SAE International

SURFACE VEHICLE STANDARD

SAE J1102 APR2013

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Superseding J1102 FEB1995

Mechanical and Material Requirements for Wheel Bolts

RATIONALE

J1102 has been reaffirmed to comply with the SAE five-year review policy.

1. ***Scope***—This SAE Standard covers the chemical, metallurgical, and mechanical requirements for two types of passenger car and truck wheel bolts, as follows:

a. Nonserrated shank bolts which are heat treated
b. Serrated shank bolts which are case hardened

2. References

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

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

SAE J121—Decarburization in Hardened and Tempered Unified Threaded Fasteners
SAE J417—Hardness Tests and Hardness Number Conversions
SAE J429—Mechanical and Material Requirements for Externally Threaded Fasteners
SAE J1061—Surface Discontinuities on General Application Bolts, Screws, and Studs

2.1.2 ASTM PUBLICATION—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 18—Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

3. Materials and Processes

3.1 Steel Characteristics

3.1.1 Nonserrated bolts in sizes through 1.0 in diameter shall be made of killed steel with carbon content of 0.28 to 0.47, sulphur 0.058 max, and phosphorous 0.048 max.

3.1.2 Serrated bolts in sizes through 9/16 in diameter shall be made of SAE 1541 steel, fine grain.

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3.1.3 Serrated bolts in sizes over 9/16 in diameter shall be made of a medium carbon alloy steel (carbon content 0.28 to 0.55), fine grain with hardenability that will produce a minimum hardness of Rockwell C47 at the center of a transverse section one diameter from the threaded end of the bolt after oil quenching.

3.1.4 The preceding analyses are product chemical analyses (percent by weight) and refer to individual determinations on uncarburized or core portion of bolts.

3.2 Heading Practice—Bolts in sizes through 3/4 in shall be cold headed. Larger sizes may be hot or cold headed, at the option of the manufacturer.

3.3 Threading Practice—All bolts, regardless of size, shall be roll threaded.

3.4 Heat Treatment Practice

3.4.1 NONSERRATED SHANK BOLTS

3.4.1.1 Bolts shall be heat treated, quenched in a liquid medium and tempered at a minimum tempering temperature of 425 °C (800 °F).

3.4.1.2 Bolts shall conform to Decarburization 1/2 H (as described in SAE J121), unless otherwise specified.

3.4.2 SERRATED SHANK BOLTS

3.4.2.1 Bolts shall be carburized in a nonnitriding atmosphere to a total depth of 0.004 to 0.012 in, oil quenched and tempered at a minimum tempering temperature of 450 °C (850 °F).

3.4.2.2 Case depth shall be measured on the body or head of the bolt.

3.5 Surface Discontinuities—Bolts in sizes up to 1.0 in diameter inclusive, and lengths up to 6.0 in inclusive shall not have surface discontinuities exceeding the limits specified in SAE J1061. Surface discontinuities for other sizes and lengths shall be within limits specified by the purchaser.

4. Mechanical and Performance Requirements

4.1 Proof Load—85 ksi

4.2 Axial Tensile Strength—120 ksi minimum

4.2.1 Bolts shall withstand the minimum tensile stress without breaking into separate parts.

4.2.2 For serrated shank bolts, a snug or press fit of the serrations to retaining fixture is recommended to minimize potential of fracture at the bolt head to shank junction.

4.3 Core Hardness—Rockwell C25-34.

4.4 Surface Hardness

4.4.1 NONSERRATED SHANK BOLTS

4.4.1.1 Bolts shall conform to the surface hardness requirements specified in SAE J429—grade 5.

4.4.2 SERRATED SHANK BOLTS

4.4.2.1 Bolts shall meet Rockwell hardness 15N 77 minimum.

4.5 Bend Test—Bolts shall withstand a 10 degree bend without breaking into separate parts.

4.6 Serration Test (Serrated Shank Bolts Only)—Bolts shall assemble in a test plate without visual evidence of surface stripping of the serrations. The serrations shall not peel such that they accumulate under the bolt head when the bolt is pressed into the specified test plate.

