The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE RECOMMENDED PRACTICE

An American National Standard

SAE J122

REAF. MAY1998

Issued 1969-09
Reaffirmed 1998-05

Superseding J122a JUL75

Surface Discontinuities on Nuts

***Foreword*—**This Reaffirmed Document has been changed only to reflect the new SAE Technical Standards Board Format. References were added as Section 2. All other Section numbers have changed accordingly.

***1. Scope*—**This SAE Recommended Practice defines, illustrates, and specifies allowable limits for the various types of surface discontinuities that may occur during the manufacture and processing of metric-series nuts, in sizes 6.3 to 25 mm and inch-series nuts in sizes 1/4 to 1 in, inclusive, which are primarily intended for use in automotive assemblies.

1.1 The basic recommended practice does not include inspection sampling requirements. It is intended that the purchaser shall specify in the original inquiry and purchase order the inspection sampling requirements which the producer must satisfy to demonstrate the acceptability of nuts with respect to surface discontinuities. Appendix A outlines inspection sampling plans applicable when such requirements are not specified by the purchaser in the original inquiry and purchase order.

2. References

2.1 Applicable Publication—The following publication forms a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

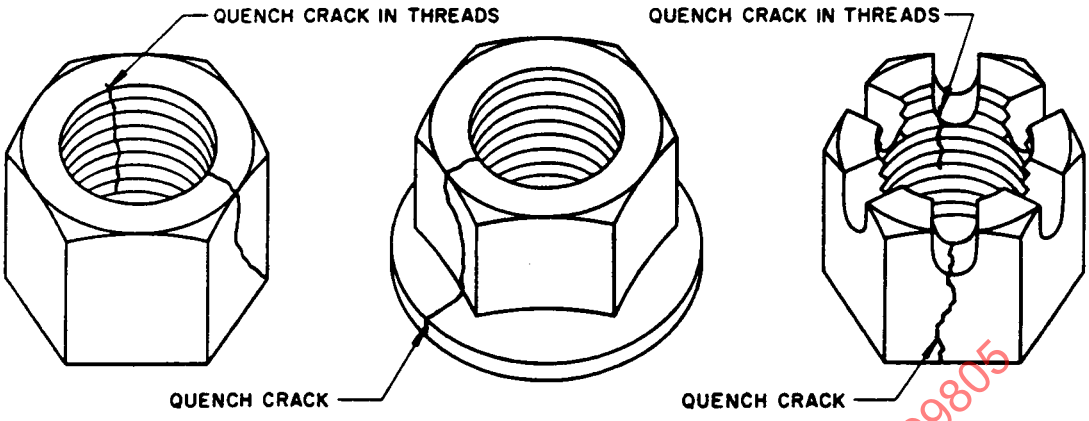
2.1.1 ASTM PUBLICATION—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM A 194—Steel Nuts for High Pressure and High Temperature Service

***3. Types of Surface Discontinuities*—**For the purpose of this recommended practice, surface discontinuities on nuts are divided into 11 "types," defined as follows:

3.1 Cracks—A crack is a clean (crystalline) fracture passing through or across the grain boundaries without inclusion of foreign elements. Cracks are normally caused by overstressing the metal during forging or other forming operation, or during heat treatment. Where parts are subjected to significant reheating, cracks usually are discolored by scale.

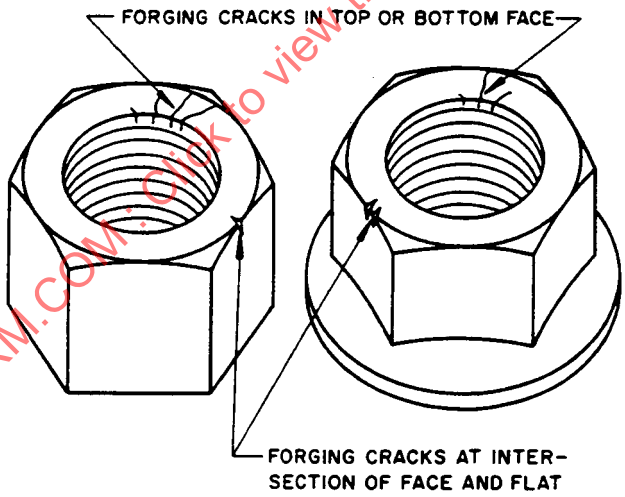
3.1.1 QUENCH CRACKS—Quench cracks may occur during heat treatment due to excessively high thermal and transformation stresses. They usually traverse an irregular and erratic course on the surface of the nut. Typical quench cracks are shown in Figure 1.



