



SURFACE VEHICLE RECOMMENDED PRACTICE

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(R) Road Vehicles - Wheels for Commercial Vehicles and Multipurpose
Passenger Vehicles - Fixing Nuts - Test Methods

RATIONALE

This SAE Recommended Practice provides the test methods for evaluating wheel/rim attachment systems using ball seat, flange or rim clamp fasteners (fixing nuts). The proof load values are calculated from the externally threaded fastener of grade 8 or class 10.9. In Table 2 the initial tension value B represents the minimum tension required to provide proper minimum joint performance. A new value, D final tension minimum, has been added to Table 2. These minimum tension values are an extension of the minimum tension line developed at value B. This ensures that the performance of the joint does not fall off as torque is increased. The retorque test has had the number of tests required increased from 5 to 10. The time between tests has been increased from 1 minute to 5 minutes to minimize the effects of heat increasing the lubricity of the motor oil.

1. SCOPE

This SAE Recommended Practice applies to fasteners/fixing nuts as specified in SAE J694 and SAE J1835 used for disc wheels and demountable rim attachment respectively.

Only the test methods necessary to assure proper wheel or rim assembly are specified. Fasteners for less common and special applications are not included.

1.1 Purpose

To ensure proper assemblies this recommended practice specifies test methods and performance requirements for Metric or English, one- or two-piece flange nuts, single ball seat nuts, inner and outer ball seat nuts, and rim clamp nuts.

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2. REFERENCES

2.1 Applicable Documents

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 724-776-4970 (outside USA), www.sae.org.

SAE J122	Surface Discontinuities on Nuts
SAE J429	Mechanical and Material Requirements for Externally Threaded Fasteners
SAE J694	Disc Wheel/Hub or Drum Interface Dimensions - Truck and Bus
SAE J1102	Mechanical and Material Requirements for Wheel Bolts
SAE J1199	Mechanical and Material Requirements for Metric Externally Threaded Steel Fasteners
SAE J1835	Fastener Hardware for Wheels for Demountable Rims

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 ISO Publications

Available from American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, Tel: 212-642-4900, www.ansi.org.

ISO 10597	Road Vehicles - Flat Attachment Fixing Nuts for Commercial Vehicles - Test Methods
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2.2.2 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 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 J393	Nomenclature - Wheels, Hubs, and Rims for Commercial Vehicles
SAE J1992	Wheels/Rims - Military Vehicles - Test Procedures and Performance Requirements

3. TEST METHODS FOR NUT BODY AND BALL SEAT NUTS

3.1 Proof Load/Compression Test Procedures

1. Use only fully processed nuts/nut assemblies, which are production parts intended for the vehicle. For inner dual ball seat nuts, the recommended test method can be seen in Figure 1. For two-piece flange nuts, the initial height of the nut (H) must be measured before beginning the proof load/compression test. The one and two piece flange nuts shall be loaded on a threaded fixture or bolt as shown in Figure 2. For outer ball seat nuts and rim clamp nuts, the recommended test method can be seen in Figure 3. The test fixture or bolt used shall be threaded to a tolerance class that is representative of the parts to be used in production.

The test procedure is:

1. The complete nut/nut assembly shall be loaded axially through the thread three times to a load of $0.6 \times \text{proof load value (F)}$.
2. After three loadings, a fourth loading of $1.0 \times F$ shall be applied.
3. The load shall be maintained for 15 s.
4. The nut shall resist the load without failure by stripping or rupture and shall be removable by hand after the load is released. If the threads on the bolt or test fixture are damaged during the test, the test should be discarded. (It may be necessary to use a manual wrench to start the nut in motion. Such wrenching is permissible provided that it is restricted to one-half turn and that the nut is then removable by hand.)

