INTERNATIONAL STANDARD ISO 3894

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

Road vehicles — Trucks — Wheels/rims — Test methods

Véhicules routiers — Véhicules utilitaires — Roues/jantes — Méthodes d'essai

First edition — 1977-06-01

UDC 629.114-44 : 629.11.012.3/.5 **Ref. No. ISO 3894-1977 (E)**

Descriptors : road vehicles, commercial road vehicles, trucks, vehicle wheels, rims, mechanical tests, bend tests, laboratory tests, mechanical properties, dynamic loads.

Price based on 10 pages

FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

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 3894 was drawn up by Technical Committee ISO/TC 22, *Road vehicles*, and was circulated to the member bodies in July 1975.

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

Australia	Iran	Spain
Belgium	Ireland	Sweden
Bulgaria	Italy	Switzerland
Czechoslovakia	Korea, Dem.P. Rep. of	Turkey
Finland	Mexico	U.S.A.
France	Poland	Yugoslavia
Germany	Romania	
Hungary	South Africa, Rep. of	

The member body of the following country expressed disapproval of the document on technical grounds :

United Kingdom

Annex A of this International Standard was circulated separately to the member bodies in October 1975, in the form of draft Addendum 1. It has been approved by the member bodies of the following countries :

Australia	Italy	Sweden
Austria	Japan	Switzerland
Belgium	Mexico	Turkey
Bulgaria	New Zealand	U.S.A.
Germany	Poland	U.S.S.R.
Hungary	Romania	Yugoslavia
Iran	South Africa, Rep. of	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

France
United Kingdom

Printed in Switzerland

INTERNATIONAL STANDARD ISO 3894-1977 (E)/ERRATUM

Published 1979-05-01

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

Road vehicles — Trucks — Wheels/rims — Test methods

ERRATUM

Page 1

Clause 4.1.2.2, second line, delete "either perpendicular or".

Page 4

Clause 6.2.2, second line, delete "either perpendicular or".

Page 10

Table 3, last line relating to aluminium, under column entitled "Accelerated test factor", add "2,8[4)]" after existing "2,0[4)]".

Road vehicles — Trucks — Wheels/rims — Test methods

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies laboratory test methods for evaluating certain essential strength characteristics of disc wheels, spoke wheels and demountable rims intended for highway use on trucks, buses, trailers and multi-purpose passenger vehicles.

The following test procedures are set forth :

— disc wheel dynamic cornering fatigue test;

— disc wheel and demountable rim endurance test under dynamic radial load;

— demountable rim wheel centre dynamic cornering test.

2 REFERENCE

ISO 3911, *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 by one of the alternative methods specified in 4.1, 4.2 and 4.3.

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 (see figure 1).

4.1.2 *Procedure*

4.1.2.1 PREPARATION

The rim of the wheel shall be adjusted and clamped securely to the test fixture. The face by which the wheel centre is supported on the testing machine shall have the same dimensional characteristics as the usual matching face used on the vehicle.

The load arm and adaptor assembly shall be attached to the mounting surface of the wheel using studs and nuts (or bolts), in good condition, representative of those used on the vehicle. The wheel fixing shall be assembled and tightened at the beginning of the test using the procedure as specified by the vehicle manufacturer or the wheel manufacturer. The mating surfaces of the test adaptor and wheel shall be free of excessive build-up of paint, dirt or foreign matter.

The studs and nuts (or bolts) shall not be lubricated. Wheel bolts or nuts may be retorqued during the test.

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

4.1.2.2 BENDING MOMENT APPLICATION

To impart a bending moment to the wheel, a force is applied either perpendicular or parallel to the plane of the mounting surface of the wheel at a specified distance (moment arm).

4.1.3 *Bending moment determination*

The bending moment M (force × moment arm) is given, in newton metres, by the formula

$$M = (\mu R + d)\, FS$$

where

μ is the assumed coefficient of friction developed between tyre and road;

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

d is the inset or outset of the wheel in metres (see ISO 3911);

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

S is the accelerated test factor.

NOTE — For values of μ and S, see table 1 of annex A.

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

The rim flange of the wheel shall be clamped securely to the test fixture. The face by which the wheel centre is supported on the testing machine shall have the same dimensional characteristics as the usual matching face used on the vehicle.

The load arm and adaptor assembly shall be attached to the mounting surface of the wheel using studs and nuts (or bolts), in good condition, representative of those used on the vehicle. The wheel fixing shall be assembled and tightened at the beginning of the test using the procedure as specified by the vehicle manufacturer or the wheel manufacturer. The mating surfaces of the test adaptor and wheel shall be free of excessive build-up of paint, dirt or foreign matter.

