SAE INTERNATIONAL

SURFACE VEHICLE RECOMMENDED PRACTICE

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Wheels/Rims - Military Vehicles
Test Procedures and Performance Requirements

RATIONALE

This document has been revised to clarify procedures when manufacturer-specific data is available.

1. SCOPE

This SAE Recommended Practice provides minimum performance requirements and uniform laboratory procedures for fatigue testing of disc wheels, demountable rims, and bolt-together divided wheels intended for normal highway use on military trucks, buses, truck-trailers, and multipurpose vehicles. Users may establish design criteria exceeding the minimum performance requirement for added confidence in a design. For other (non-military) wheels and rims intended for normal highway use on trucks and buses, refer to SAE J267. For wheels intended for normal highway and temporary use on passenger cars, light trucks, and multipurpose vehicles, refer to SAE J328. For wheels used on trailers drawn by passenger cars, light trucks, or multipurpose vehicles, refer to SAE J1204. This document does not cover off-highway or other special application wheels and rims.

2. REFERENCES

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

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

2.1.2 Tire and Rim Association Publications

Available from The Tire and Rim Association, Inc., 175 Montrose West Avenue, Suite 150, Copley, OH 44321, Tel: 330-666-8121, www.us-tra.org.

Yearbook and Engineering Design Information Book (EDI), The Tire and Rim Association, Inc.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/J1992_202307/

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J267 Wheels/Rims - Truck and Bus - Performance Requirements and Test Procedures for Radial and Cornering Fatigue

SAE J328 Wheels - Passenger Car and Light Truck Performance Requirements and Test Procedures

SAE J694 Disc Wheel and Hub or Drum Interface Dimensions - Truck and Bus

SAE J1204 Wheels - Recreational and Utility Trailer Fatigue Test Procedure and Performance Requirements

Kinstler, J., "The Science and Methodology of SAE Wheel Fatigue Test Specifications," SAE Technical Paper 2005-01-1826, 2005, https://doi.org/10.4271/2005-01-1826.

2.2.2 ISO Publications

Copies of these documents are available online at https://webstore.ansi.org/.

ISO 3894 Road Vehicles - Wheels/Rims for Commercial Vehicles - Test Methods

2.2.3 OSHA Publications

Available from U.S. Department of Labor/OSHA, 200 Constitution Avenue, Washington, DC 20210, Tel: 800-321-6742, www.osha.gov/pls/publications/pubindex.list.

29 CFR Part 1910.177 Servicing Multi-Piece and Single-Piece Rim Wheels

3. DEFINITIONS

3.1 BOLT-TOGETHER DIVIDED WHEEL

A wheel that has a removable wheel portion which is attached to the fixed wheel portion by wheel clamp bolts and nuts (see Figure 1).

3.2 FIXED WHEEL PORTION

The portion of a bolt-together divided wheel that fastens to the vehicle axle hub flange.

3.3 LUG NUT

Hardware designed for securing the wheel to the vehicle.

3.4 REMOVABLE WHEEL PORTION

The portion of a bolt-together divided wheel which can be removed from the fixed wheel portion in order to service the tire.

3.5 SEALING DEVICE

A component fitted between the removable and fixed wheel portions to prevent fluid (air or otherwise) from leaking out of the tire and bolt-together divided wheel assembly.

3.6 WHEEL CLAMP BOLT

An externally threaded fastener which when used with wheel clamp nuts serves to secure the removable wheel portion to the fixed wheel portion of a bolt-together divided wheel.

3.7 WHEEL CLAMP NUT

An internally threaded fastener which when used with wheel clamp bolts serves to secure the removable wheel portion to the fixed wheel portion of a bolt-together divided wheel.