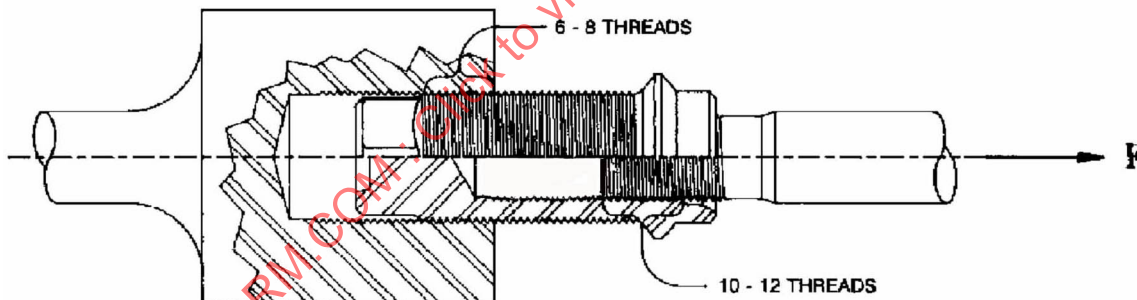


Figure 1 - Inner dual ball seat nut proof load test method

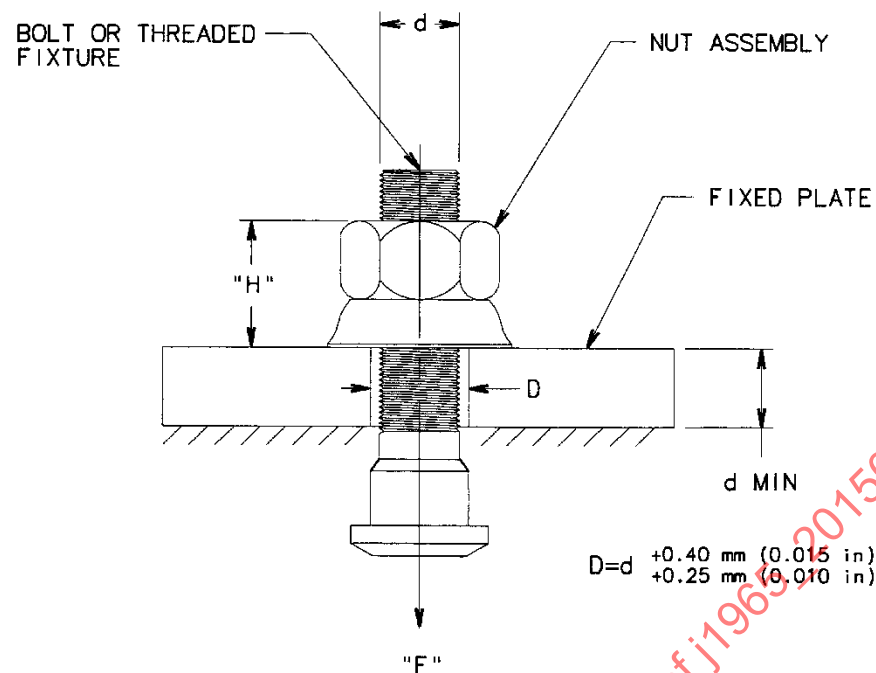


Figure 2 - One or two-piece flange nut proof load/compression test method

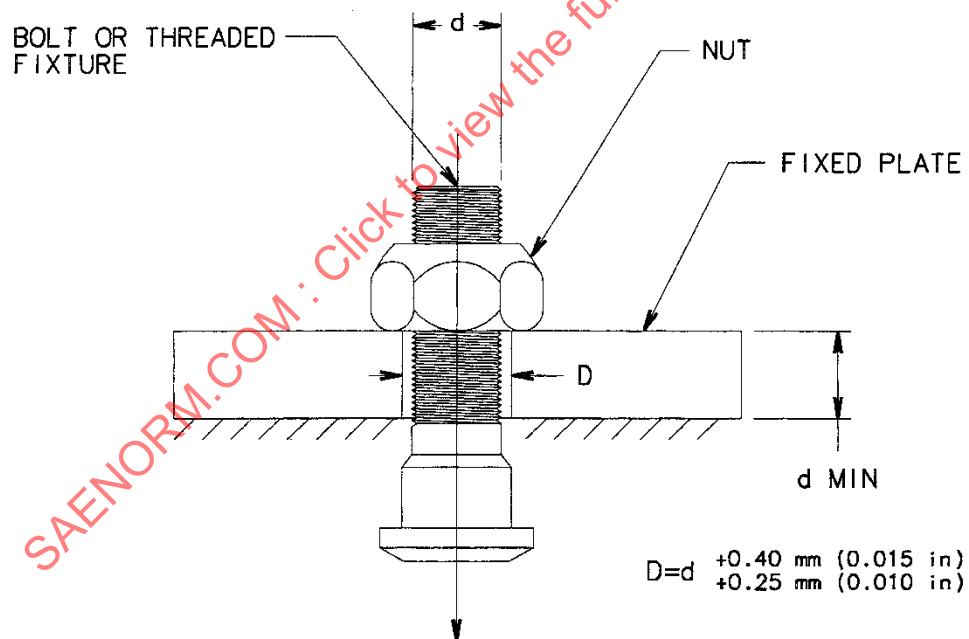


Figure 3 – Single and outer ball seat or rim clamp nut proof load test method

3.2 Proof Load Values

See Table 1.

