



TEST REQUIREMENTS FOR TRUCK STEEL WHEELS

ES 3.11

Page 1/8

SPECIFICATION D'ESSAI DES ROUES EN ACIER DE CAMIONS
PRÜFVERFAHREN FÜR NUTZFAHRZEUG - STAHL - RÄDER

1 - SCOPE

This Euwa Standard specifies, in accordance with ISO 3894, two laboratory methods for testing certain essential strength characteristics of disc wheels and spoke wheels with one piece rims, multipiece rims and segmented rims intended for road use on trucks, buses and trailers.

The test methods are:

- dynamic cornering fatigue test (90°)
- dynamic radial fatigue test.

2 - WHEEL DEFINITIONS

The following standard is valid and has to be used for fully processed new wheels / rims which are representative of wheel / rims intended for the specific vehicles. No wheel/rims shall be used for more that one test.

Wheel definitions are:

- * disc wheel with
 - one piece drop centre rims
 - multipiece rims (two piece-, three piece-, four piece- and five piece-rims)
- * spoke wheels and spoke wheel adaptors with
 - 18°/15° mounting bevel or
 - 28° mounting bevel with:
 - one piece drop centre rims
 - multipiece rims
 - segmented rims.

Nomenclature and designations are based on ISO 3911.

3 - DYNAMIC CORNERING FATIGUE TEST

The dynamic cornering fatigue test shall be conducted by the 90° loading method with one of the two alternative methods for clamping (see Figure 1).

3.1 - DISC WHEEL DYNAMIC CORNERING FATIGUE TEST

3.1.1 - 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).

Main changes compared to the last issue:

In chapter 3.1.2.1: revised and improved the first sentence, in agreement with ES-3.16

3.1.2 - PROCEDURE

3.1.2.1 - Preparation

The rim of the wheel shall be clamped securely to the test fixture. The face of the support of the testing machine shall have equivalent fixation 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. The test adaptor diameter should preferably be the minimum hub diameter, according to ES-3.16.

The load arm and adaptor assembly shall be attached 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. The wheel fixing shall be assembled and tightened at the beginning of the test using the procedure as specified by the vehicle or wheel manufacturer.

Wheel bolts or nuts may be retorqued during the test.

3.1.2.2 - Bending moment application

To impart a bending moment to the wheel, a force shall be applied parallel to the plane of the mounting surface of the wheel at a specified distance (moment arm) (See Figure 1).

The bending moment shall be maintained within $\pm 5\%$ of the calculated value.

3.1.3 - BENDING MOMENT DETERMINATION

The bending moment **M** (force x moment arm), shall be determined from the formula:

$$M = (\mu \cdot R_{dyn} + d) \cdot F_v \cdot S \quad [Nm]$$

where:

μ [-] is the assumed coefficient of friction developed between tyre and road; for tyres on drop centre rims use " $\mu = 0,7$ ", for tyres on bead seat rims use " $\mu = 0,65$ "

R_{dyn} [m] is the dynamic loaded radius defined as the circumference divided by 2π of the largest tyre to be used on the wheel as specified by the vehicle or wheel manufacturer.

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

F_v [N] is the load rating of the wheel, as specified by the vehicle or wheel manufacturer.

S [-] is the accelerated test factor, use $S = 2$

3.1.4 - TEST TERMINATION DEFINITION

3.1.4.1 Inability of wheel to sustain load

3.1.4.2 Maximum increasing of the deflection of the moment arm up to 15 % of the original value (depends on test rig).

3.1.4.3 Required fatigue-life is shown in annex A, tables 1 and 2.

3.2 - SPOKE WHEEL DYNAMIC CORNERING FATIGUE TEST

3.2.1. till 3.2.4.2

The paragraphs 3.1.1 till 3.1.4.2 shall be used in an equivalent way for spoke wheels (see also Figure 2).

3.2.4.3 Required fatigue-life is shown in annex A, table 3.

4 - DYNAMIC RADIAL FATIGUE TEST FOR DISC WHEELS

4.1 - 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 load; the suggested equipment incorporates a driven rotatable drum set which presents a smooth surface wider than the loaded test tyre section width. Drum with a running surface on the internal diameter are also practicable.

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 external 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 (Figure 3/a + 3/b).

4.2 - PROCEDURE

Tyres selected for this wheel test shall be in agreement with the load rating (F) of the wheel or shall be representative of the maximum load capacity tyre specified by the vehicle or wheel manufacturer (whichever is greater).