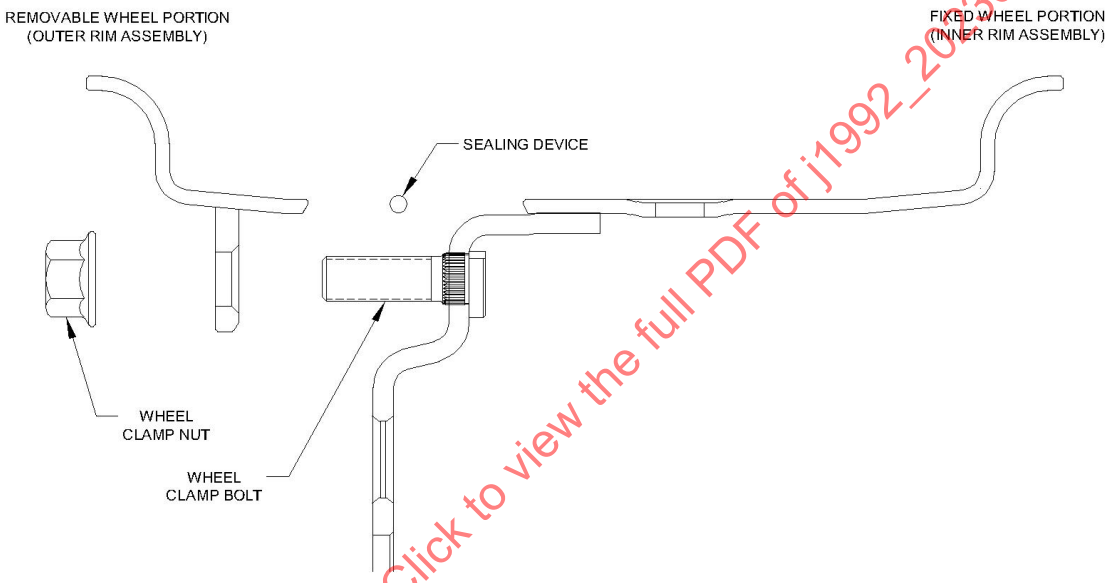

Figure 1 - Example of a bolt-together divided wheel

4. DYNAMIC CORNERING FATIGUE

The test wheels, when subject to the following test procedures, shall meet the minimum performance requirement specified in Table 1.

Table 1 - Cornering fatigue test - test load factors and cycle requirements

Wheel Description				Performance Requirements	
Material	Rim Diameter Code	Inset/Outset Millimeters	Inset/Outset Inches	Accelerated Test Factor	Minimum Cycle Life
Ferrous	16 and larger[1]	All	All	1.10 1.30 1.45	60000 40000 30000
Aluminum	16	127 or more	5 or more	1.35 1.63	250000 80000
Aluminum	All	All	All	1.35	250000

[1] Exclude 17.5 and larger with rim width of 266.7 mm (10.50 inches) and wider (wide base tire wheels).

4.1 Equipment

Use a test machine that:

a. Imparts a constant rotating bending moment to the wheel. See Figure 2A or 2B. The test load may be applied to the shaft either above or below the rotating table for both single-piece and bolt-together divided wheels.

b. Maintains the test load within ±3%.

c. Monitors and measures the deflection of the system.

d. Has a rigid load arm shaft.

NOTE: Moment arm may extend above table instead of below table.