Table 1 - Proof load values

	F (kN)	F (lb)
Inner Dual Ball Seat Nuts		
3/4-16 Class 10.9 (Grade 8) mechanical properties	249.1	56 000
3/4-16 Class 8.8 (Grade 5) mechanical properties	164.6	37 000
15/16-12	278.9	62 700
M20x1.5 Class 10.9 (Grade 8) mechanical properties	225.1	50 600
One-Piece Flange Nuts		
9/16-18	98.3	22 100
5/8-18	124.1	27 900
11/16-16	149.0	33 500
Two-Piece Flange Nuts		
9/16-18	108.5	24 400
5/8-18	136.6	30 700
7/8-14	271.3	61 000
M14x1.5	103.2	23 200
M18x1.5	179.3	40 300
M20x1.5	225.1	50 600
M22x1.5	276.2	62 100
Single or Outer Ball Seat Nuts		
3/4-16	164.6	37 000
1 1/8-16	222.4	50 000
15/16-12	278.9	62 700
1 5/16-12	378.1	85 000
M20 X1.5	225.1	50 600
M30x1.5	532.9	119 800
Rim Clamp Nut		
3/4-10	197.5	44 400

3.3 Failure Criteria and Surface Discontinuities

- The criteria for rejection due to cracks or other surface discontinuities are shown in section 5.
- For two-piece flange nuts, the permanent deformation in nut height (H) after unloading must not exceed 0.13 mm (0.005 in).

4. NUT ASSEMBLY TEST METHODS (TWO-PIECE FLANGE NUT ONLY)

4.1 Torque/Tension—Clamping Force

The purpose of this test is to assure the ability of the nut assembly to provide proper clamping force. The coating protection and lubrication if specified should be representative of the production parts to provide the representative coefficient of friction. Two test methods are acceptable: static torque using a load cell and torque wrench, and dynamic torque using load cell and torque transducer.

4.1.1 Selection

Use only fully processed nut assemblies and studs, which are representative of production parts intended for the vehicle. New nuts and studs should be used for each test. A minimum of 5 fasteners shall be tested.

4.1.2 Test Procedure - Static Torque

The nut shall be tested on a load cell of sufficient capacity for the size of nut to be tested. A torque wrench of sufficient capacity shall be used for tightening the nut. The following shall be recorded:

- a. Tightening torque, Initial (A)
- b. Stud tension, Initial (B)
- c. Tightening torque, Final (C)
- d. Stud tension, Final (Max) (E)

Table 2 - Test torques and tensions

Thread	A Initial Torque	B Initial Tension (Min)	C Final Torque	D Final Tension (Min)	E Final Tension (Max)
	N·m (ft·lb)	kN (lb)	N·m (ft·lb)	kN (lb)	kN (lb)
M14x1.5	149 (110)	44.5 (10 000)	190 (140)	56.7 (12 725)	103.2 (23 200)
M18x1.5	249 (184)	80.1 (18 000)	430 (317)	137.9 (31 000)	179.3 (40 300)
M20x1.5	339 (250)	100.1 (22 500)	610 (450)	180.1 (40 500)	225.1 (50 600)
M22x1.5	502 (370)	133.4 (30 000)	678 (500)	180.3 (40 550)	276.2 (62 100)
9/16-18	169 (125)	52.5 (11 800)	190 (140)	58.7 (13 200)	108.5 (24 400)
5/8-18	176 (130)	54.3 (12 200)	244 (180)	75.1 (16 900)	136.5 (30 700)
7/8-14	475 (350)	89.0 (20 000)	678 (500)	127.0 (28 570)	271.3 (61 000)

The torque is applied to the nut with a torque wrench using a smooth, steady pull as each torque level (initial and final) is approached and attained. Test studs must be representative of those used in production. The wheel mounting faces and all other surfaces of the nut are to be kept dry and clean.

Test procedure

1. Lubricate the test stud threads with 2 drops of motor oil (optional)
2. Run the test nut onto the test stud by hand to condition the components (optional)
3. Lubricate the nut between the nut body and the thrust washer with 2 drops of motor oil (optional)
4. Tighten the nut to the initial torque (A) shown in Table 2 and record the bolt tension (B) obtained
5. Resume tightening to the final torque (C) as shown in Table 2 and record the bolt tension obtained
6. Evaluate test per failure definition in section 4.1.4