For disc wheel, 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.

The wheel nuts shall be torqued to the torque limits specified by the vehicle or wheel 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 the mating surfaces of nuts and bolt holes.

The test load and inflation pressure are based on wheel/rim ratings.

The inflation pressures shown in the following table are for information only.

Tyre pressure at usage load - bar	Tyre test pressure - bar
Up to 3,1	4,5
3,2 to 4,5	5,5
4,6 to 5,8	6,9
5,9 to 7,2	9,0
7,3 to 8,3	9,9

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

4.3 - RADIAL LOAD DETERMINATION

The radial load F_r , shall be determined from the formula:

$$F_r = F_v \cdot k \quad [N]$$

where:

F_v [N] is the load rating of the wheel / rim, as specified by the vehicle or wheel / rim manufacturer.

k [-] is the accelerated test load factor, use $K = 2,2$.

4.4 - TEST TERMINATION DEFINITION

4.4.1 Inability of wheel/rim to sustain load

4.4.2 Inability of wheel/rim to sustain tyre pressure

4.4.3 Required fatigue-life is shown in annex B, table 1.

ANNEX "A" - TEST FACTORS FOR DYNAMIC CORNERING FATIGUE TEST

TABLE 1

DISC WHEELS - Drop Centre Rims				
Material	Rim Diameter	Test Factor S	Bending Moment	Cycles
Ferrous	All rims and sizes	2	M = 75 %	$2,5 \times 10^5$
			M = 50 %	$2,0 \times 10^6$

TABLE 2

DISC WHEELS - Bead Seat Rims				
Material	Rim Diameter	Test Factor S	Bending Moment	Cycles
Ferrous	All rims and sizes	2	M = 65 %	$3,0 \times 10^4$
			M = 40 %	$4,5 \times 10^5$

TABLE 3

SPOKE WHEELS				
Wheels or Adaptors including Bolts, Nuts and Clamping Parts				
Material	Rim Diameter	Test Factor S	Bending Moment	Cycles
Ferrous	All sizes	2	M = 75 %	6×10^4
			M = 50 %	6×10^5

ANNEX "B" - TEST FACTORS FOR DYNAMIC RADIAL FATIGUE TEST
TABLE 1

DISC WHEELS				
Material	Rim Diameter	Test Factor K	Vertical Force	Cycles
Ferrous	All rims and sizes	2,2	F = 100 %	$5,0 \times 10^5$

