Methods of Tests of Wheel Rims for Heavy Commercial Vehicles

FOREWORD

This Test Standard was proposed by The Automotive Research Association of India as guideline for testing wheel rims of heavy commercial vehicles (HCV)

Recently there have been changes in axle load norms by government of India in which the axle loads have been increased by around 10-15 percent. The outcomes mentioned in this standard are derived from experiments conducted on actual vehicles and data and results derived thereof.

This Standard does not supersede any existing regulatory standard and is to be used purely as a guideline

METHODS OF TESTS FOR WHEELS/RIMS FOR HEAVY COMMERCIAL VEHICLES

1 SCOPE

This standard specifies a laboratory test Method for evaluating certain essential fatigue life characteristics of Wheel Rims intended for road use on Heavy Commercial Vehicles. The test is a Biaxial-Fatigue Test

2 REFERENCES

IS 9438 : 2018 Title : Performance requirements and methods of test for wheels/rims for trucks and buses

ES 3.23 : 2017 (EUWA Standard) Title : Biaxial Fatigue Test for Truck Wheels

SAE J2562 : 2005 Title : Biaxial Wheel Fatigue Test

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 inside edge of the tire is mounted on vehicles

3.2 Static Loaded Radius

The measurement in meters in loaded condition from the wheel axle centerline 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 intended for the vehicle shall be used for the tests. No wheel/rim shall be used for more than one test.

5 TEST

5.1 Biaxial Wheel Fatigue Test

5.1.1 *Equipment*

The test to be carried out using suitable biaxial (simultaneous radial + lateral) with wheel rim at appropriate speed. The test machine can be similar to outline as per the "Biaxial wheel test facility for commercial vehicle" (FhG/LBF – Patent EP 00 63 245, US 44 75 383) document

As shown in Figure 1, the test rig is made of a drum (1), connected to the machine main frame by means of bearings, two actuators, mounted on the machine main frame and connected to the loading frame (4). On the loading frame is mounted the vehicle dummy shaft suitable for "wheel end" fixing. The two actuators are acting in perpendicular directions: horizontal and vertical. The vertical actuator (3), free of sliding in horizontal direction, is connected to the loading frame by means of a hinge while the horizontal one (2), fixed to the machine frame, is linked with loading frame by means of a connecting rod (5). The wheel rolls inside the driving drum while loaded by the actuators. Inside the drum two side rings offer reaction to the tyre while horizontal force is acting. The wheel tilts according to actuator forces and position of connecting rod pivot (6) on loading frame. A block program, describing vertical and horizontal load, running in a computer is repeated until test termination

5.1.2 *Test Load Block Cycle*

The test load block cycle is made up of a series of combinations of vertical and lateral loads with a fixed number of revolutions for each combination. The test loads to be derived for the wheel rim considering the maximum corner load based on front or rear axle corner loads, whichever is maximum.

The test load block cycle is given in Annexure 1

The Lateral Load sign convention is as follows

- Inward Load (Towards the vehicle) : Negative
- Outward Load (Away from Vehicle) : Positive

5.1.3 *Test Procedure*

5.1.3.1 Test Preparation:

The wheel shall be prepared with the proper tyre fitted and valve mounted. Inflation cold pressure shall be as specified by the tyre manufacturer. The wheel shall be installed in the machine with original fasteners and using the vehicle manufacturer specified nut torque. Original or a representative hub should be used if available. The dummy vehicle axle shall be adjusted to set the wheel centre in line with the vertical actuator. The drum side ring position shall be adjusted to limit the tyre thread rooming with a small margin (10-20 mm per side). Shock absorber connected to the loading frame shall not limit all its possible movements during test execution.