The studs and nuts (or bolts) shall not be lubricated.

Wheel bolts or nuts may be retorqued during the test.

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

4.2.2.2 BENDING MOMENT APPLICATION

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

4.2.3 *Test load and moment arm determination*

The diagonal test load resultant D is given, in newtons, by the formula :

$$D = FS$$

where

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

S is the accelerated test factor.

The moment arm M.A. is given, in metres, by the formula :

$$\text{M.A.} = R \operatorname{tg} 40^\circ + d$$

where

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

d is the inset or outset of the wheel in metres (see ISO 3911);

$\operatorname{tg} 40^\circ = 0{,}84$.

NOTE — For values of S, see table 2 of annex A.

4.3 Cornering fatigue test (Two-axis load method — Alternative No. 3)

4.3.1 *Equipment*

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

4.3.2 *Procedure*

4.3.2.1 PREPARATION

The rim flange of the wheel shall be clamped securely to the test fixture. The face by which the wheel centre is supported on the testing machine shall have the same dimensional characteristics as the usual matching face used on the vehicle.

The load arm and adaptor assembly shall be attached to the mounting surface of the wheel using studs and nuts (or bolts), in good condition, representative of those used on the vehicle. The wheel fixing shall be assembled and tightened at the beginning of the test using the procedure as specified by the vehicle manufacturer or the wheel manufacturer. The mating surfaces of the test adaptor and wheel shall be free of excessive build-up of paint, dirt or foreign matter.

The studs and nuts (or bolts) shall not be lubricated.

Wheel bolts or nuts may be retorqued during the test.

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

4.3.2.2 BENDING MOMENT, AXIAL AND RADIAL LOAD APPLICATION

To impart a bending moment, axial and radial load, to the wheel, two forces are applied, one radial and one axial. The radial load is applied at the centre line of the rim, perpendicular to the wheel axis. The axial load is applied to the rim flange, parallel to the wheel axis (see figure 3).

4.3.3 *Test load determination*

The axial test load F_1 and the radial test load F_2 are given, in newtons, by the formulae :

$$F_1 = FS_1$$

$$F_2 = FS_2$$

where

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

S_1 is the accelerated test factor No. 1;

S_2 is the accelerated test factor No. 2.

NOTE – For values of S_1 and S_2, see annex B[1].

4.4 Failure criteria

4.4.1 Inability of wheel to sustain load.

4.4.2 A fatigue crack penetrating through a section of the wheel.

5 DISC WHEEL AND DEMOUNTABLE RIM ENDURANCE TEST UNDER DYNAMIC RADIAL LOAD

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 diameter of the drum is 1 700 mm. The test wheel (single application) and tyre fixture shall provide loading normal to the surface of the drum and in line radially with the centre of the test wheel and the drum. The axes of the drum and test wheel shall be parallel.

5.2 Procedure

5.2.1 *Preparation*

Tyres selected for the test wheel shall be representative of the maximum load capacity tyre specified by the wheel or vehicle manufacturer. For disc wheels, the test adaptor shall be representative of production hubs using studs and nuts representative of those specified for the wheel. For demountable rims, the test adaptor shall be representative of production spoke wheels using studs, nuts and clamps representative of those specified for the rim. The wheel nuts shall be torqued to the torque limits specified by the wheel or vehicle manufacturer for stud size and type of nut used. Nut torque values shall be checked and reset periodically during the course of the test in order to compensate for the "wearing-in" of mating surfaces of nuts and bolt holes.

The studs and nuts shall not be lubricated.

The test load and inflation pressure are based on wheel/rim ratings. Test inflation pressures shown below are for information only.

Tyre pressure at usage load	Tyre test pressure
kPa*	kPa*
Up to 310	450
320 to 450	550
460 to 580	690
590 to 720	900
730 to 830	1 000

* 100 kPa = 1 bar

The selected test inflation pressure and load shall be maintained within ± 5 %.

5.2.2 *Force application*

A constant radial load shall be imparted to the wheel as the wheel rotates.

5.3 Radial load determination

The radial load F_r is given, in newtons, by the formula :

$$F_r = FK$$

where

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

K is the accelerated test load factor.

NOTE – For values of K, see table 3 of annex A.

