The Engineering Society For Advancing Mobility Land Sea Air and Space®

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Wheels/Rims — Trucks — Test Procedures and Performance Requirements

SAE Recommended Practice
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an American National Standard

SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®

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TRUCK AND BUS PRACTICE

an American National Standard

SAE J267

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Ø WHEELS/RIMS - TRUCKS - TEST PROCEDURES AND PERFORMANCE REQUIREMENTS

1. SCOPE: This SAE Recommended Practice provides uniform laboratory procedures for fatigue testing certain production disc wheels, wheels for demountable rims, and demountable rims intended for normal highway use on trucks, buses, truck-trailers, and multipurpose passenger vehicles. Standardized fatigue tests are yet to be developed for wheels and rims not covered in this recommended practice.

2. REFERENCES:

SAE J393 - Nomenclature - Wheels, Hubs, and Rims for Commercial Vehicles

ISO 3894 - Road Vehicles - Commerical Vehicles - Wheels/Rims - Test Methods

3. TEST PROCEDURES:

3.1 Wheels/Rims for Test: Use only fully processed wheels/rims which are representative of production parts intended for vehicle application. New separate wheels/rims and new related components of multipiece rims will be used for each test.

3.2 Cornering Fatigue Test, Disc Wheels: The cornering fatigue test shall be conducted by one of the following methods as specified by the wheel manufacturer.

NOTE: Both test methods have been proved valid; however, there is not necessarily a correlation between the two tests in number of cycles and/or load.

3.2.1 Cornering Fatigue - 40 Deg Loading Method:

3.2.1.1 Equipment: The test machine shall be such that either the wheel rotates under the influence of a stationary bending moment and axial load, or the stationary wheel is subjected to an axial load and rotating bending moment (See Fig. 1).

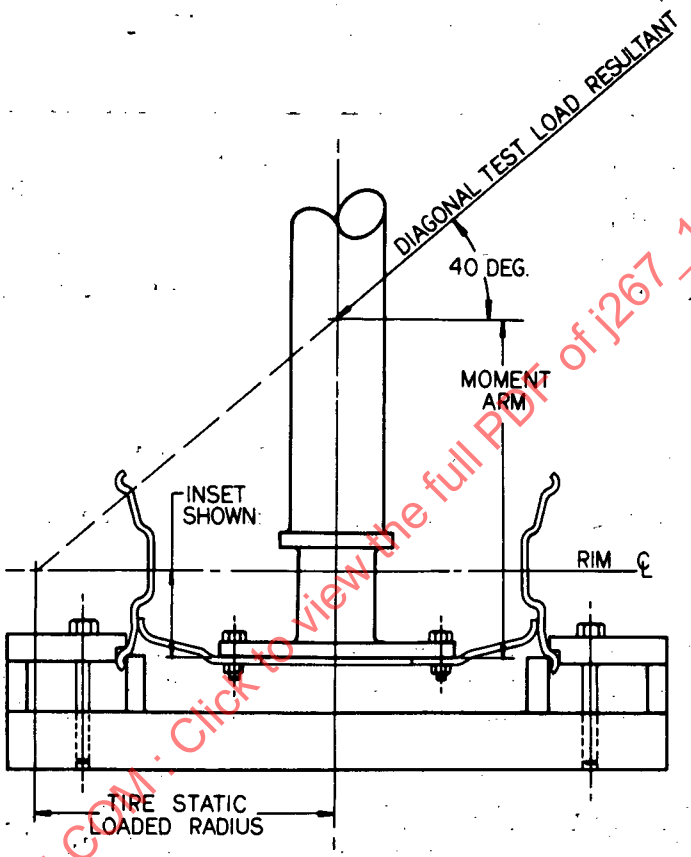

FIG. 1 - CORNERING FATIGUE, 40 DEG LOADING METHOD

3.2.1.2 Procedure: The rim shall be clamped securely to the test device. A rigid load arm shaft with a test adaptor with a mounting surface representative of production hubs shall be attached to the mounting surface of the wheel, using studs and nuts representative of those specified for the wheel. These wheel nuts shall be torqued to the torque limits specified in Table A-1 of the Appendix for the stud size and type of nut. The mating surfaces of the test adaptor and wheel shall be free of excessive buildup of paint, dirt, or foreign material. The final clamped position of the wheel without load shall not exceed an eccentricity of 0.010 in (0.254 mm) total indicator reading, normal to the point of loading. The load system shall maintain the specified load within ±3%. The nominal angle of the test load resultant will be 40 deg from a plane through the center of the rim as shown in Fig. 1.