NOTE: Quench cracks of any depth, any length, or in any location on a nut are not permissible discontinuities.

FIGURE 1—TYPICAL QUENCH CRACKS

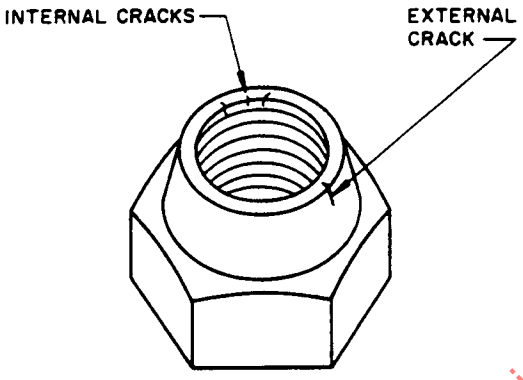
3.1.2 FORGING CRACKS—Forging cracks may occur during the cutoff or forging operations and are located on the top and bottom face of the nut, and at the intersection of the face and flat. Typical forging cracks are shown in Figure 2.



NOTE: Forging cracks are permissible discontinuities if within the limits specified in paragraph 4.2.2.2.

FIGURE 2—TYPICAL FORGING CRACKS

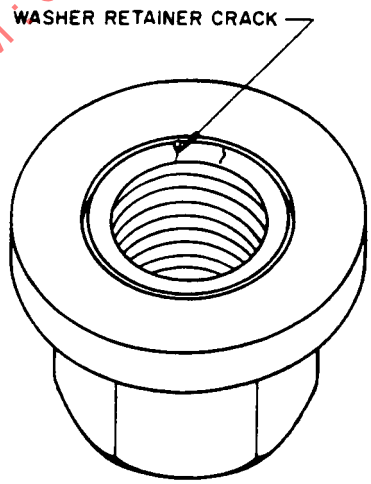
3.1.3 LOCKING ELEMENT FORMATION CRACKS—These cracks may occur due to the application of pressure against the nut when introducing the locking element into prevailing torque nuts. Cracks of this type are usually located in the vicinity of the locking element and may either be on the internal or external surface. Typical locking element formation cracks are shown in Figure 3.



NOTE: Locking element formation cracks located on the external surface of the nut are not permissible discontinuites.
Locking element formation cracks located on the internal surface of the nut are permissible discontinuities if within the limits specified in paragraph 4.2.3.1.

FIGURE 3—TYPICAL LOCKING ELEMENT FORMATION CRACKS ON PREVAILING-TORQUE NUTS

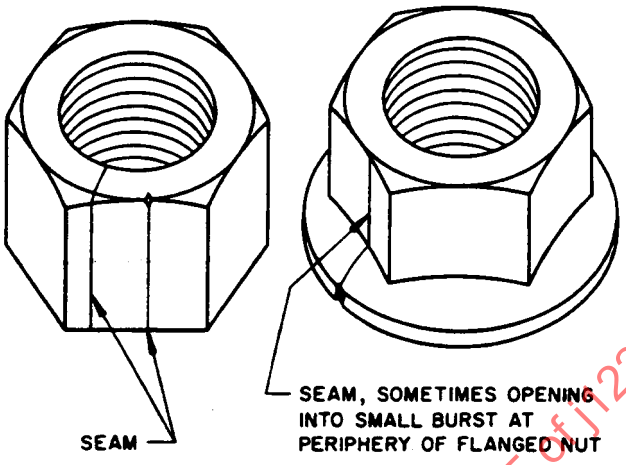
3.1.4 WASHER RETAINER CRACK—A washer retainer crack is an opening in a lip or hub of metal used for captivating a washer on a nut. Washer retainer cracks may occur when pressure is applied to the lip or hub during assembly of the washer. Such cracks are limited to the contour of the hub or lip used for retaining purposes. Typical washer retainer cracks are shown in Figure 4.



