भारतीय मानक
Indian Standard

IS 9438 : 2018

ट्रकों एवं बसों के पहियों/रिमों की कार्यकारी अपेक्षाएँ एवं परीक्षण पद्धतियाँ

(पहला   पुनरीक्षण)

Performance Requirements and Methods of Tests for Wheels/ Rims for Trucks and Buses

(First Revision)

ICS 43.040.50; 43.080.10; 43.080.20

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Automotive Tyres, Tubes and Rims Sectional Committee, TED 7

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the finalized by the Automotive Tyres, Tubes and Rim Sectional Committee had been approved by the Transport Engineering Division Council.

This standard was first published in1980.This revision has been undertaken to align this standard with international practices. This standard is in agreement with the International Standard ISO 3894 : 2005 'Road vehicles — Wheels/rims for commercial vehicles — Test methods', issued by the International Organization for Standardization. It also includes the performance requirements apart from test methods. In this revision the aluminium wheels have also been included and accelerated test factors for cornering fatigue test have been specified.

In the formulation of this standard, assistance has also been derived from SAEJ267a,'Wheels — Passenger cars — Performance requirements and test methods'. Issued by the Society of Automotive Engineers (Inc), USA and ISO 3894 — 1977 'Road vehicles — Truck wheel rims — Test methods'.

This standard does not lay down the profiles and other general requirements. Reference may be made to the following standards for these requirements:

IS No.	Title
10694 (Part1) : 2009	Automotive vehicles — Rims — General requirements: Part 1 Nomenclature, designation, marking and measurement (*second revision*)
10694 (Part 3) : 1991	Automotive vehicles — Rims — General requirements: Part 3 Commercial vehicle rims (*first revision*)

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

PERFORMANCE REQUIREMENTS AND METHODS OF TEST FOR WHEELS/RIMS FOR TRUCKS AND BUSES

(First Revision)

1 SCOPE

This standard specifies three laboratory test Methods and Performance Requirements for evaluating certain essential fatigue strength characteristics of disc wheels, spoke wheels and demountable rims intended for road use on Commercial Vehicles, Buses, Trailers and Multipurpose Passenger vehicles.

The test methods are:

a) Dynamic cornering fatiguetest (for disc wheel rims),

b) Dynamic radial fatigue test (for disc wheel rims and wheel with demountable rims),

c) Dynamic cornering fatigue test (for wheel rims with demountable rims),

1.1 Test termination for the tests on wheels has also been specified.

2 REFERENCE

The following standard contain provision, which through reference in this text constitutes provision of the standard. At the time of publication, the edition indicated was valid. All standards are subject to revision and parties to agreements based on this standard is encouraged to investigate the possibility of applying the most recent edition of the standard indicated below:

IS No.	Title
14272 : 2011	Automotive vehicles — Types terminology

3 TERMS AND DEFINITIONS

For the purpose of this standard the following terms and definitions shall apply.

3.1 Wheel Rim — The wheel rim is the 'outer edge of a wheel, holding the tyre'. It makes up the outer circular design of the wheel on which the in side edge of the tire is mounted on vehicles such as automobiles to agreements based on this standard.

3.2 Static Loaded Radius — The measurement in meters from the wheel axle centerline to the ground when the tyre is properly inflated corresponding to the rated load.

3.3 Inset and Outset

3.3.1 *Inset* — The in set is the distance between the mounting face of the disc and the rim centerline. This distance is called in set when the mounting face is in side of the rim centerline.

3.3.2 *Outset* — The inset is the distance between the mounting face of the disc and the rim centerline. This distance is called out set when the mounting face is out side of the rim centerline.

3.4 Drop Centre Rim — The centre section of the rim being lower than the two outer edges, this allows the bead of the tire to be pushed in to the low are a on one side while the other side is pulled over and off the flange measurement in meters from the wheel axle center line to the ground when the tyre is properly inflated corresponding to the rated load.

4 GENERAL

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

5 TESTS

5.1 Dynamic Cornering Fatigue Test (for Disc Wheel Rims)

5.1.1 *Equipment*

The test machine shall have a driven rotatable device where by either the wheel rotates under the influence of a stationary bending moment or the wheel is stationary and is subject to a rotating bending moment [*see* Fig. 1A and Fig. 1B].

