

Mechanical and Material Requirements for Metric Wheel Bolts

- 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 J121M—Decarburization in Hardened and Tempered Metric Threaded Fasteners

SAE J417—Hardness Tests and Hardness Number Conversions

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

ASTM F 606M—Standard Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets.

- 2.1.3 ISO PUBLICATION**—Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002.

ISO 898-1—Mechanical properties of fasteners—Part 1: Bolts, screws and studs

3. Materials and Processes

3.1 Steel Characteristics

- 3.1.1** Nonserrated bolts shall be made of carbon killed steel conforming to ISO 898-1 for property class 8.8.

- 3.1.2** Serrated bolts in sizes through 14 mm diameter shall be made of SAE 1541 steel, fine grain.

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3.1.3 Serrated bolts in sizes over 14 mm 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 20 mm 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 to a minimum tempering temperature of 425 °C.

3.4.1.2 Bolts shall conform to Decarburization 1/2 H (as described in SAE J121M), 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 0.10 to 0.30 mm, oil quenched and tempered at a minimum tempering temperature of 450 °C.

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 24 mm diameter inclusive, and lengths up to 150 mm 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 Nonserrated Shank Bolts

4.1.1 Bolts shall conform to the latest revision of ISO 898-1 for property class 8.8.

4.2 Serrated Shank Bolts

4.2.1 PROOF LOAD—600 MPa

4.2.2 AXIAL TENSILE STRENGTH—830 MPa minimum

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

4.2.2.2 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.

4.2.3 CORE HARDNESS—Rockwell C25-34.

4.2.4 SURFACE HARDNESS—Bolts shall meet Rockwell hardness 15N 77 minimum.

4.2.5 BEND TEST—Bolts shall withstand a 10 degree bend without breaking into separate parts.



- 4.2.6 **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 ASTM F 606M 3.2.
- 5.2 **Axial Tensile Strength**—Same as defined in ASTM F 606M 3.4.
- 5.3 **Core Hardness**—Same as defined in ASTM F 606M 3.1.
- 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 12.7 mm 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

- 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.
- After mounting, grind and polish the surface in accordance with good metallographic practice.
- 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.

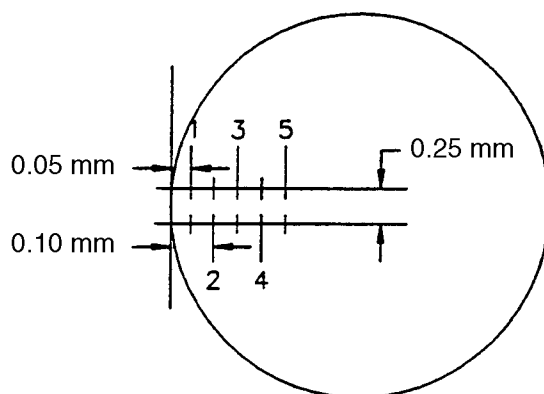
If the microscope is of a type with a ground glass screen, the extent of carburization can be measured directly with a scale. If an eye-piece is used for measurement, it should be an appropriate type containing a cross hair or a scale.

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 1.0 mm from the product outer surface and each subsequent measurement interval shall be 0.5 mm moving towards the core of the specimen.
- b. To determine total case depth, the first measurement shall be taken 0.05 mm from the specimen outer surface and each subsequent hardness measurement shall be at 0.05 mm intervals from the previous reading moving 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

6. *Marking*

6.1 Nonserrated shank bolts shall be marked with numerical 8.8 and manufacturer's identification marking on the top of the head and the markings may be raised or depressed at the option of the manufacturer.

6.2 Serrated shank bolts shall be marked with 1102M and the manufacturer's identification marking.

6.2.1 Bolts shall be marked also with the letter "M" on the end of the bolt.

6.2.2 Manufacturer's identification mark and "1102M" numerical designation shall be located on the top of the head and the markings may be raised or depressed at the option of the manufacturer.

PREPARED BY THE SAE FASTENERS COMMITTEE

SAE J1102M Revised MAR2001

Rationale—Not applicable.

Relationship of SAE Standard to ISO Standard—Not applicable.

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Reference Section

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Developed by the SAE Fasteners Committee