

**WHEEL NUT SEAT SYSTEM TEST PROCEDURES AND PERFORMANCE
REQUIREMENTS FOR PASSENGER CARS AND LIGHT TRUCKS**

1. **Scope**—This SAE Recommended Practice provides minimum performance requirements and uniform procedures for nut seat system strength of wheels intended for normal highway use on passenger cars, light trucks, (except dual wheels, which are covered by SAE J1965) and multipurpose passenger vehicles. The nut seat system includes the wheel, wheel bolts, and wheel nuts as applicable. Many factors must be considered in design and validation of wheel attachments for each specific vehicle. The individual components should be evaluated per the SAE standards referenced.

2. **References**

2.1 **Applicable Publications**—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1102—Mechanical and Material Requirements for Wheel Bolts

SAE J1965—Road Vehicles—Wheels for Commercial Vehicles and Multipurpose Passenger Vehicles—
Fixing Nuts—Test Methods

SAE J2283—Mechanical and Material Requirements for One-Piece Wheel Nuts

SAE J2315—Wheel Nut Seat Strength Recommendations

3. **Definitions**

3.1 **Wheel Nut Seat**—See Figure 1.

3.2 **Wheel Bolt**—See Figure 1.

3.3 **Wheel Nut**—See Figure 1.

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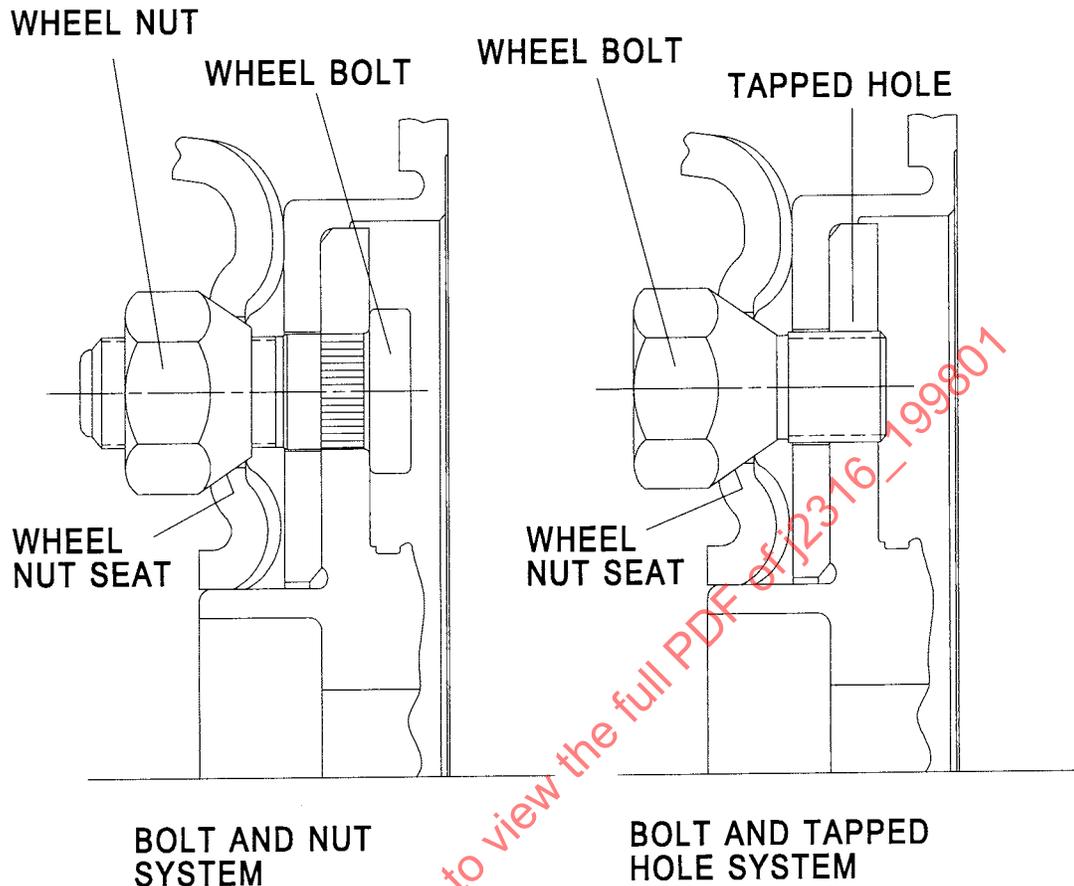


FIGURE 1—DEFINITIONS

3.4 Ultimate Strength—Maximum values of bolt tension and tightening torque achieved when tightened to failure (bolt break or wheel nut seat yield where torque and tension no longer increase during tightening).

4. Test Procedures—Two system tests are specified: Torque-Tension/New, which evaluates the initial wheel installation when all components are new, and Torque-Tension/Reuse, which evaluates the effect of reinstallation of the components in service.

Although a wheel attachment consists of multiple fasteners, the torque-tension tests in this document shall be conducted with only one fastener at a time.