5.1.2 *Procedure*

5.1.2.1 *Preparation*

Clamp the rim of the wheel securely to the test machine with the help of suitable adaptors/jigsin accordance with Fig.1 A or Fig.1 B. The adaptor face of the test machine shall have equivalent mounting systems to those used on the vehicle .The same dimensional characteristics as the usual matching face used on the vehicle. Themating 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 loading arm (moment arm) and adaptor

assembly to the mounting surface of the wheel using studsor bolts, and nuts which are in good condition, lubricated ornon-lubricated in accordance with the intended vehicle application (as specified by the vehicle manufacturer), andare representative of those used onthevehicle . 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 beretorqued during thetest.

5.1.3 *Bending Moment Application*

To impart a bending moment to the wheel, apply a for

ceparallel to the plane of the wheel mounting surface at a specified distance with the loadingarm (moment arm) as shown in Fig. 1A or Fig. 1B.

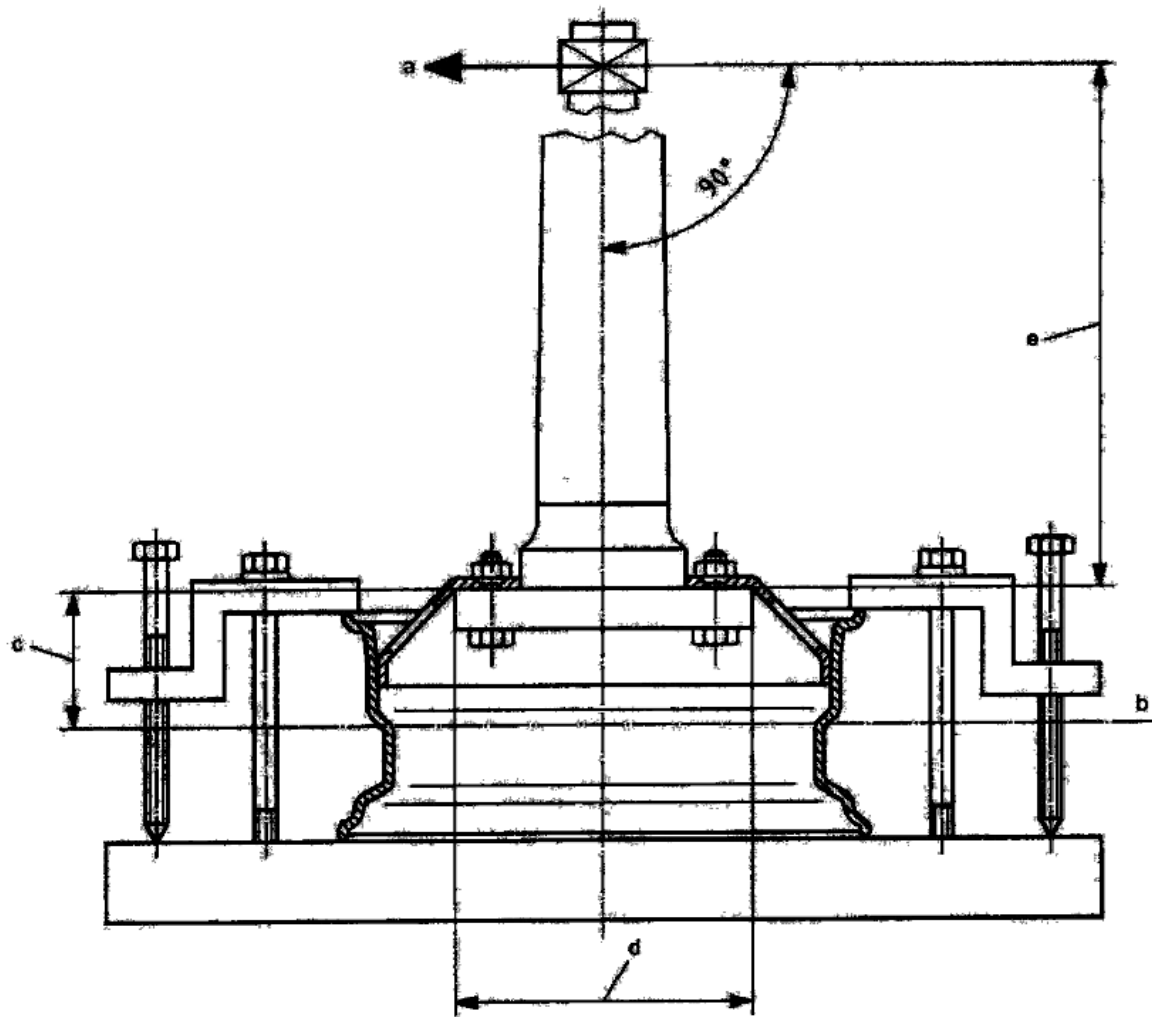Maintain the bending moment within the accuracy of ± 5 percent of the calculated value.

