SOCIETY OF AUTOMOTIVE ENGINEERS, INC. • TWO PENNSYLVANIA PLAZA • NEW YORK, NEW YORK 10001

LAND SEA AIR SPACE

TECHNICAL REPORT J267a

WHEELS/RIMS—TRUCKS—TEST PROCEDURES AND PERFORMANCE REQUIREMENTS—SAE J267a

SAE Recommended Practice

Report of Wheel Committee approved September 1971 and last revised September 1973.

1. Scope--This SAE Recommended Practice provides uniform laboratory procedures for fatigue testing certain production disc wheels, spoke wheels, 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/rims not covered in this recommended practice.

2. Definitions—A detailed listing of basic nomenclature is contained in SAE J393.

3. Test Procedures

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

3.2 Disc Wheel Dynamic Cornering Fatigue Test—The dynamic cornering fatigue test must be conducted by one of the following alternate 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 (ALTERNATE 1)

3.2.1.1 *Equipment*—The test machine shall be one with a means to impart a constant rotating bending moment and axial load to the wheel. (See Fig. 1.)

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.

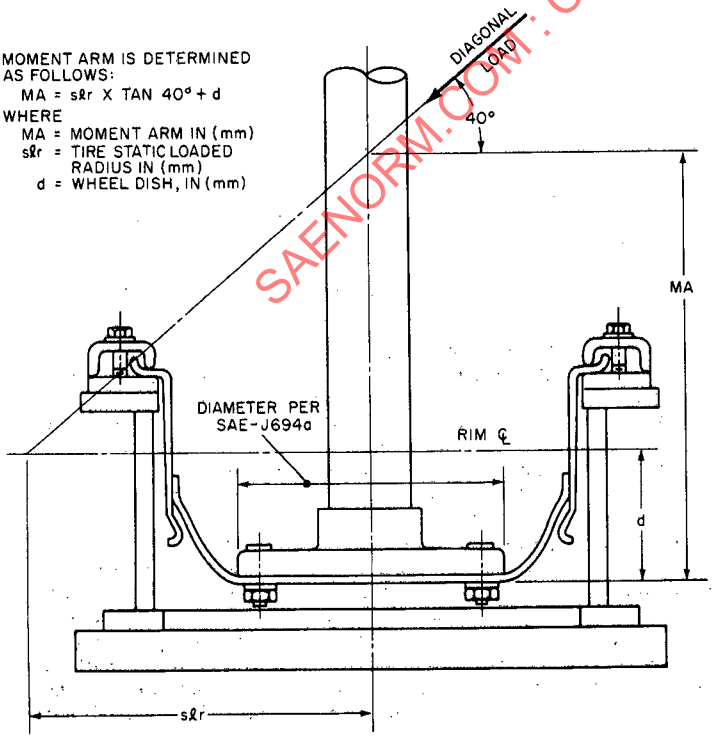


FIG. 1—CORNERING FATIGUE, 40 DEG LOADING METHOD

TABLE 1—TEST LOAD FACTORS AND CYCLE REQUIREMENTS FOR CORNERING FATIGUE TEST, ALTERNATE 1

Disc Wheel Description						Performance Requirements	
Material	Bolt Circle		Rim Dia(s)		Offset	Accelerated Test Factor	Min Cycle Life
	in	mm	in	mm			
Ferrous	Less than 11.25	Less than 285.75	16 and greater	406 and greater	NA	1.6	20,000
Ferrous[a]	8.75	222.25	15	380	NA	1.6	20,000
Ferrous	Less than 11.25 (except 8.75 bolt circle x 15 dia as noted above)	Less than 285.75 (except 222.25 bolt circle x 380 dia as noted above)	Less than 15	Less than 380	NA	—[b]	—[b]
Ferrous	11.25 and greater	285.75 and greater	NA	NA	NA	1.9	30,000

NA—Not applicable.
[a]Wheels used for low platform trailers.
[b]Use 90 deg loading method, paragraph 3.2.2.

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:

$$D = L \times K$$

where:

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

where:

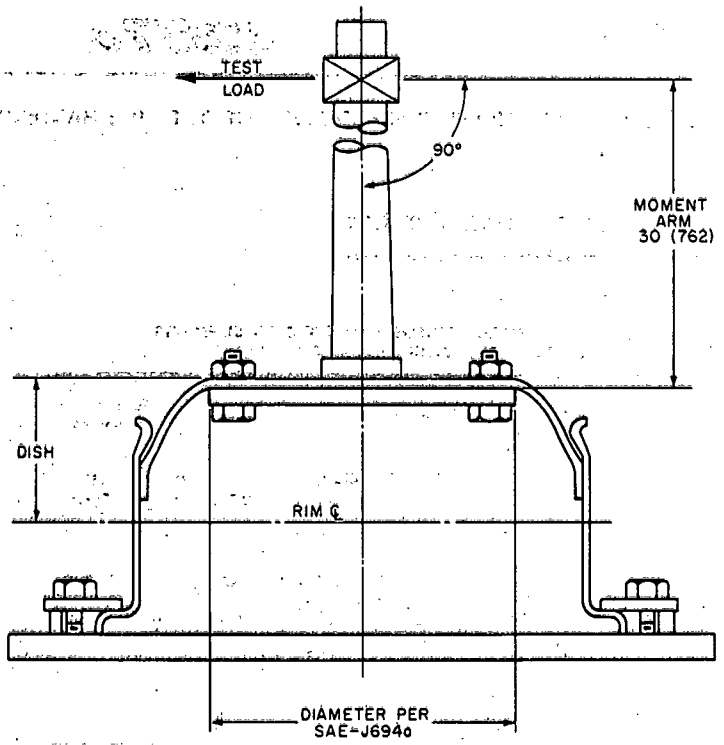
slr = static loaded radius of the largest tire to be used on the wheel as specified by the vehicle or wheel manufacturer, in (mm). Refer to Table A-2 of the Appendix for static loaded radius
tan 40 deg = tangent of 40 deg = 0.84
d = offset of wheel, in (mm). See Fig. 3 in SAE J393 to determine if d is positive or negative. If wheel may be used as both a positive or negative offset, use positive offset.

3.2.1.4 *Test Load Factors and Cycle Requirements*—See Table 1.

3.2.2 CORNERING FATIGUE—90 DEG LOADING METHOD (ALTERNATE 2)

3.2.2.1 *Equipment*—The test machine shall be one with a means to impart a constant rotating bending moment to the wheel. (See Fig. 2.)

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



NOTE: DIMENSIONS ARE IN (mm)

FIG. 2—CORNERING FATIGUE, 90 DEG LOADING METHOD

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:

$$M = \frac{L\,[(\text{slr})\,\mu + d]}{12}\,(K)$$

where:

M = bending moment, lbf-ft (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 12 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 = offset of wheel, inches (mm x 12 x 10^{-3}). Refer to Table A-2 of the Appendix for static loaded radius. See Fig. 3 in SAE J393 to determine if d is positive or negative. If wheel may be used as both a positive or negative offset, use positive offset
K = accelerated test factor

3.2.2.4 *Test Load Factors and Cycle Requirements*—See Table 2.

3.2.3 FAILURE DEFINITION

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

3.3 Disc Wheel and Demountable Rim Dynamic Radial Fatigue Test

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 (187.5 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

TABLE 2—TEST LOAD FACTORS AND CYCLE REQUIREMENTS FOR CORNERING FATIGUE TEST, ALTERNATE 2

Disc Wheel Description						Performance Requirements	
Material	Bolt Circle	Rim Dia(s)		Offset		Accelerated Test Factor	Min Cycle Life
		in	mm	in	mm		
Ferrous	Any bolt circle	13, 14, 15	330, 356, 381	Less than 4	Less than 101.6	1.60	18,000
Ferrous	Any bolt circle	16 and larger[a]	406 and larger[a]	Less than 4	Less than 101.6	1.33	30,000
Ferrous	Any bolt circle	Any diameter[a]	Any diameter[a]	4 or more	101.6 or more	1.10	60,000
Aluminum	10 hole 11.25 in (285.75 mm) and larger	Any diameter	Any diameter	Any offset	Any offset	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).

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 the following table:

Tire Pressure at Usage Load		Test Pressure	
psi	kPa	psi	kPa
Up to 45	Up to 310	65	450
46 to 65	320 to 450	80	550
66 to 85	460 to 580	100	690
86 to 105	590 to 720	130	900
106 to 120	730 to 830	145	1000

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

3.3.3 RADIAL LOAD DETERMINATION—The radial load is determined as follows:

$$R = LK$$

where:

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

3.3.4 TEST LOAD FACTORS AND CYCLE REQUIREMENTS—See Table 3.

3.3.5 FAILURE DEFINITION

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

3.4 Spoke Wheel Dynamic Cornering Fatigue Test

3.4.1 EQUIPMENT—The test machine shall be one with a means to impart a constant rotating bending moment to the wheel. (See Fig. 3.)

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 forign 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 ±6%.