5.4 Failure criteria

5.4.1 Inability of wheel/rim to sustain load.

5.4.2 A fatigue crack penetrating through a section of the wheel.

6 DEMOUNTABLE RIM WHEEL CENTRE DYNAMIC CORNERING 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 4).

1) Under study.

6.2 Procedure

6.2.1 *Preparation*

The demountable rim wheel centre or the wheel and tyre assembly shall be clamped securely to the test fixture. To ensure this, the wheel fixing shall be assembled and tightened at the beginning of the test using the procedures as specified by the vehicle manufacturer or by the wheel manufacturer. The mating surfaces of the test adaptor and wheel shall be free of excessive build-up of paint, dirt or foreign material. A rigid load-arm shaft with a test hub adaptor shall be attached to the hub of the wheel.

The studs and nuts shall not be lubricated.

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

NOTE — If the wheel application is always used with a brake drum/rotor, the wheel may be tested with a brake drum/rotor attached. If the wheel application is ever to be used without a brake drum/rotor, the wheel must be tested without a brake drum/rotor attached.

6.2.2 *Bending moment application*

To impart a bending moment to the wheel, a force is applied either perpendicular or parallel to the plane of the mounting surface of the wheel at a specified distance (moment arm).

6.3 Bending moment determination

The bending moment M (force × moment arm) is given, in newton metres, by the formula :

$$M = \mu RFS$$

where

μ is the assumed coefficient of friction developed between tyre and road;

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

F is the load rating of the wheel, in newtons, as specified by the wheel manufacturer;

S is the accelerated test factor.

NOTE — For values of μ and S, see table 4 of annex A.