5.1.4 *Bending Moment Determination*

Determine the bending moment *M* (force × loading/ moment arm) is given in Newton metres, by the following formula:

$$M = (\mu.R + d)\, Fv \times S$$
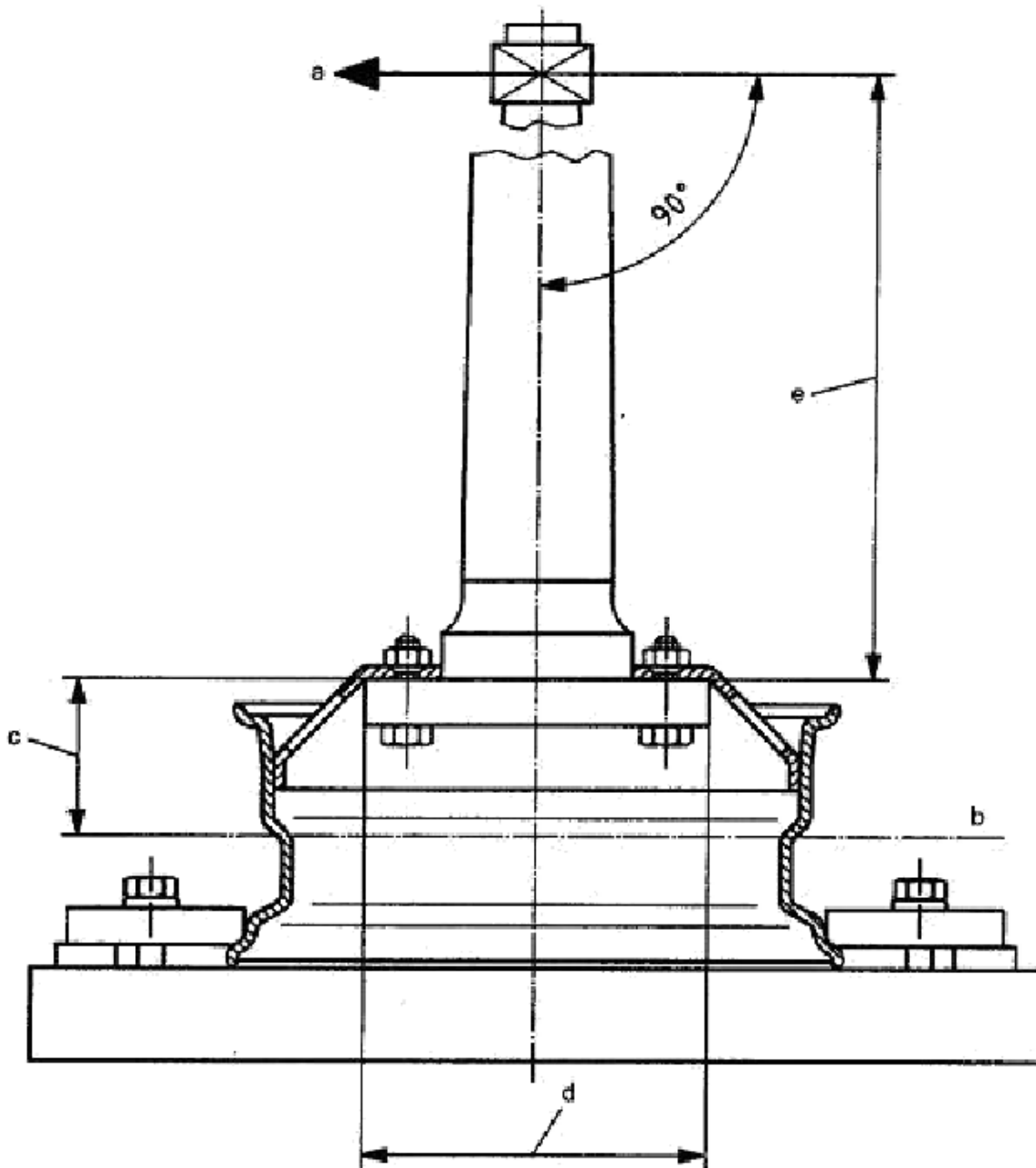
1A 90° Loading Method example showing bottom clamping