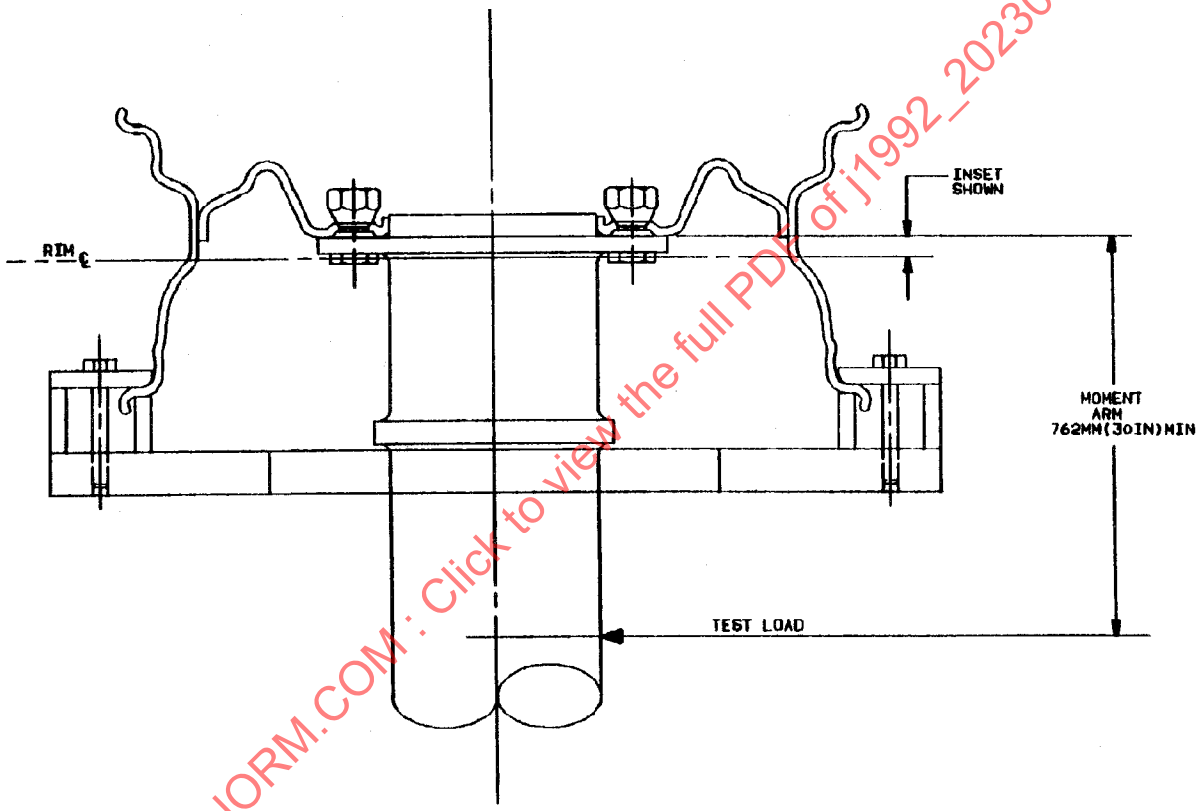

Figure 2A - Cornering fatigue test for disc wheels (typical setup)