6.4 Failure criteria

6.4.1 Inability of wheel to sustain load.

6.4.2 A fatigue crack penetrating through a section of the wheel.

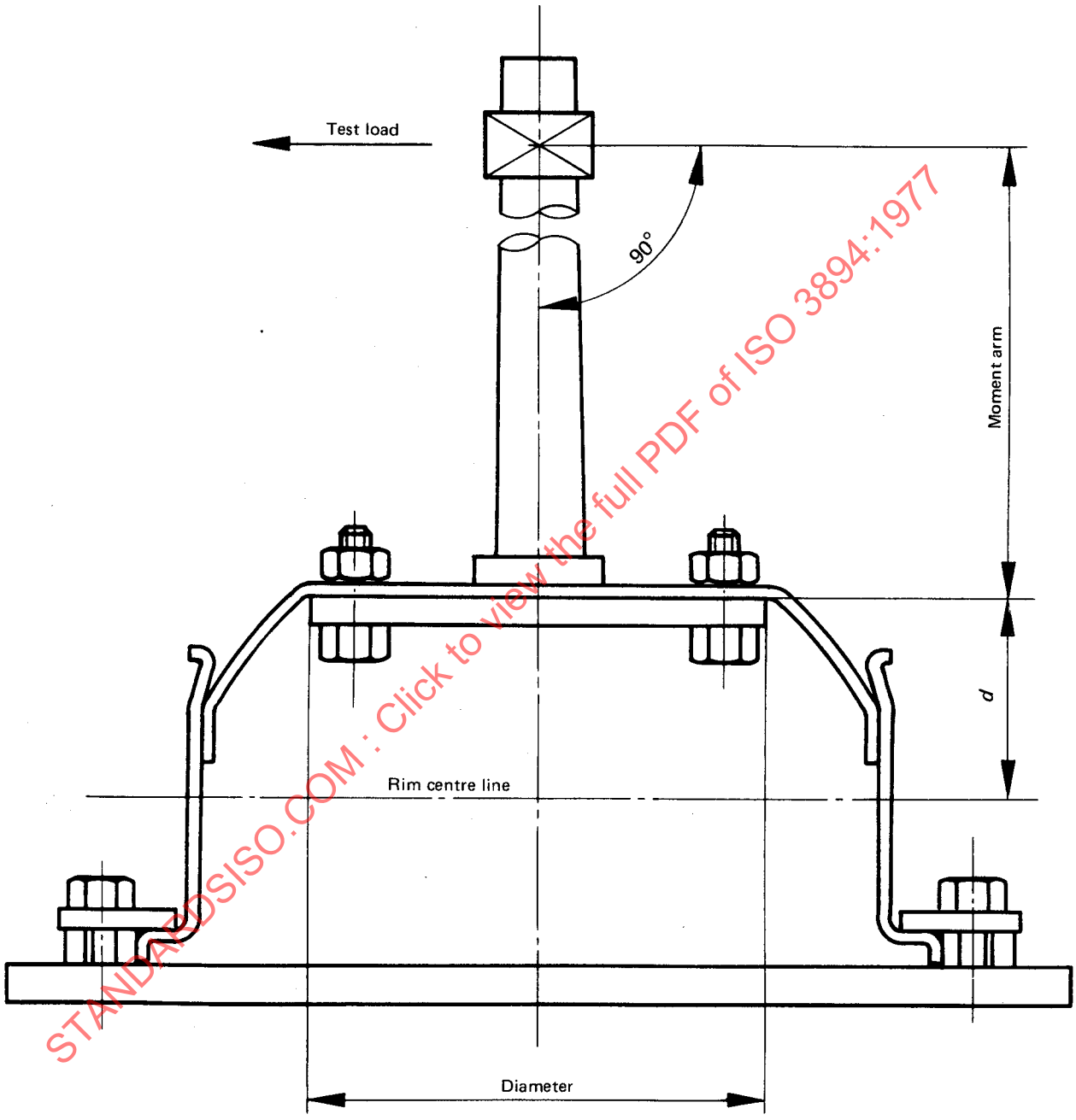


FIGURE 1 — **Cornering fatigue test — 90° Loading method**