1B 90° Loading Method example Showing Top Clamping

Key

a – Test load
b – Rimcentreplane
c – Inset, d
d – Diameter
e – Loading/Moment arm, *l*

Fig. 1 Dynamic Cornering Fatigue Test

where

μ = assumed coefficient of friction developed between tyre and road (*see* Table 1)

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

d = inset or out set (positive for inset; negative for out set), of the wheel, in metres.

If the wheel may be used as an inset and out set wheel, then the inset value shall be used;

Fv = load rating of the wheel, in Newton, as specified by vehicle or wheel manufacturer;

S = accelerated test factor (*see* Table 1).

5.1.5 *Minimum No. of Performance Cycles to be Completed*

The wheel rim shall withstand minimum number of performance cycles without failure as specified in Table 1, prior to test termination.

5.1.6 *Test Termination*

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

a) Inability of the wheel rim to sustain the calculated test bending moment;

b) Propagation of crack or cracks existing prior to test or new visible stress-caused cracks penetrating through a section of the wheel.

3

c) The wheel shall with stand a minimum no. of performance cycles without failureas mentioned at Annex A (*see* Table 1).

5.2 Dynamic Radial Fatigue Test (for Disc Wheels and Wheels with Demountable Rims)

5.2.1 *Equipment*

The test machine shall be equipped with a means of imparting constant radial load as the wheel rotates. There are many means of imparting radial loads.The suggested equipment in corporate sadriven rotatable drum set which presents a smooth surface wider than the loaded test tyre section width. The recommended minimum externaldiameter of the drum is 1700 mm ± 1 percent. The test wheel (single application) and tyre fixture shall provide loading normal to the surface of the external surface and inline radially with the centre of the test wheel and drum. The axes of the drumand test wheel shall be parallel.

5.2.1.1 *Procedure*

Tyres selected for this test shall meet the load rating F_v of the wheel or be representative of the maximum load capacity tyres pecified by the vehicle or wheel manufacturer, which ever is greater. For disc wheels, the test adaptor shall be representative of production hub susing bolts or studs, and nuts which are in good condition, lubricated or non-lubricated in accordance with the intended vehicle application (as specified by the vehicle manufacturer), and are representative of those used on the vehicle. For demountable rims, the test adaptor shall be representative of production spoke wheels using bolts or studs and nuts and clamps which are in good condition, lubricated or non lubricated in accordance with the in tended vehicle application (as specified by the vehicle manufacturer), and are representative of those used on the vehicle. Torque the wheel nuts to the torque limit specified by the vehicle or wheel manufacturer for the 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 nutand bolt holes.

The test load inflation pressure is based on wheel/rim rating. Test inflation pressures shown beloware for in formation only:

Tyre Pressure at Usage Load, kPa[1]	Tyre Test Pressure, kPa
upto 310	450
320 to 450	550
460 to 580	690
590 to 720	900
730 to 830	1 000

[1] 100 kPa = 1 bar.

For any tyre pressure at usage other than above values, the tyre test pressure shall be as specified by wheel or vehicle manufacturer

The selected cold test inflation pressure shall be maintained within ± 5percent.The test radial load shall be maintained within ±5 percent of the calculated value.