4.1 Test Components—Fully processed (including finish) wheels or wheel discs, wheel bolts, and wheel nuts representative of production parts intended for the vehicle. For systems where wheel nuts are tightened onto serrated shank wheel bolts (bolt and nut system), hexagon head test bolts may be used in place of the wheel bolts, but they must be the same thread size and finish with similar hardness as the wheel bolts. For systems where wheel bolts are tightened directly against the wheel and into a tapped hole in the hub or axle (bolt and tapped hole system), special test blocks may be used in place of the hub or axle, but they must be the same thread size, length of thread, material, and finish as the hub or axle tapped hole. All components shall be new (unused) for each test sample.

4.2 Test Equipment

- 4.2.1 TENSION MEASURING DEVICE—Must be capable of measuring axial tension induced in the wheel bolt as it is tightened. Accuracy shall be $\pm 5\%$ of tension reading.
- 4.2.2 TORQUE MEASURING DEVICE—Must be capable of measuring torque applied to the wheel nut (or wheel bolt on a tapped hole system) as it is tightened. Accuracy shall be $\pm 5\%$ of torque reading.
- 4.2.3 TEST SOCKET—Socket shall not contact the wheel nut seat or the threaded end of the wheel bolt at any time during the test.
- 4.2.4 SUPPORT PLATE—A flat plate to fully support the wheel disc mounting surface for the wheel nut seat being tested. Thickness of the support plate and tension measuring device shall allow sufficient length of thread engagement between the wheel bolt and wheel nut when tightened.
- 4.2.5 TIGHTENING DEVICE—Must be capable of tightening to the Ultimate Torque of the components being tested. Recommended tightening speed shall not exceed 20 rpm at 50 Nm and above and shall be chatter free (graph of applied torque versus nut rotation recorded continuously during tightening, shall not exhibit cyclic torque fluctuation).

- 4.3 **Torque-Tension/New**—Using all new components, insert the wheel bolt (or the tapped block if bolt and tapped hole system) into the tension measuring device and secure such that it cannot rotate during tightening. Place the wheel disc against the support plate and engage the wheel nut (or wheel bolt if bolt and tapped hole system) with the mating thread.

Tighten the wheel nut (or wheel bolt if bolt and tapped hole system) continuously until failure (bolt break or bolt tension no longer increases during tightening) or to 150% of Minimum Ultimate Torque specified in Table 1.

Measures torque and tension continuously during tightening (dynamic torque and tension).

Install new components (wheel nut seat, wheel bolt, and wheel nut) and repeat previous procedure for a total of ten samples.

- 4.4 **Torque-Tension/Reuse**—Install new test components as described in 4.3.

Tighten the fastener continuously at a speed not to exceed 10 rpm (in order to minimize heat buildup) to the Test Torque specified in Table 1.

Measure torque and tension continuously during tightening. Record bolt tension at the Test Torque.

Completely loosen the fastener and retighten the same components to the Test Torque as described previously. Repeat this step for a total of 10 cycles, recording bolt tension for each cycle. Pause a minimum of 30 s between cycles to minimize heat buildup which may affect test results.

Install new components (wheel nut seat, wheel bolt, and wheel nut) and repeat previous procedure for a total of five samples.

5. Performance Requirements—The wheels, wheel bolts, and wheel nuts, when tested according to the procedures described in Section 4, shall meet the following minimum performance requirements:

5.1 Torque-Tension/New—When tightened to the Test Torque, the average and average minus 3 standard deviations of bolt tension shall not be less than the corresponding Minimum Tension values established by the vehicle manufacturer. Minimum tension requirements vary depending on many variables such as vehicle mass, tire static loaded radius, wheel attachment configuration (number and size of fasteners and bolt circle diameter). The torque tension relationship is dependent on configuration, material, and finish of the fasteners and wheel nut seat. Any change to these variables will affect minimum tension achieved at the Test Torque.

Ultimate Torque for each sample shall not be less than the maximum installation torque specification for the vehicle application being tested and the average Ultimate Torque shall not be less than 120% of the maximum service torque specification for that vehicle. If the vehicle torque specifications are not known, the Minimum Ultimate Torque values shown in Table 1 should be used in place of the maximum installation torque specification and the maximum service torque specification.

The bolt and nut threads shall not strip.

5.2 Torque-Tension/Reuse—Average bolt tension at the Test Torque achieved in cycles 2 to 10 shall not be less than 60% of the average tension achieved in cycle 1 (first tightening with new components).

The bolt and nut threads shall not strip.

The nut (or bolt if tapped hole system) shall be removable by hand at completion of test (after bolt tension has been released).

TABLE 1—TORQUE-TENSION TEST PARAMETERS⁽¹⁾

Thread Size	Test Torque Nm	Minimum Ultimate Torque ⁽²⁾ Nm
M10 x 1.25	50	60
M12 x 1.25	110	140
M12 x 1.5	110	140
M14 x 1.5	140	190
1/2–20	110	140
9/16–18	140	190

1. Tabulated values pertain to conical and spherical nut seat configurations. Other configurations, such as flanged or captive washer bearing surfaces, may require other values.
2. Maximum installation torque specification for the vehicle application being tested. If the specification is not known, use the values shown in the table.

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