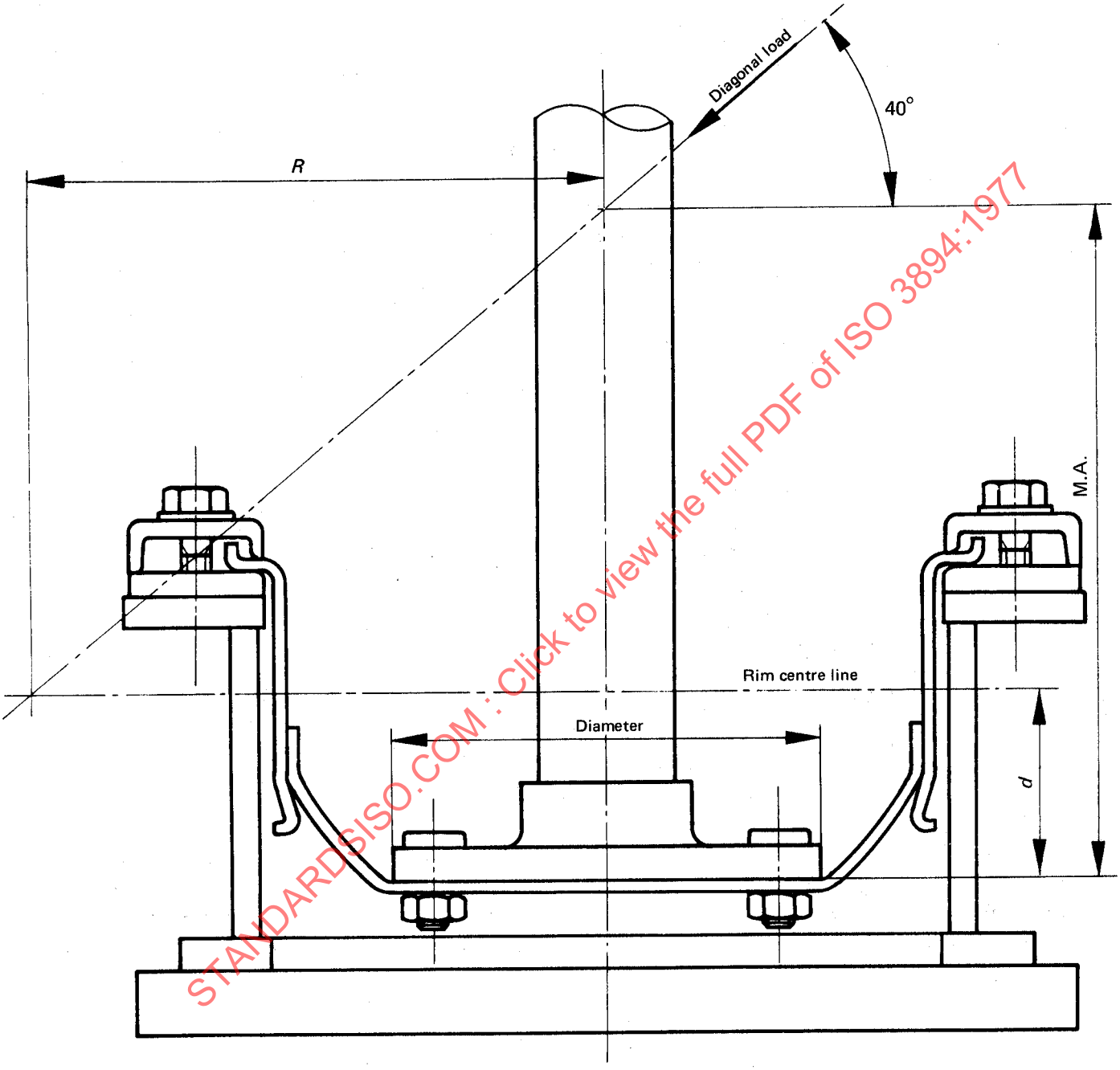
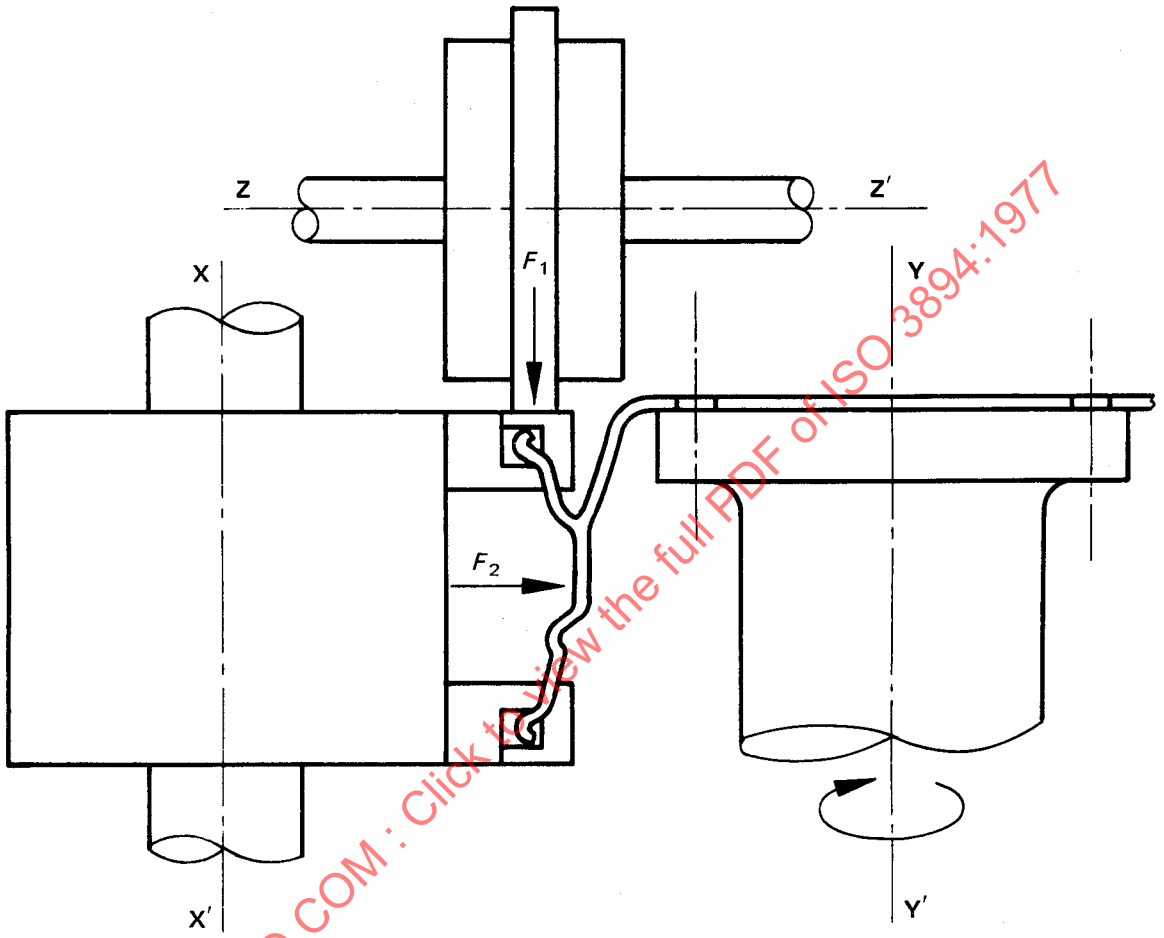


FIGURE 2 — **Cornering fatigue test — 40° Loading method**



XX′, YY′, ZZ′ in the same plane

ZZ′ ⊥ **XX′**

XX′ // **YY′**

FIGURE 3 – **Cornering fatigue test – Two-axis load method**