NOTE: If the wheel application is always used with a brake drum/

TABLE 3—TEST LOAD FACTORS AND CYCLE REQUIREMENTS FOR DYNAMIC RADIAL FATIGUE TEST

Disc Wheel Description					Performance Requirements	
Material	Bolt Circle	Rim Dia(s) in	Rim Dia(s) mm	Offset	Accelerated Test Factor	Min. Cycle Life
Ferrous	Any bolt circle	13, 14, 15, 16, full drop center	330, 336, 381, 406, full drop center	Any offset	2.2	500,000
Ferrous	Any bolt circle	15, 16, semi-drop center	381, 406, semi-drop center	Any offset	2.2	500,000
Ferrous	Any bolt circle	16.5, 17.5, full drop center[a]	419, 444, full drop center[a]	Any offset	2.2[b] 1.8[b]	500,000 1,000,000
Ferrous	Any bolt circle	15, 17, 18, 20, 22, 24, flat base	381, 432, 457, 508, 559, 610, flat base	Any offset	2.0[b] 1.9[b] 1.8[b] 1.7[b] 1.6[b]	500,000 600,000 700,000 850,000 1,000,000
Ferrous	Any bolt circle	19.5, 22.5, 24.5, drop center[c]	495, 572, 622 drop center[c]	Any offset	2.0 1.9 1.8 1.7 1.6	500,000 600,000 700,000 850,000 1,000,000
Aluminum	10 hole, 11.25 in (285.75 mm) and larger	Any diameter	Any diameter	Any offset	2.8[d] 2.0[d]	100,000 1,000,000

[a] 9.75 in (248 mm) rim width and narrower.
[b] Use load factor and corresponding cycle life to achieve adequate tire life to run the test.
[c] Exclude 10.50 in (267 mm) rim width and wider with diameters of 19.5 and 22.5 in (495 and 572 mm).
[d] Use load factor and corresponding cycle life to achieve adequate tire and related wheel/rim component life to run the test.

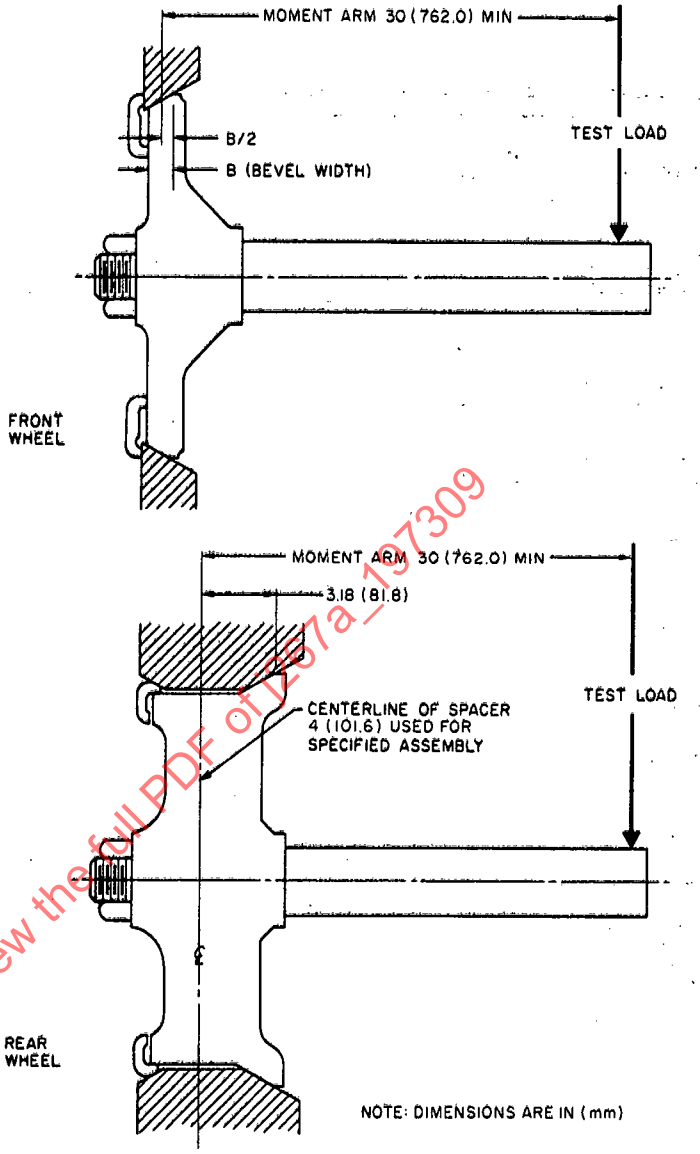


FIG. 3—CORNERING FATIGUE, 90 DEG LOADING METHOD

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:

$$M = \frac{L\,[(slr)\,\mu]}{12}\,(K)$$

where:

M = bending moment, lbf-ft (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 12 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)
K = accelerated test factor

3.4.4 TEST LOAD FACTORS AND CYCLE REQUIREMENTS

Wheel Description	K[a]	Min. Cycle Life[a]
All ferrous spoke wheels	1.71 1.50	35,000 100,000

[a] Use load factor and corresponding cycle life to achieve adequate bearing life to run the test

3.4.5 FAILURE DEFINITION

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