3.2.1.3 Test Load and Moment Arm Determination: The test load and moment arm are determined as follows:

$$D = (S)L$$

where: D = diagonal test load resultant, lb force (N)
L = load rating of the wheel as specified by the wheel manufacturer, lb force (N)
S = accelerated test factor
Moment arm = slr tan 40 deg + d

where: slr = static loaded radius of the largest tire to be used on the wheel as specified by the vehicle or wheel manufacturer, in (mm). Refer to Table A-2 of the Appendix for static loaded radius.
tan 40 deg = tangent of 40 deg = 0.84
d = inset or outset (positive for inset, negative for outset) of the wheel, in (mm). If wheel may be used as inset or outset, use inset (See SAE J393).

3.2.1.4 Test Load Factors and Cycle Requirements: See Table 1.

TABLE 1 - TEST LOAD FACTORS AND CYCLE REQUIREMENTS FOR CORNERING FATIGUE TEST, 40 DEG LOADING METHOD

Disc Wheel Description						Performance Requirements	
	Bolt Circle		Rim Diameter Size Code				
Material	in	mm	in	mm	Inset/ Outset	Accelerated Test Factor	Min Cycle Life
Ferrous	Less than 11.25	Less than 285.75	16 and greater[c]	406 and greater[c]	All	1.6	20 000
Ferrous[a]	8.75	222.25	15	380	All	1.6	20 000
Ferrous	All except 8.75	All except 222.25	Less than 16	Less than 406	All	b	b
Ferrous	11.25 and greater	285.75 and greater	All[c]	All[c]	All	1.9	30 000

[a]Wheels used for low platform trailers.
[b]Use 90 deg loading method, paragraph 3.2.2.
[c]Exclude 17.5 in (444.5 mm) diameter and larger with rim width of 10.50 in (266.7 mm) and wider (wide-base truck-bus wheels).

3.2.2 Cornering Fatigue - 90 Deg Loading Method:

3.2.2.1 Equipment: The test machine shall be such that either the wheel rotates under the influence of a stationary bending moment, or the stationary wheel is subjected to a rotating bending moment. (See Fig. 2.)

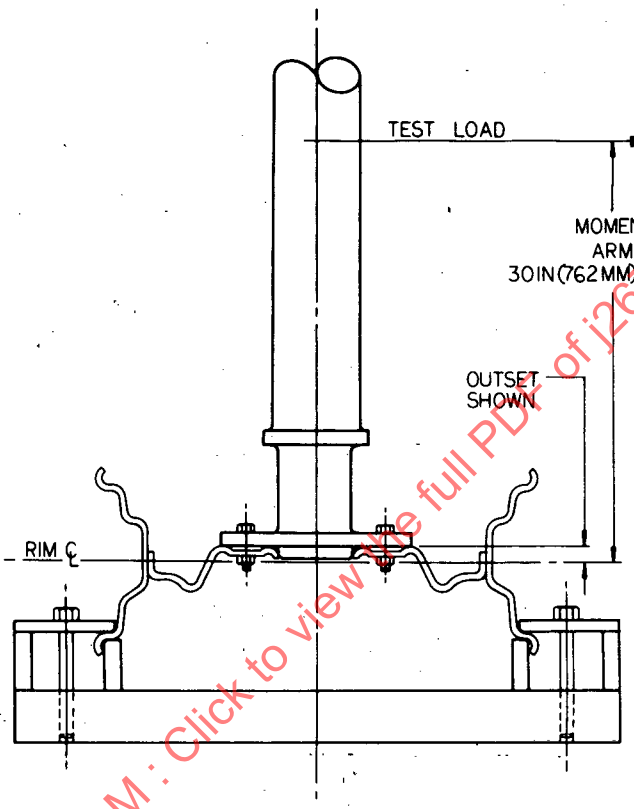

FIG. 2 - CORNERING FATIGUE, 90 DEG LOADING METHOD

3.2.2.2 Procedure: The rim shall be clamped securely to the test device. A rigid load arm shaft with a test adaptor with a mounting surface representative of production hubs shall be attached to the mounting surface of the wheel, using studs and nuts representative of those specified for the wheel. These wheel nuts shall be torqued to the torque limits specified in Table A-1 of the Appendix for the stud size and the type of nut. The mating surfaces of the test adaptor and wheel shall be free of excessive buildup of paint, dirt, or foreign matter. The final clamped position of the wheel without load should not exceed an eccentricity of 0.010 in (0.254 mm) total indicator reading normal to the shaft axis at the point of loading. The load system shall maintain the specified load within +3%. The application of the test load will be parallel to a plane through the center of the rim as shown in Fig. 2.