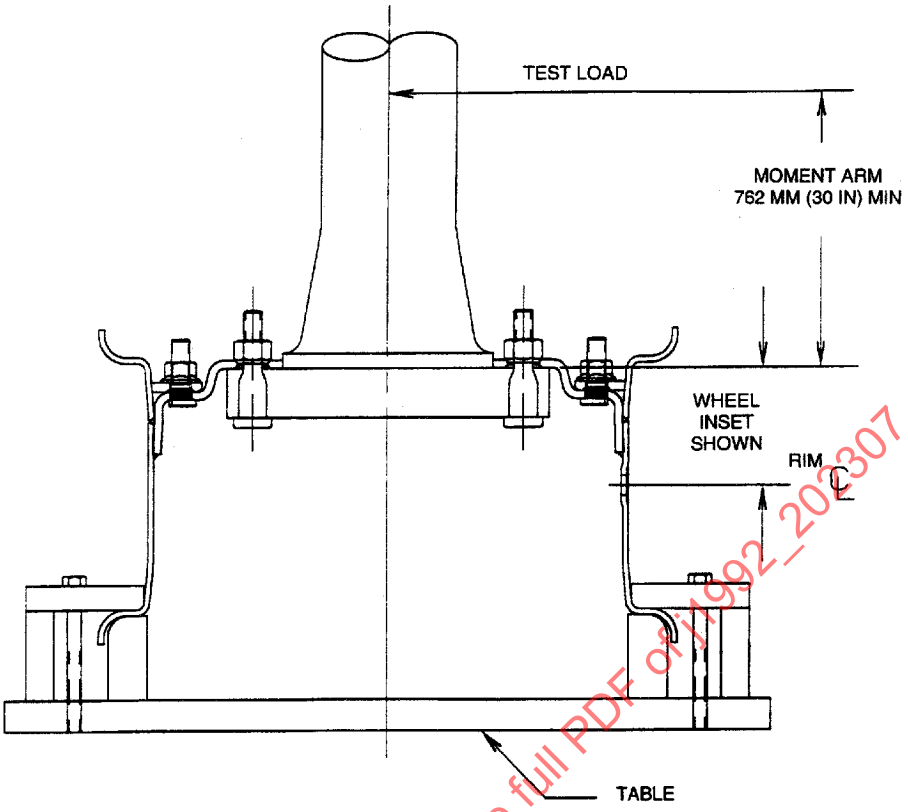

Figure 2B - Cornering fatigue test for bolt-together divided wheels (typical setup)

4.2 Procedure

a. Use a test adapter and lug nuts that are representative of those specified for the wheel. Dimensions for the test adapter (wheel backup diameter) shall be representative of the hub/drum as used on the intended vehicle.

b. Verify the mating surfaces of the adapter are free of foreign material or excessive wear.

c. For bolt-together divided wheels, tighten the wheel clamp nuts/bolts to manufacturer recommendations.

d. Attach the wheel to a rigid load arm shaft and test adapter.

e. Tighten the lug nuts to the torque specified in Appendix A for the thread size and type of nut. Utilize torque values provided by the vehicle or wheel manufacturer if they differ from the values in Appendix A. Torque shall be checked and reset periodically during the course of a test in order to compensate for the “wearing in” of mating surfaces.

f. Clamp the rim securely to the test device.

g. Adjust the system so that shaft runout is not more than 0.25 mm (0.010 inch) total indicator reading at the point of loading.

4.3 Test Loading

a. Test load and bending moment determination: The test load is determined by Equation 1:

$$\text{Test Load} = \frac{M}{\text{Moment arm}} \text{ (see Figure 2A or 2B)} \quad \text{(Eq. 1)}$$

M is determined by Equation 2:

$$M = (L)\,[\mu\,(slr) + d]\,(S) \quad \text{(Eq. 2)}$$

where:

M = bending moment, N-m (lbf-in)

μ = coefficient of friction developed between tire and road, use 0.7 for μ

slr = Largest static loaded radius (slr) of the tires to be used on the wheel as found in Appendix B or calculated from the current Tire and Rim Association Inc. Engineering Design Information (EDI), mm x 10^{-3} (inches). If static loaded radius (slr) data is available from the tire manufacturer, the tire manufacturer data shall be considered.

d = Inset or outset, mm x 10^{-3} (inches) (positive for inset, negative for outset) of the wheel. If the wheel may be used as inset or outset, use inset. Refer to SAE J393.

S = accelerated test factor; see Table 1

L = load rating of the wheel as specified by the wheel manufacturer, N (lbf)

b. For minimum cycle life, see Table 1.

c. Apply the test load parallel to a plane through the center of the rim as shown in Figure 2A or 2B. Load may push against shaft or pull the shaft.

4.4 Test Wheels

Use only fully processed new wheels, which are representative of wheels intended for the vehicle and ready for road use. New wheels and new related components shall be used for each test. In order for ease of fatigue crack detection, aluminum wheel/rim test samples may be uncoated, but must pass through all of the manufacturing processes to duplicate the thermal effects and/or characteristics of the final product. All tests for bolt-together divided wheels must be run using a complete assembly with the wheel clamp bolts and nuts torqued per manufacturer's recommendation. Use of sealing device is optional.

4.5 Test Criteria/Test Termination

The wheel under test must complete the minimum number of test cycles prior to test termination. The test shall be terminated by the inability of the wheel to sustain load, and/or a visually detected fatigue crack penetrating through a section, and/or a broken wheel clamp bolt separated from the wheel assembly. Broken studs or other parts of the test fixture do not require test termination but may result in damage to the wheel and test invalidation.

5. DYNAMIC RADIAL FATIGUE TEST

The test wheels/rims, when subject to the following test procedures, shall meet the minimum performance requirement specified in Table 2.

