INTERNATIONAL STANDARD

ISO 3894

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Commercial vehicles — Wheels/rims — Test methods

Véhicules utilitaires — Roues/jantes — Méthodes d'essai

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 3894 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 19, *Wheels*.

This second edition cancels and replaces the first edition (ISO 3894:1977), of which it constitutes a technical revision.

Annex A forms an integral part of this International Standard.

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Introduction

This International Standard was developed in response to requests to establish uniform test methods to evaluate certain fatigue strength characteristics of wheels used on commercial road vehicles. Only laboratory test methods are given. No minimum performance levels are part of this International Standard.

The standardization of test methods allows manufacturers of vehicles and/or wheels to evaluate their products in a uniform manner. By using these methods, wheels from different parts of the world can be compared and evaluated for use.

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Commercial vehicles — Wheels/rims — Test methods

1 Scope

This International Standard specifies three laboratory methods for testing certain essential strength characteristics of disc wheels, spoke wheels and demountable rims intended for road use on commercial vehicles, buses, trailers and multipurpose passenger vehicles, as defined in ISO 3833.

The test methods are

a) disc wheel dynamic cornering fatigue tests;

b) disc wheels and wheels with demountable rims — dynamic radial fatigue tests; and

c) wheels with demountable rims — dynamic cornering fatigue test.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3833:1977, *Road vehicles — Types — Terms and definitions.*

ISO 3911:1977, *Wheels/rims — Nomenclature, designation, marking, and units of measurement.*

3 General

Only fully processed new wheels/rims which are representative of wheels/rims intended for the vehicle shall be used for the tests. No wheel/rim shall be used for more than one test.

4 Disc wheel dynamic cornering fatigue test

The dynamic cornering fatigue test shall be conducted in accordance with one of the alternative methods specified in 4.1 and 4.2.

4.1 Cornering fatigue test 90° loading method — Alternative No. 1

4.1.1 Equipment

The test machine shall have a driven rotatable device whereby either the wheel rotates under the influence of a stationary bending moment or the wheel is stationary and is subjected to a rotating bending moment.

4.1.2 Procedure

4.1.2.1 Preparation

Clamp the rim of the wheel securely to the test fixture in accordance with figure 1a) or 1b). The adaptor face of the test machine shall have equivalent mounting systems to those used on the vehicle. The mating surface of the test adaptor and wheel shall be free of excessive scoring and deformation, and excessive build-up of paint, dirt or foreign matter.

Attach the load arm and adaptor assembly to the mounting surface of the wheel using non-lubricated studs or bolts, and nuts, in good condition, representative of those used on the vehicle. Assemble and tighten the wheel fixing at the beginning of the test using the procedure specified by the vehicle or wheel manufacturer.

Wheel bolts or nuts may be retorqued during the test.

4.1.2.2 Bending moment application

To impart a bending moment to the wheel, apply a force parallel to the plane of the wheel mounting surface at a specified distance with the moment arm as shown in figures 1a) and 1b).

Maintain the bending moment within ± 5 % of the calculated value.

4.1.3 Bending moment determination

Determine the bending moment M (force × moment arm), in newton metres, from the formula:

$$M = (\mu R + d)F_v S$$

where

μ is the assumed coefficient of friction developed between tyre and road (see table A.1);

R is the static loaded radius, in metres, of the largest tyre to be used on the wheel as specified by the vehicle or wheel manufacturer;

d is the inset or outset (positive for inset, negative for outset), of the wheel, in metres (see ISO 3911). If the wheel may be used as both an inset and outset wheel, then the inset value shall be used;

F_v is the load rating of the wheel, in newtons, as specified by the vehicle or wheel manufacturer;

S is the accelerated test factor (see table A.1).

4.2 Cornering fatigue test 40° loading method — Alternative No. 2

4.2.1 Equipment

The test machine shall have a driven rotatable device whereby either the wheel rotates under the influence of a stationary bending moment and axial load, or the wheel is stationary and is subjected to a rotating bending moment and axial load (see figure 2).