3.2.2.3 Test Load and Bending Moment Determination: The test load is determined by:

$$\text{Test load} = \frac{M}{\text{Moment arm}} \text{ (See Fig. 2)}$$

M is determined by the formula:

$$M = [\mu(slr) + d]\,(S)\,L$$

where: M = bending moment, lbf-in (N·m)
L = load rating of the wheel as specified by the wheel manufacturer, lb force (N)
slr = static loaded radius of the largest tire to be used on the wheel as specified by the vehicle or wheel manufacturer, in (mm x 10^{-3}). Refer to Table A-2 of the Appendix for static loaded radius.
μ = coefficient of friction developed between tire and road (0.7)
d = inset or outset (positive for inset, negative for outset) of the wheel, in (mm). If wheel may be used as inset or outset, use inset (See SAE J393).
S = accelerated test factor

3.2.2.4 Test Load Factors and Cycle Requirements: See Table 2.

TABLE 2 - TEST LOAD FACTORS AND CYCLE REQUIREMENTS FOR CORNERING FATIGUE TEST, 90 DEG LOADING METHOD

Disc Wheel Description						Performance Requirements	
		Rim Diameter Size Code		Inset/Outset			
Material	Bolt Circle	in	mm	in	mm	Accelerated Test Factor	Min Cycle Life
Ferrous	All	13, 14, 15	330, 356, 381	Less than 4	Less than 101.6	1.60	18 000
Ferrous	All	16 and larger[a]	406 and larger[a]	Less than 4	Less than 101.6	1.45	30 000
Ferrous	All	All[a]	All[a]	4 or more	101.6 or more	1.10 1.30	60 000 40 000
Aluminum	All	20 and larger[a]	508 and larger[a]	All	All	1.35	250 000

[a]Exclude 17.5 in (444.5 mm) diameter and larger with rim width of 10.50 in (266.7 mm) and wider (wide-base truck-bus wheels).

3.2.3 Test Termination Definition:

(a) Inability of wheel to sustain load.
(b) A visually detected fatigue crack penetrating through a section.

3.3 Radial Fatigue Test, Disc Wheels and Demountable Rims:

3.3.1 Equipment: The test machine shall be one with a driven, rotatable drum which presents a smooth surface wider than the loaded test tire section width. The suggested diameter of the drum is 67.23 in (1707.6 mm) which results in 300 revolutions/mile (186 revolutions/km). The test wheel (single application) and tire fixture must provide loading normal to the surface of the drum and in line radially with the center of the test wheel and the drum. The axes of the drum and the test wheel must be parallel.

3.3.2 Procedure: Tires selected for this test shall be representative of a size and construction approved by the Tire and Rim Association and the wheel/rim manufacture for the wheel/rim under test. 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 in Table A-1 of the Appendix for stud size and type of nut used. The test load and the inflation pressure are based on wheel/rim ratings. Test inflation pressure should be selected in accordance with Table 3.

The selected-test inflation pressure and load shall both be maintained within ±3%.

TABLE 3 - TEST INFLATION PRESSURES

Max. Inflation Pressure Rating		Test Pressure, Minimum
psi	kPa	
0 through 45	0 through 310	65 psi (450 kPa)
Over 45	Over 310	1.2 x Max. Inflation Pressure Rating

3.3.3 Radial Load Determination: The radial load is determined as follows:

$$R = (S)L$$

where: R = radial load, lb force (N)
L = load rating of the wheel/rim as specified by the wheel/rim manufacturer, lb force (N)
S = accelerated test factor

3.3.4 Test Load Factors and Cycle Requirements: See Table 4.

TABLE 4 - TEST LOAD FACTORS AND CYCLE REQUIREMENTS FOR RADIAL FATIGUE TEST

Wheel/Rim Description					Performance Requirements	
		Rim Diameter Size Code				
Material	Bolt Circle	in	mm	Inset/ Outset[b]	Accel-erated Test Factor	Min. Cycle Life
Ferrous	All	13, 14, 15, 16, 16.5[a] 17.5[a] Full Drop Center 15, 16 Semi Drop Center	330, 336, 381, 406, 419[a] 444[a] Full Drop Center 381, 406 Semi Drop Center	All	2.2 1.8	500 000 1 000 000
Ferrous	All	15, 17, 18, 20, 22, 24 Flat Base 17.5HC, 19.5, 22.5, 24.5 Drop Center	381, 432, 457, 508, 559 610 Flat Base 444HC, 495, 572, 622 Drop Center	All	2.0 1.9 1.8 1.7 1.6	500 000 600 000 700 000 850 000 1 000 000
Aluminum	All	20 and larger	508 and larger	All	2.8 2.0	100 000 1 000 000

[a]9.75 in (248 mm) rim width and narrower.
[b]Offset for demountable rims.

3.3.5 Test Termination Definition:

(a) Inability of wheel/rim to sustain load or contain air.
(b) A visually detected fatigue crack penetrating through a section.