5.2.2 *Radial Load Determination*

Determine the radial load F_r in Newton, by the following formula:

where

F_r = rating of the wheel or rim, in Newton, as specified by the vehicle or wheel/rim manufacturer, and

K = accelerated test load factor (*see* Table 2).

5.2.3 *Minimum No. of Performance Cycles to be Completed*

The wheel rim shall with stand minimum no.of performance cycles with out failure as specified in Table 2, prior to test termination.

5.2.4 *Test Termination*

The test shall be terminated in either of the three following circumstances;

a) In ability of wheel rim to sustain the calculated test radial load.

b) Propagation of a crack or cracks existing prior to test or new visible stress-caused cracks penetrating through a section of the wheel.

c) The wheel shall with stand a minimum load cycles with out failure as mentioned at Annex A (*see* Table 2).

5.3 Dynamic Cornering FatigueTest (for Wheels with Demountable Rims)

5.3.1 *Equipment*

The test machine shall have a driven rotatable device where by 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* Fig. 3).

5.3.2 *Procedure*

5.3.2.1 *Preparation*

Clamp the wheel to the test machine with the help of suitable adaptors/jigs. To ensure this, assemble and tighten the wheel fixing at the be ginning of the test using the procedures specified by the vehicle or wheel manufacturer. Attach a rigid loading/moment arm shaft with a test hub adaptor to the hub wheel. The mating surfaces of the test adaptor and wheel shall be free of
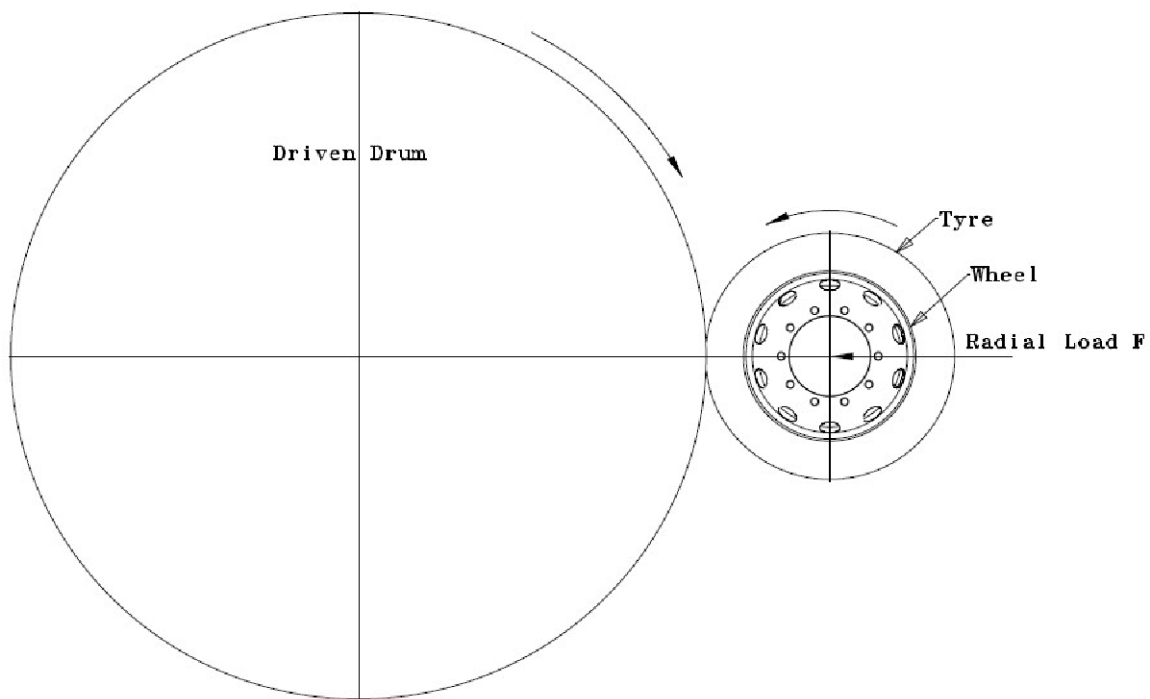
FIG. 2 TYPICAL SETUP OF DYNAMIC RADIAL FATIGUE TEST

excessive build-up of paint, dirt or foreign material. Use studs, nuts and clamps which are in good condition, lubricate dorn on-lubricated in accordance with the in tended vehicle application (as specified by the vehicle manufacturer), and are representative of those used on the vehicle or specified for the rim.