4.2.2 Procedure

4.2.2.1 Preparation

Clamp the rim flange of the wheel securely to the test fixture. The support face of the test machine shall have equivalent wheel mounting systems to those used on the vehicle. The mating surfaces of the test adaptor and wheel shall be free of excessive scoring and deformation, and excessive build-up of paint, dirt or foreign matter.

Attach the load arm and adaptor assembly to the mounting surface of the wheel using non-lubricated studs or bolts, and nuts, in good condition, representative of those used on the vehicle. Assemble and tighten the wheel fixing at the beginning of the test using the procedure as specified by the vehicle or wheel manufacturer. Wheel bolts or nuts may be re-torqued during the test.

4.2.2.2 Bending moment application

To impart a bending moment and axial load to the wheel, apply a force at a nominal angle of 40° from a plane through the rim centre at the specified distance (moment arm l), specified in 4.2.3, as shown in figure 2.

Maintain the bending moment within ± 5 % of the calculated value.

4.2.3 Test load and moment arm determination

Determine the resultant diagonal test load, D, in newtons, from the formula:

$$D = F_v S$$

where

F_v is the load rating of the wheel, in newtons, as specified by the vehicle or wheel manufacturer;

S is the accelerated test factor (see table A.2).

The moment arm l, in metres, shall be determined from the formula:

$$l = \mathrm{R} \tan 40° + d$$

where

R is the static loaded radius, in metres, of the largest tyre to be used on the wheel as specified by the vehicle or wheel manufacturer;

d is the inset or outset (positive for inset, negative for outset) of the wheel, in metres (see ISO 3911). If the wheel may be used as both an inset and outset wheel, then the inset value shall be used.