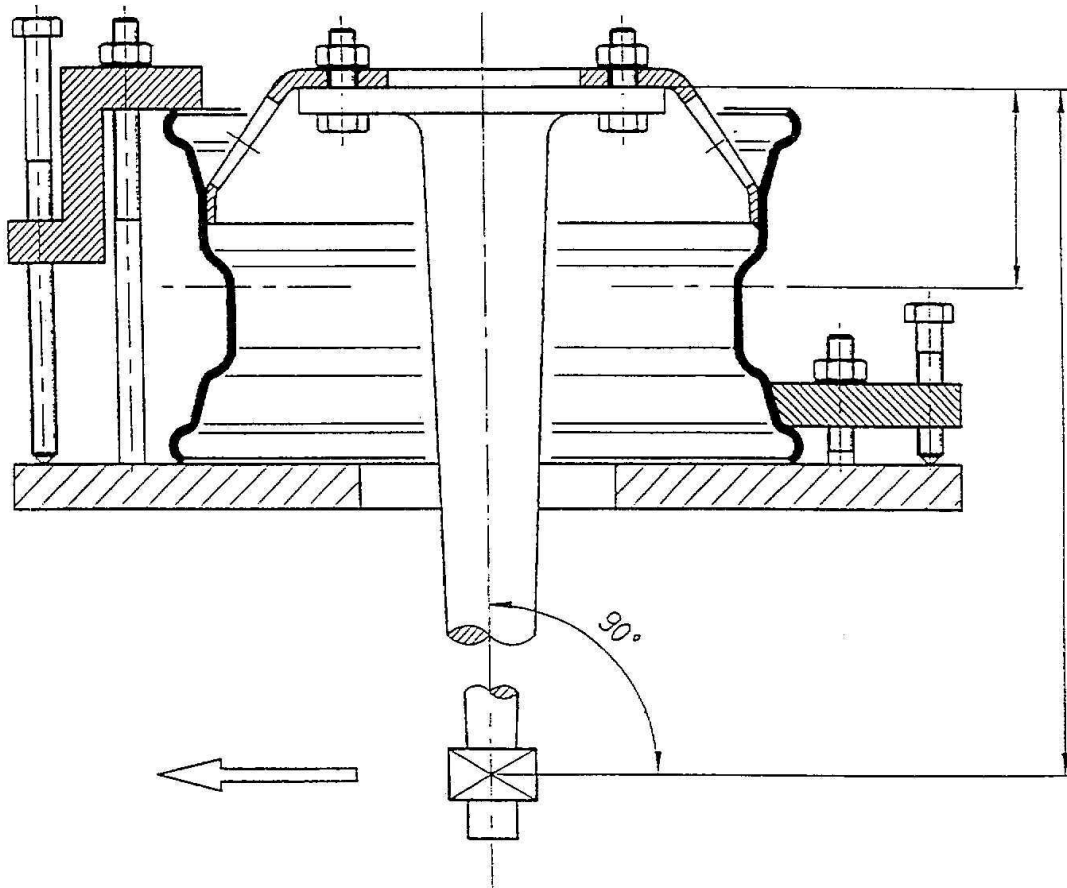


Figure 1 DYNAMIC CORNERING FATIGUE TEST - DISC WHEEL
90° LOADING AND CLAMPING METHOD

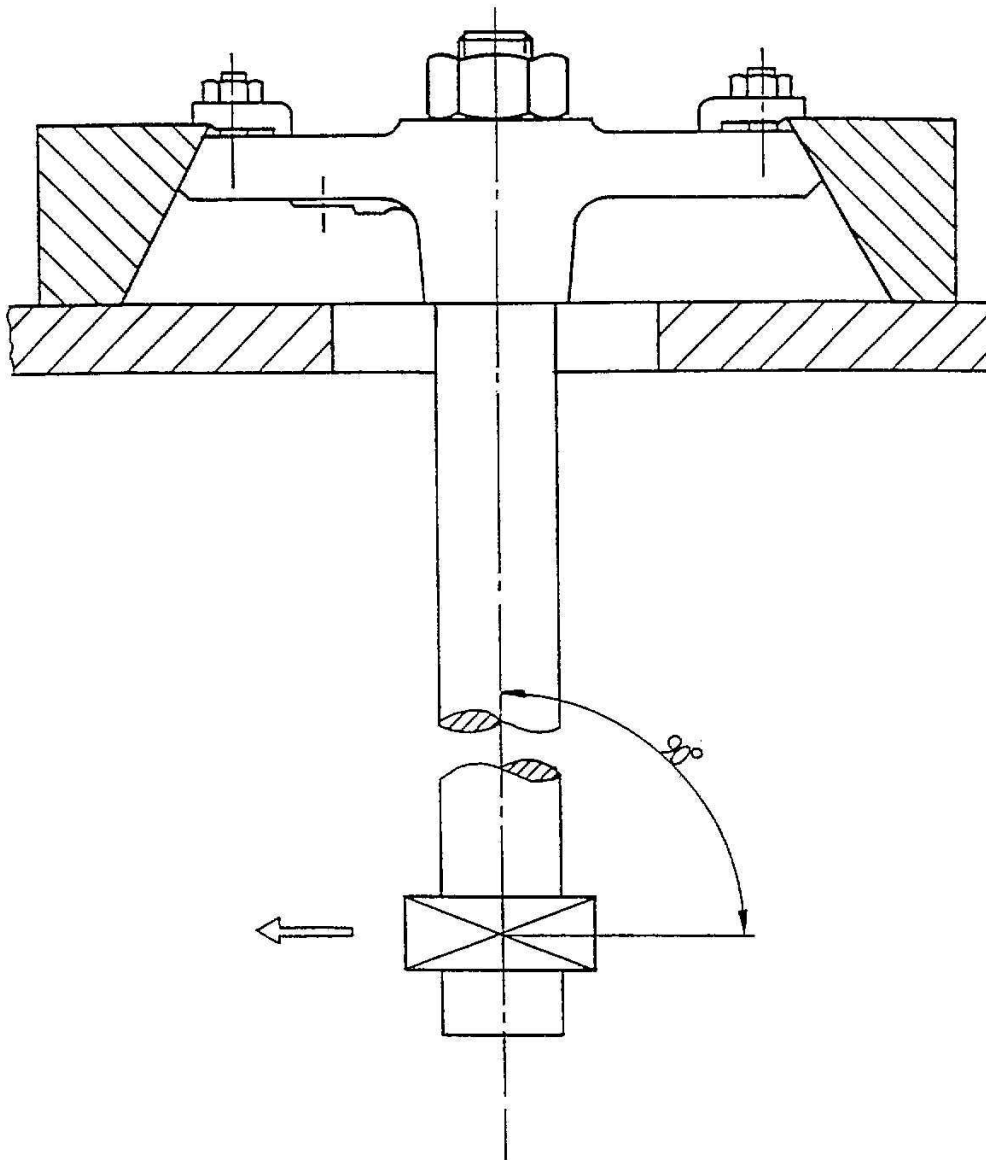


Figure 2 DYNAMIC CORNERING FATIGUE TEST - SPOKE WHEELS