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 with out a brake drum, the wheel shall be tested with out a brake drum attached.

5.3.3 *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 loading/moment arm.

The load system shall maintain the specified bending moment within the accuracy of ±5 percent of the calculated value.

5.3.4 *Moment Determination Bending*

Determine the bending moment M (force × loading/ moment arm), in Newton metres, by the following formula:

$$M = \mu \times R \times F_\text{v} \times S$$

where

μ = assumed coefficient of friction developed between tyre and road (*see* Table 3);

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

F_v = load rating of the wheel, in Newton, as specified by the vehicle or wheel manufacturer; and

S = accelerated test factor (*see* Table 3).

5.3.5 *Minimum No. of Performance Cycles to be Completed*

The wheel rim shall with stand minimum no.of performance cycles with out failure as specified in Table 3, prior to test termination.

5.3.6 *Test Termination*

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

a) Inability of wheel rim to sustain the calculated bending moment.

b) Propagation of a crack or cracks existing prior to test visibles tress-caused cracks penetrating through a section of the wheel.

c) The wheels hall with stand a minimum no.of performance cycles with out failure as mentioned at Annex A (*see* Table 3).

6 CRITERIA FOR TYPE APPROVAL

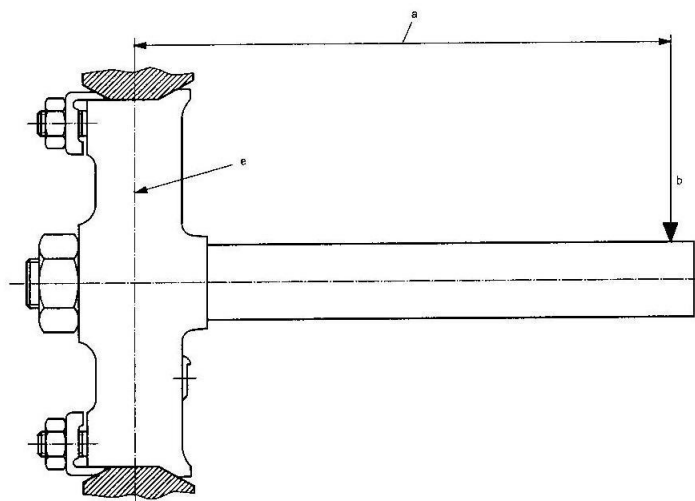**6.1 Type Approval Procedure**

6.1.1 Application for type approval to be submitted by the wheel rim manufacturer or vehicle manufacturer.
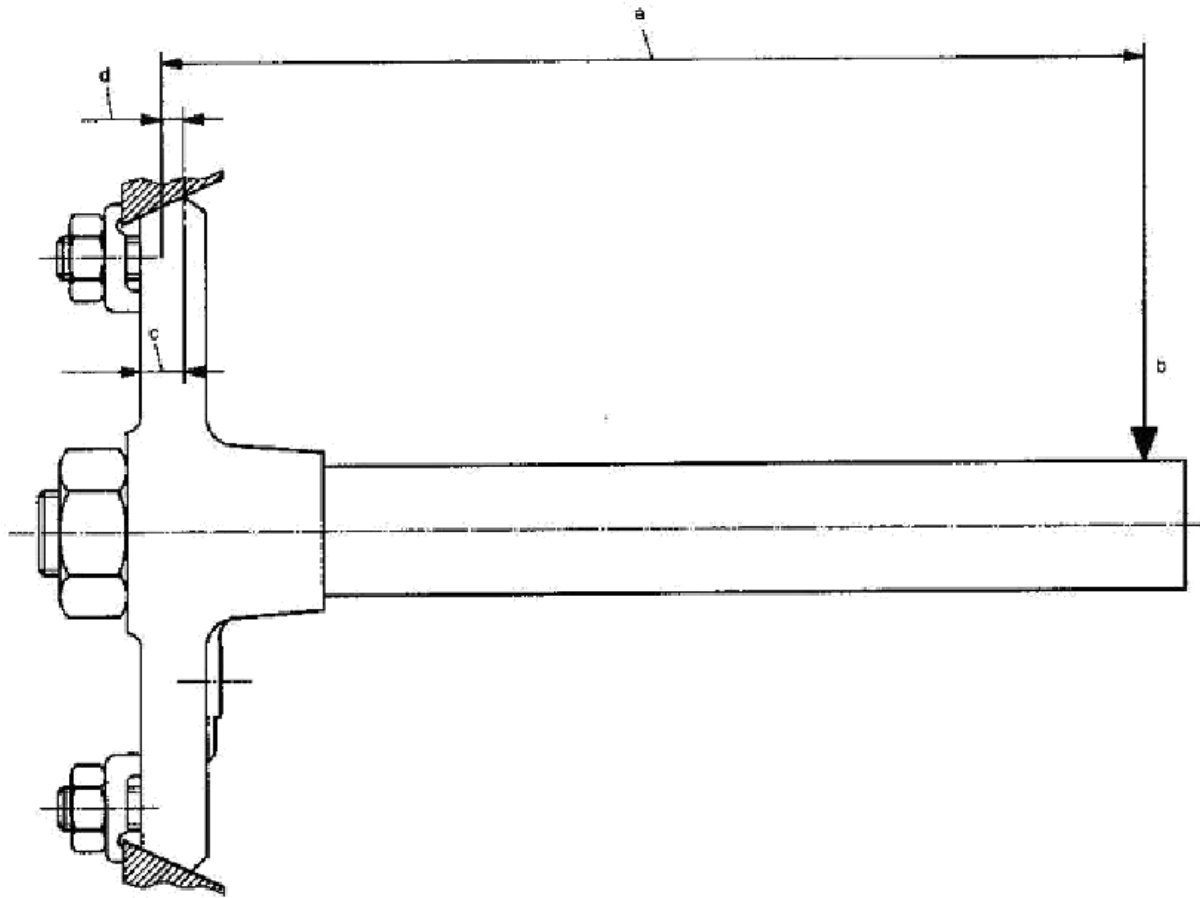
3 A FRONT WHEEL

3 B REAR WHEEL

Key
    a – *Key*
    a – loading moment arm
    b – Test load
    c – Bevel width, b. d – b/2
    e – Centreplaneof spacer used forspecifiedassembly.

FIG. 3 WHEELS WITH DEMOUNTABLE RIMS–DYNAMIC CORNERING FATIGUE TEST

6.1.2 The application for type approval shall containat least the technical information as specified in Annex B.

6.1.3 Every functional modification in technical specifications declared in accordance with **6.1.2** shall be intimated to the test agency. The test agency may then consider, whether,

a) wheel rim with modification complies with specified requirement; or

b) any further verification/test(s) is (are) required.

For considering whether any further verification/test(s) is (are) required or not (Criteria for Extension of Type Approval) specified at Annex C shall be used.

7 CONFORMITY OF PRODUCTION (COP) TESTS

7.1 Dynamic Cornering Fatigue Test

7.1.1 The frequency of COP tests shall be in accordance with AIS : 037-2005 (Amendment No. 3, Annex B, Sl No. 11).

ANNEX A

(*Clauses* 5.1.4 *and* 5.1.5)

TEST FACTORS AND MINIMUM NO. OF PERFORMANCE CYCLES

A-1 To permit uniform application of test methods specified, the test factors and performance requirements shown in Tables 1 to 3 shall be used when conducting the test.