5.1 Equipment

Use a test machine that:

a. Has a driven rotatable drum which presents a smooth surface wider than the loaded test tire section width.

b. Has a suggested drum diameter of 1707.06 mm (67.21 inches), giving 187.5 revolutions per kilometer (301.75 revolutions per mile)

c. Imparts a constant load to the wheel/rim. This load must be perpendicular to the surface of the drum and in line radially with the center of the test wheel/rim and the center of the drum.

d. Can maintain the test load and inflation within ±3%.

e. Holds the axis of the test wheel/rim and the drum parallel.

Table 2 - Radial fatigue test - test load factors and cycle requirements

Wheel/Rim Description				Performance Requirements	
Material	Rim Diameter Code	Inset/Outset[1] Millimeters	Inset/Outset[1] Inches	Accelerated Test Factor	Minimum Cycle Life
Ferrous	16, 17 5 Degree Drop Center	All	All	2.2 1.8	500000 1000000
Ferrous	15, 20, 22, 24 5 Degree Flat Base	All	All	2.0 1.9 1.8 1.7 1.6 1.4 1.3	500000 600000 700000 850000 1000000 1450000 1800000
	17.5HC, 19.5, 22.5, 24.5 15 Degree Drop Center				
Aluminum	All	All	All	2.8 2.0	100000 1000000

[1] Offset for demountable rims.

5.2 Procedure

a. Select test tires that are representative of the maximum size and type to be used on the wheel/rim. Buffing tires is permissible.

b. Use a test adapter and lug nuts (and clamps for demountable rims) that are representative of those specified for the wheel/rim. Dimensions for the test adapter (wheel backup diameter) shall be representative of the hub/drum as used on the intended vehicle.

c. Mount the tire and for bolt-together divided wheels, tighten the wheel clamp nuts/bolts to manufacturer recommendations.

d. Inflate the tire to 448 kPa ± 14 kPa (65 psi ± 2 psi) for tires with usage pressure of 310 kPa (45 psi) or less. For wheels and tires intended for use at higher pressures, use 1.2 times the usage pressure, but not less than 448 kPa ± 14 kPa (65 psi ± 2 psi).

e. Tighten the lug nuts to the torque specified in Appendix A for the thread size and type of nut. Utilize torque values provided by the vehicle or wheel manufacturer if they differ from the values in Appendix A. Torque shall be checked and reset periodically during the course of a test in order to compensate for the “wearing in” of mating surfaces.

f. There may be an increase in inflation pressure during the test. Since this is normal, it is permissible to adjust the inflation pressure back to the test pressure.

5.3 Radial Test Loading

a. Radial load determination: The radial load is determined as follows in Equation 3:

$$R = (S)\,L \qquad \text{(Eq. 3)}$$

where:

R = radial load, N (lbf)

S = accelerated test factor; see Table 2

L = load rating of the wheel/rim as specified by the wheel/rim manufacturer, N (lbf)

b. For minimum cycle life, see Table 2.

5.4 Test Wheels/Rims

Use only fully processed new wheels/rims which are representative of wheels/rims intended for the vehicle and ready for road use. New wheels/rims and new related components shall be used for each test. In order for ease of fatigue crack detection, aluminum wheel/rim test samples may be uncoated but must pass through all of the manufacturing processes to duplicate the thermal effects and/or characteristics of the final product. All tests for bolt-together divided wheels must be run using a complete assembly with the wheel clamp bolts and nuts torqued per manufacturer’s recommendation.

5.5 Test Criteria/Test Termination

The wheel/rim under test must complete the minimum number of test cycles prior to test termination. The test shall be terminated by the inability of the wheel/rim to sustain load, and/or a visually detected fatigue crack penetrating through a section, and/or a broken wheel clamp bolt separated from the wheel assembly. Failure of the test tire, broken studs, or other parts of the test fixture do not require test termination but may result in damage to the wheel/rim and test invalidation.

6. NOTES

6.1 Revision Indicator

A change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY SAE TRUCK AND BUS WHEEL COMMITTEE