90° LOADING AND CLAMPING METHOD

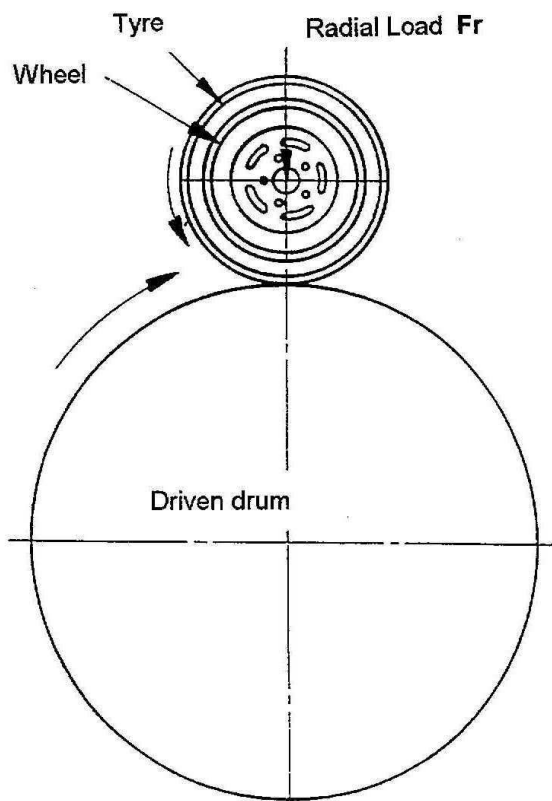


Figure 3/a (external drum)

DYNAMIC RADIAL FATIGUE TEST - DISC WHEEL

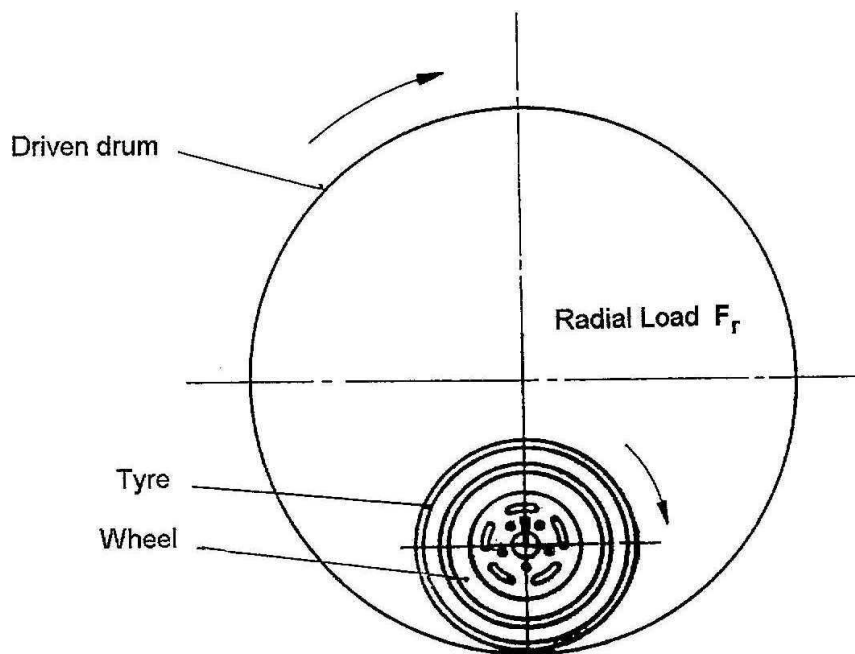


Figure 3/b (internal drum)

DYNAMIC RADIAL FATIGUE TEST - DISC WHEEL