5. Test Methods

5.1 Proof Load—Same as defined in SAE J429.

5.2 Axial Tensile Strength—Same as defined in SAE J429.

5.3 Core Hardness—Same as defined in SAE J429.

5.4 Surface Hardness—Tests to determine surface hardness conditions shall be conducted on the ends, head, or unthreaded and nonserrated portion of the shanks which have been prepared by lightly grinding or polishing to ensure accurate reproducible readings in accordance with SAE J417. Proper correction factors shall be used when hardness tests are made on curved surfaces, per ASTM E 18.

5.5 Bend Test—The test bolt shall be threaded or clamped into a hardened block or other suitable device with three threads exposed. A force perpendicular to the centerline of the bolt shall be applied against the bolt head and continued until the bolt is permanently bent through 10 degrees.

5.6 Serration Test (Serrated Shank Bolts Only)—The test bolt shall be pressed into a hole in a steel plate or appropriate wheel hub or axle flange until the head is seated by applying an axial compression load to the head of the bolt. The bolt shall then be removed and visually examined for evidence of serration stripping. If a wheel hub or axle flange is used it shall be of the same material and hardness required for the part into which the bolt is normally assembled in production. If a plate is used, it shall be 0.5 in thick with a hardness of Brinell 269-285. The hole size shall be as specified by the purchaser; however, if not specified, the diameter shall be the average of the mean major and mean minor serration diameters.

5.7 Methods for Measuring Carburization—Two methods for measuring carburization are provided. The microscopic method is intended primarily for routine inspection purposes. The hardness method is intended primarily for referee purposes.

5.7.1 MICROSCOPIC METHOD

5.7.1.1 Specimens—Transverse sections taken through the head, shank, or unthreaded portion of the bolt, after all heat treating operations have been performed on the product.

5.7.1.2 Preparation

a. Mount specimen for grinding and polishing. Protection from rounding the surface to be examined is essential. The specimen should be mounted in a clamp or in a plastic mount, the latter being the preferred method.
b. After mounting, grind and polish the surface in accordance with good metallographic practice.
c. Etching in a 3% nital (concentrated nitric acid) or picral (saturated picric acid) is usually suitable for showing changes in microstructure for carburization, a darker shade of tempered martensite than that of the immediately adjacent base metal.

5.7.1.3 *Measurement*—Unless otherwise agreed on between purchaser and producer, examine at 100X magnification.

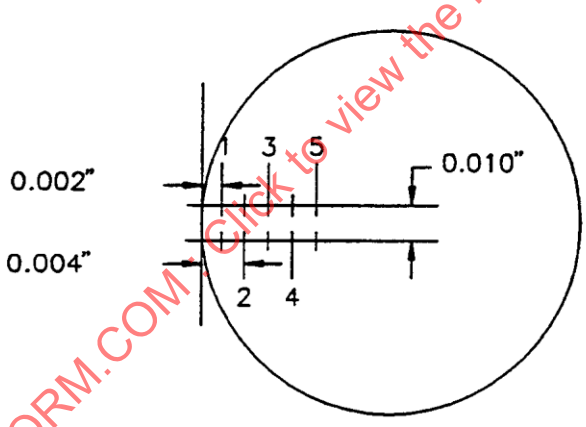
If the microscope is of a type with a ground glass screen, the extent of carburization can be measured directly with a scale. If an eye-piece is used for measurement, it should be an appropriate type containing a cross hair or a scale.

5.7.2 HARDNESS METHOD

5.7.2.1 Prepare specimens as outlined in 5.7.1.1 and 5.7.1.2, except the specimen is not to be etched.

5.7.2.2 *Measurement*—Unless otherwise agreed on between purchaser and producer, hardness measurements are made using a Knoop Indenter with a 500 g load or Vickers DPH with a 300 g load.

a. Determine the average base metal hardness from at least six readings. The initial indentation measurement shall be taken 0.040 in from the product outer surface and each subsequent measurement interval shall be 0.020 in moving towards the core of the specimen.
b. To determine total case depth, the first measurement shall be taken 0.002 in from the specimen outer surface and each subsequent hardness measurement shall be at 0.002 in intervals from the previous reading towards the core of the part. For accuracy, the measurements should be staggered to ensure sufficient indentation separation (Figure 1).
c. Total case depth shall be established from the average base metal hardness value to an intersecting line where a distinct increased hardness change occurs.



Total case depth determination by hardness method, staggering test locations for accuracy.

FIGURE 1—CASE DEPTH BY HARDNESS METHOD