Table 1 Test Factors for Dynamic Cornering Fatigue Test and Minimum No. of Performance Cycles
(*Clause* A-1)

Sl No.	Disc Wheel Description						Performance Requirements
	Material	Bolt Circle Diameter mm	Rim Diameter Designation	Inset or Outset mm	Accelerated Test Factor S	Coefficient of Friction μ	Minimum No. of Cycles to be Completed
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Ferrous	Any bolt circle	13, 14, 15	Inset below 100 and all out set	1.60		18 000
ii)	Ferrous	Any bolt circle	16 and above	Inset below100 and all outset	1.45		30 000
iii)	Ferrous	Any bolt circle	Any diameter	Inset 100 and above	1.10 1.30	0.7	60 000 40 000
iv)	Aluminum	Any bolt circle	16 and above	Inset below 100 and all outset	1.35 1.63		250 000 80 000
v)	Aluminum	Any bolt circle	17.5 and larger	All in set or outset	1.35		250 000

Table 2 Test Factors for Dynamic Radial Fatigue Test, Loading Methodand Minimum No. of Performance Cycles

(*Clauses* 5.2.2 *and* 5.2.4)

Sl No.	Disc Wheel Description					Performance Requirements
	Material	Bolt Circle Diameter mm	Rim Diameter Designation	Inset or Outset mm	Accelerated Test Factor[1] S	Minimum No. of Cycles to be Completed
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Ferrous	Any bolt circle	13, 14, 15, 16, 17 (5°drop centre)	All	2.2	500 000
					1.8	1 000 000
ii)	Ferrous	Any bolt circle	15, 17, 18, 20, 22, 24 17.5HC, 19.5, 22.5, 24.5	All	2.0	500 000
					1.9	600 000
					1.8	700 000
					1.7	850000
					1.6	1 000 000
iii)	Aluminum	Any bolt circle	16	127 or more	2.8	100 000
					2.0	1 000 000
iv)	Aluminum	Any bolt circle	17.5 and Larger	All	2.8	100 000
					2.0	1 000 000
[1] Use load factor to achieve adequately life run the test.						

Table 3 Test Load Factors for Wheels with Demountable Rims-Dynamic Cornering Fatigue Test

(*Clauses* 5.3.4 *and* 5.3.5)

Sl No.	Material	Accelerated Test Factor S	Coefficient of Friction μ	Minimum No. of Performance Cycles to be Completed
(1)	(2)	(3)	(4)	(5)
i)	Ferrous All	1.9	0.7	18000
		1.5		30000

ANNEX B

(*Clause* 6.1.2)

INFORMATION TO BE SUBMITETD FOR TYPE APPROVAL OF WHEEL RIMS

1	Manufacturer's Name and Address
2	Telephone No.
3	Fax No.
4	E-mail address
5	Contact person
6	Wheel rim designation
7	Wheel rim category (*Disc wheel/Wheel with demountable rim*)
8	Wheel type
8.1	Material with grade
8.2	Wheel mounting holes (Nos.)
8.3	Maximum vertical axle (Front/Rear) load capacity (kN)
8.4	Recommended inflation Service Pressure (kPa)
9	Inset/Outset (mm)
10	Dynamic loaded radius (mm)
10.1	Static loaded radius (mm)
11	Tightening torque for studs and nuts
11.1	Size of Nut/Stud
12	Detail of necessary accessories (if applicable)
12.1	Suitable for tubeless tyre mounting
13	Drawings, in triplicate, sufficiently detailed to permit identification of the type. They shall also show the position intended for the approval mark and for the wheel markings

ANNEX C

(*Clause* 6.1.3)

CRITERIA FOR EXTENSION OF TYPE APPROVAL

Nature of Change	Applicable Verifications/Tests
Decrease in rim thickness, mounting hole size and change of material	Cornering fatigue and radial fatigue test shall be conducted
Change of service pressure of tyre	Radial fatigue test shall be conducted
Change in part number, colour, aesthetic change	No test is required
Change in numbers of holes for mounting	Cornering fatigue test shall be conducted
Change in manufacturing plant location	Cornering fatigue test shall be conducted

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 2323 0131, 2323 3375, 2323 9402   *Website*: www.bis.org.in

Regional Offices:		*Telephones*
Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	2323 7617 2323 3841
Eastern	: 1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi KOLKATA 700054	2337 8499, 2337 8561 2337 8626, 2337 9120
Northern	: Plot No. 4-A, Sector 27-B, Madhya Marg, CHANDIGARH 160019	26 50206 265 0290
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