5.1.3.2 Test Execution:

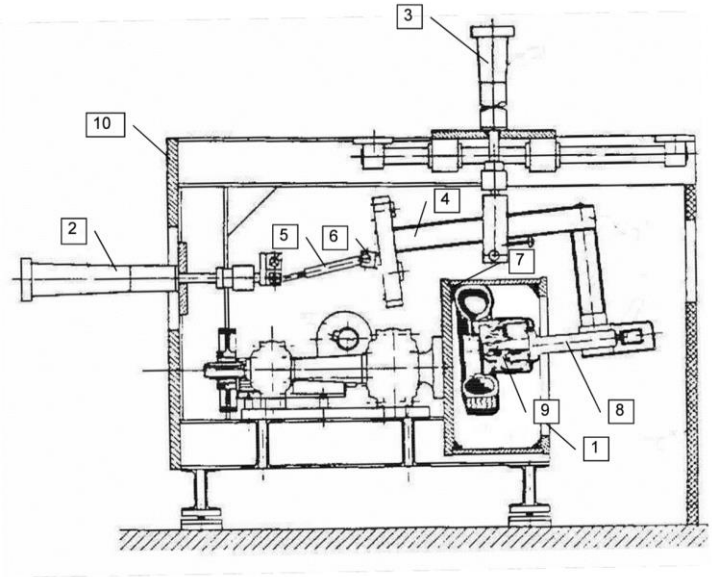
The test load block (Refer Annexure 1) shall be repeated until test termination as specified in 5.1.3.3. After every 5000 km of test, the nut torque shall be readjusted to the specified value. In case of doubts of wheel failure or functionality loss, record the residual nut torque and un-mount the wheel for a comprehensive check. Appropriate crack detection method such as Dye Penetrant Test shall be used. After

that, the nominal mounting conditions and control procedure described above have to be repeated

5.1.3.3 Test termination:
Wheel rim should withstand multiple repeats of test blocks equating to accelerated running of 46,000 kms on the test rig for a desired life of 10,00,000 kms. The Test load block is given in terms of revolutions and needs to be converted to kms using the rolling radius of wheel under test.
e.g. For a wheel radius of 0.51m, 1 test block covers 460km and has to be run for 100 times to complete 46000 kms of accelerated testing

The test outcome shall be deemed failed in case of following

- Inability of wheel/rim to sustain load.
- Inability of wheel/rim to sustain tyre pressure.
- Failure of wheel neighbour components with wheel damaging (hub, fastener Development of new visible stress-caused cracks penetrating through a section of the wheel or propagation of a crack or cracks existing prior to test.



1 Drum
2 Lateral actuator
3 Vertical actuator
4 Loading frame
5 Horizontal actuator – Loading frame connecting rod
6 Connecting rod pivot on loading frame
7 Drum side rings
8 Dummy vehicle axle
9 Wheel end
10 Main frame

Figure 1 : Biaxial Wheel Test Setup

Annexure 1 : Test Load Block

Sr No	Normalised Vertical Load (g)	Normalised Lateral Load (g)	Vertical Load (N)*	Lateral Load (N)*	Test Cycles** in 1 Block
1	0.65	0.14	22295	4802	61
2	1.03	-0.61	35329	-20923	22
3	1.03	-0.44	35329	-15092	46
4	1.03	-0.36	35329	-12348	705
5	1.03	-0.28	35329	-9604	4457
6	1.22	-0.44	41846	-15092	264
7	1.22	-0.36	41846	-12348	1678
8	1.22	-0.28	41846	-9604	9088
9	1.22	0.14	41846	4802	762
10	1.22	0.23	41846	7889	26
11	1.41	-0.53	48363	-18179	197
12	1.6	-0.44	54880	-15092	875
13	1.6	-0.36	54880	-12348	3999
14	1.6	-0.28	54880	-9604	11428
15	1.6	0.14	54880	4802	3262
16	1.8	-0.7	61740	-24010	31
17	1.8	-0.44	61740	-15092	330
18	1.8	-0.36	61740	-12348	1357
19	1.8	-0.28	61740	-9604	2171
20	1.8	-0.19	61740	-6517	22720
21	1.8	-0.11	61740	-3773	13977
22	1.8	0.06	61740	2058	163
23	1.99	-0.86	68257	-29498	383
24	2.18	-0.44	74774	-15092	775
25	2.18	-0.28	74774	-9604	1730
26	2.18	-0.02	74774	-686	51820
27	2.55	0	87465	0	11281

**Note: 1G load for the wheel bearing is considered as 3.5t = 34.3kN. (Considering corner load of the front axle having the rated load capacity 7t)*

***Note: The indicated cycles are the minimum number of cycles to be tested per block, and the same can be adjusted as per practical limitations of the test speed*