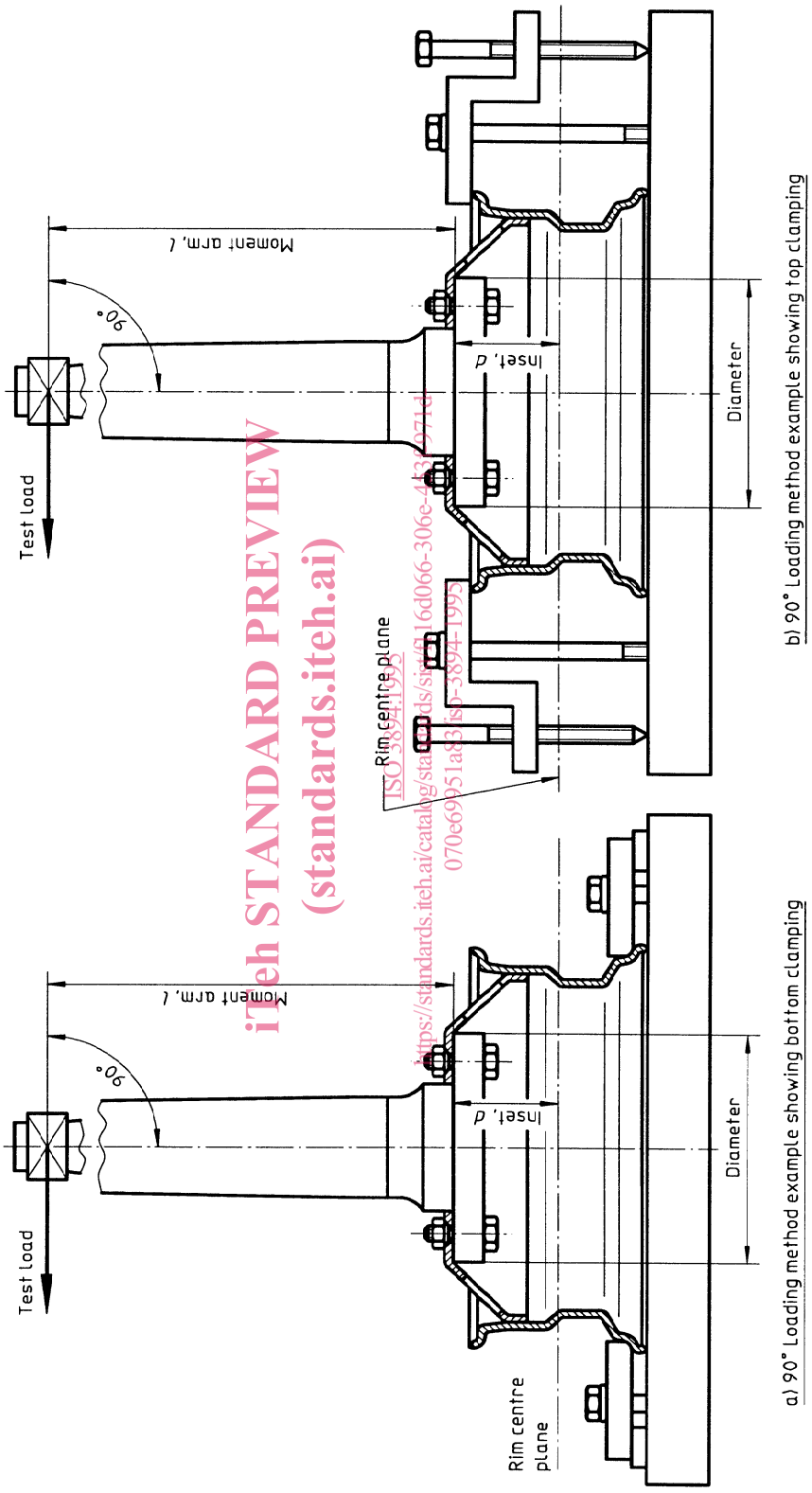

Figure 1 — Dynamic cornering fatigue test

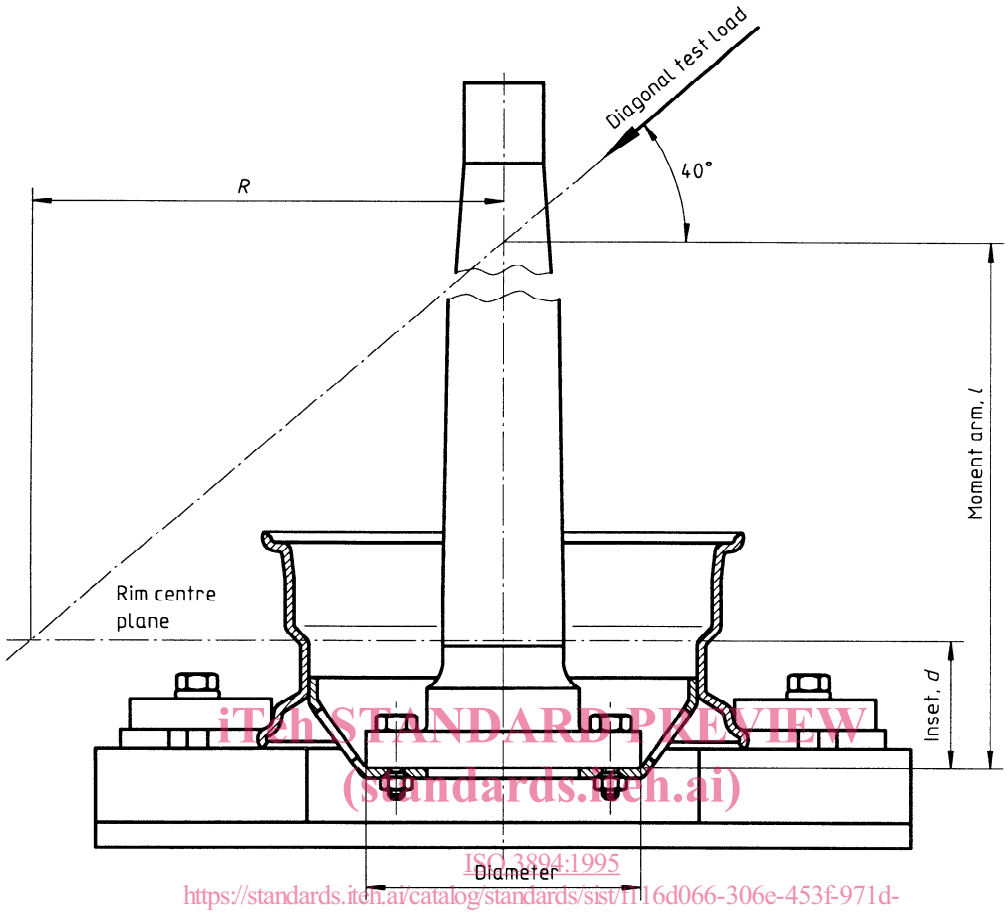

Figure 2 — Dynamic cornering fatigue test — 40° loading method

4.3 Test termination

The test shall be terminated in either of the two following circumstances:

— inability of wheel to sustain load;

— propagation of a crack(s) existing prior to test or new visible stress-caused cracks penetrating through a section of the wheel.

5 Disc wheel and wheels with demountable rims — Dynamic radial fatigue test

5.1 Equipment

The test machine shall be equipped with a means of imparting a constant radial load as the wheel rotates. There are many means of imparting radial loads: the suggested equipment incorporates a driven rotatable drum set which presents a smooth surface wider than the loaded test tyre section width. The recommended minimum external diameter of the drum is 1 700 mm.

The test wheel (single application) and tyre fixture shall provide loading normal to the drum external surface and in line radially with the centre of the test wheel and drum. The axes of the drum and test wheel shall be parallel.

5.2 Procedure

Tyres selected for this wheel test shall meet the load rating F_v of the wheel or be representative of the maximum load capacity tyre specified by the vehicle or wheel manufacturer, whichever is greater.

For disc wheels, the test adaptor shall be representative of production hubs using non-lubricated studs or bolts and nuts representative of those specified for the wheel. For demountable rims, the test adaptor

shall be representative of production spoke wheels using non-lubricated studs, nuts and clamps representative of those specified for the rim. Torque the wheel nuts to the torque limits specified by the vehicle or wheel manufacturer for stud size and type of nut used. Check nut torque values and reset them periodically during the course of the test in order to compensate for the wearing-in of mating surfaces of nuts and bolt holes.

The test load and inflation pressures are based on wheel/rim ratings. Test inflation pressures shown in table 1 are for information only.

Table 1 — Test inflation pressures

Tyre pressure at usage load kPa 1)	Tyre test pressure kPa 1)
up to 310	450
320 to 450	550
460 to 580	690
590 to 720	900
730 to 830	1 000
1) 100 kPa = 1 bar	

The selected cold test inflation pressure shall be maintained within ± 5 %. The load system shall maintain the specified load within ± 5 % of the calculated value.

5.3 Radial load determination

Determine the radial load F_r, in newtons, from the formula:

$$F_r = F_v K$$

where

F_v is the load rating of the wheel/rim, in newtons, as specified by the vehicle or wheel/rim manufacturer;

K is the accelerated test load factor (see table A.3).

5.4 Test termination

The test shall be terminated in either of the two following circumstances:

- inability of wheel/rim to sustain the load or tyre pressure;
- propagation of a crack(s) existing prior to test or new visible stress-caused cracks penetrating through a section of the wheel.

6 Wheels with demountable rims — Dynamic cornering fatigue test

6.1 Equipment

The test machine shall have a driven rotatable device whereby either the wheel rotates under the influence of a stationary bending moment or the wheel is stationary and is subjected to a rotating bending moment (see figure 3).

6.2 Procedure

6.2.1 Preparation

Clamp the wheel securely to the test fixture. To ensure this, assemble and tighten the wheel fixing at the beginning of the test using the procedures specified by the vehicle or wheel manufacturer. Attach a rigid load-arm shaft with a test hub adaptor to the hub of the wheel. The mating surfaces of the test adaptor and wheel shall be free of excessive build-up of paint, dirt or foreign material. The studs and nuts shall not be lubricated.

If the wheel application is always used with a brake drum, the wheel may be tested with a brake drum attached. If the wheel application is ever to be used without a brake drum, the wheel shall be tested without a brake drum attached.

6.2.2 Bending moment application

To impart a bending moment to the wheel, apply a force parallel to the plane of the mounting surface of the wheel at a specified distance with the moment arm.

The load system shall maintain the specified load within ± 5 % of the calculated value.