3.4 Cornering Fatigue Test, Wheels for Demountable Rims:

3.4.1 Equipment: The test machine shall be such that either the wheel rotates under the influence of a stationary bending moment, or the stationary wheel is subjected to a rotating bending moment. (See Fig. 3.)

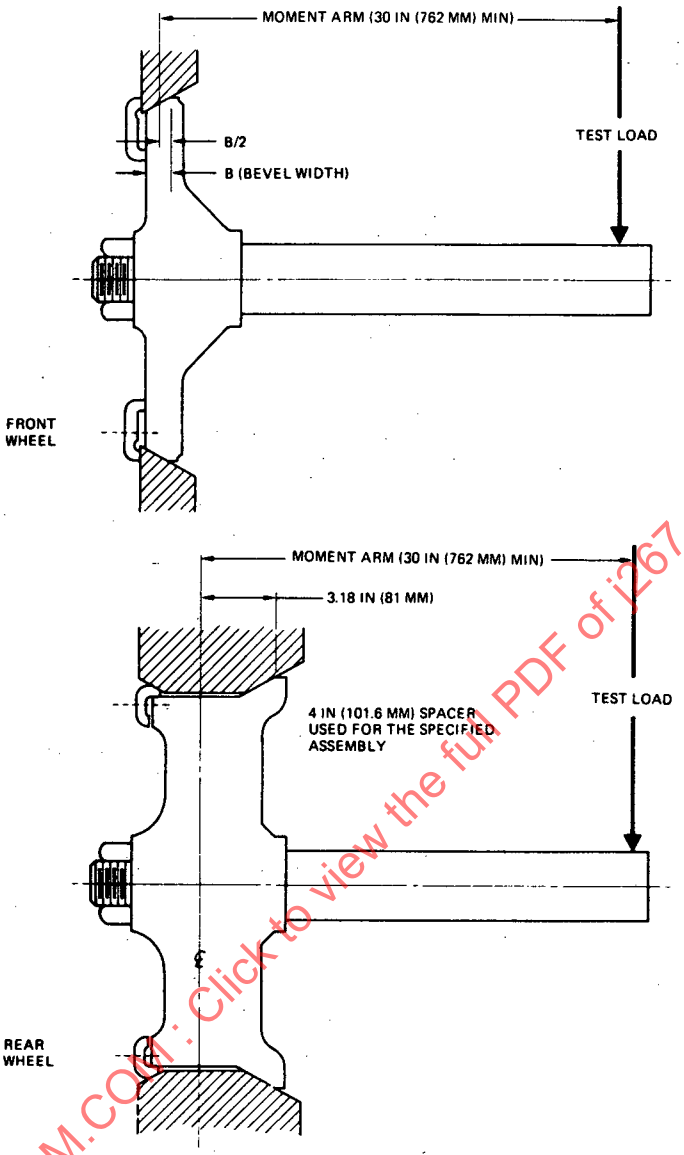

FIG. 3 - CORNERING FATIGUE, 90 DEG LOADING METHOD

3.4.2 Procedure: The wheel shall be clamped securely to the test device using studs and/or bolts and nuts representative of those specified for the wheel assembly. The rim clamp nuts shall be torqued to the torque limits specified in Table A-1 of the Appendix for the stud or bolt size listed for spoke wheels. The mating surfaces of the test adaptor and wheel shall be free of excessive buildup 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 final clamped position of the wheel without load shall not exceed an eccentricity of 0.010 in (0.254 mm) total indicator reading normal to the shaft axis at the point of loading. The load system must maintain the specified test 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.

3.4.3 Test Load and Bending Moment Determination: The test load is determined by:

$$\text{Test load} = \frac{M}{\text{Moment arm}} \text{ (See Fig. 3)}$$

M is determined by the formula:

$$M = \mu\,(\text{slr})\,(S)L$$

where: M = bending moment, lbf-in (N·m)
L = load rating of the wheel as specified by the wheel manufacturer, lb force (N)
slr = static loaded radius of the largest tire to be used on the wheel as specified by the vehicle or wheel manufacturer, in (mm x 10^{-3}). Refer to Table A-2 of the Appendix for static loaded radius.
μ = coefficient of friction developed between tire and road (0.7)
S = accelerated test factor

3.4.4 Test Load Factors and Cycle Requirements: See Table 5.

TABLE 5 - TEST LOAD FACTORS AND CYCLE REQUIREMENTS FOR CORNERING FATIGUE TEST, WHEELS FOR DEMOUNTABLE RIMS

Material	Accelerated Test Factor	Min Cycle Life
Ferrous	1.90	35 000
	1.50	100 000

3.4.5 Test Termination Definition:

(a) Inability of wheel to sustain load.
(b) A visually detected fatigue crack penetrating through a section.