2 Wheels for test

Use only fully processed wheels including all coatings representative of production parts intended for the vehicle.

2.3 Test equipment

The test equipment shall be capable of supporting the complete wheel mounting area with a rigid flat surface which is dimensionally representative of the vehicle hub (see Figure 1). The equipment shall provide a hardened (R_c 45 min) punch or load applicator with a shape designed to match the seat face and the fastener contact area representative of that specified for the wheel. The punch or load applicator shall provide a measured, non-rotational axial force of F (the maximum load obtained in the bolt when the nut is tightened to the maximum recommended torque) perpendicular to the plane of the supporting surface. F shall depend on the type of fastener used to fix the wheel on the hub. Only one nut seat of a wheel shall be loaded at a time. In addition to the loading mechanism, devices to measure nut seat deformation or punch travel shall be required.



Key

F measured axial force

H nut seat height

1 hardened punch

2 nut/bolt seat

3 supporting surface

Figure 1 — Test nomenclature and loading fixture

2.4 Strength test procedures

2.4.1 Deformation test method

The deformation test shall be carried out as follows:

a) Insert the test wheel in the loading device and align the punch with the nut seat.

b) Apply the load F_0 (0,6 × F) to the nut seat and measure the nut seat height (H_0).

c) Apply a load (F) and hold for 15 s.

d) Reduce the load to F_0 and measure the nut seat height (H_1).

e) Repeat steps c) and d) five times and measure the nut seat height (H_n) at F_0 load each time.

f) Repeat steps a) through e) on each nut seat of the wheel. The entire procedure is repeated on additional wheels if necessary.

Performance requirements shall be as follows:

a) The nut seat shall not have newly formed cracks.

b) The nut seat height change ($H_1 - H_0$) after the first cycle shall not exceed 0,6 mm.

c) The fifth nut seat height change ($H_5 - H_0$) shall not exceed 0,80 mm.

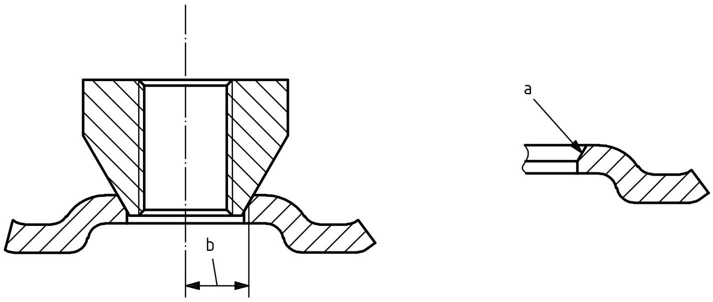
2.4.2 Yield strength test method

Insert a new test wheel on the loading device and align the load applicator with the nut seat. Apply the load to the individual nut boss until complete collapse. Record the maximum load prior to collapse. Test each nut seat, but do not perform tests on adjacent nut bosses. Therefore, two or more new wheels shall be required to completely evaluate the wheel.

Annex A
(informative)

Bearing surface recommendation

The repeatability of the yield strength test and deformation test is optimum when the following criteria is met or exceeded. This recommendation uses the applied stresses to predict yielding at a critical value given by the maximum shear stress (Tresca) criterion. At the critical value, the sum of the applied stresses from the stud tension and nut torque equal the yield point of the nut seat material. The applied stresses are a conservative approximation for the principal stresses. It is important to note that stud tension creates a compressive stress on the nut seat.



[a] Bearing surface.

[b] Mean radius.

Figure A.1 — Nomenclature for mean radius and bearing area

The tables below give example values of B_s for typical assumed properties. Use the following formula to calculate bearing surface areas for wheels made from materials with other properties:

$$B_s = [T_s + (T_q/R)]/Y$$

where

B_s is the bearing surface;

T_s is the stud tension;

T_q is the applied torque;

R is the mean radius of nut seat;

Y is the yield strength of the material.

Table A.1 — Calculated steel wheel minimum bearing surface using stress differentials (sq. mm)

	Applied Torque (Nm)							
Stud Tension (N)	90	100	110	120	130	140	150	160
12 000	92,7	97,5	102,3	107,0	111,8	116,6	121,3	126,1
16 000	109,3	114,1	118,9	123,6	128,4	133,2	137,9	142,7
20 000	125,9	130,7	135,5	140,2	145,0	149,8	154,5	159,3
24 000	142,5	147,3	152,0	156,8	161,6	166,4	171,1	175,9
28 000	159,1	163,9	168,6	173,4	178,2	183,0	187,7	192,5

This calculation assumes a minimum yield of 241 Mpa and a mean nut seat diameter of 17,4 mm to represent typical low carbon steels.

Table A.2 — Calculated aluminum wheel minimum bearing surface using stress differentials (sq. mm)

	Applied Torques (Nm)							
Stud Tension (N)	90	100	110	120	130	140	150	160
12 000	185,0	194,1	203,2	212,3	221,4	230,5	239,6	248,7
16 000	219,3	228,4	237,5	246,6	255,7	264,8	273,9	283,1
20 000	253,6	262,7	271,9	281,0	290,1	299,2	308,3	317,4
24 000	288,0	297,1	306,2	315,3	324,4	333,5	342,6	351,7
28 000	322,3	331,4	340,5	349,6	358,7	367,8	377,0	386,1

This calculation assumes a minimum yield of 116,5 Mpa and a mean nut seat diameter of 18,85 mm to represent typical aluminum wheels.

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