NOTE: Washer retainer cracks are permissible discontinuities.

FIGURE 4—TYPICAL WASHER RETAINER CRACKS

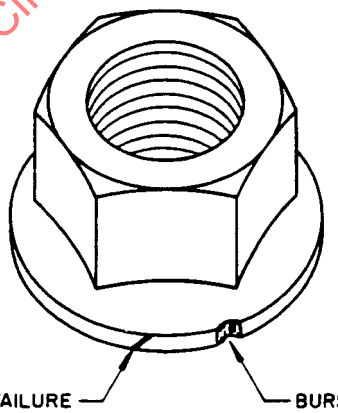
3.2 Seams—A seam is a narrow continuous discontinuity in the metal. Seams are generally inherent in the raw material from which the nut is made. Seams in nuts are usually straight or smooth curved line discontinuities running generally parallel to the nut axis. Typical seams are shown in Figure 5.



NOTE: Seams are permissible discontinuities only if within the limits specified in paragraph 4.3.1.

FIGURE 5—TYPICAL SEAMS

3.3 Bursts—A burst is an open break in the metal. Bursts may occur at the periphery of flanged nuts. A typical burst is shown in Figure 6.

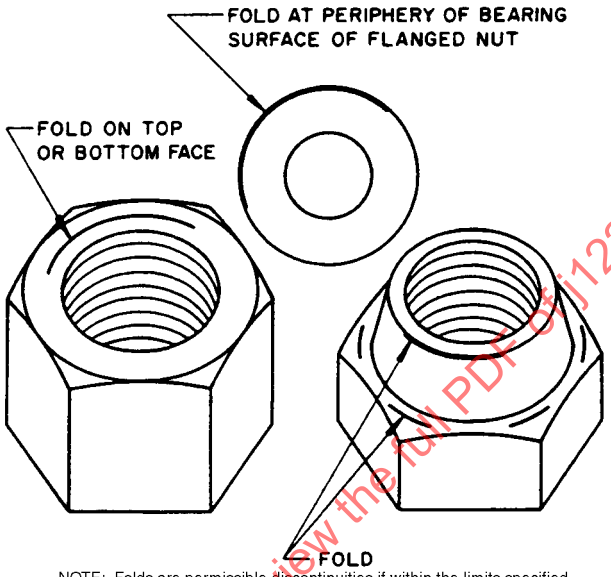


NOTE: Bursts are permissible discontinuities if within the limits specified in paragraph 4.4.
Shear failures are permissible discontinuities if within the limits specified in paragraph 4.5.

FIGURE 6—TYPICAL BURST AND SHEAR FAILURES ON FLANGED NUTS

3.4 Shear Failures—A shear failure is an open break in the metal, located at the periphery of flanged nuts and approximately at a 45 degree angle to the nut axis. Shear failures occur most frequently with flanged nuts and are due to overstressing the metal during forging. A typical shear failure is shown in Figure 6.

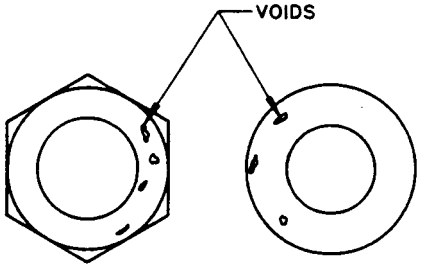
3.5 Folds—A fold is a doubling over of metal which may occur during the forging operation. Folds in nuts may occur at or near the intersection of diameter changes or on the top or bottom face of the nut. Typical folds are shown in Figure 7.



NOTE: Folds are permissible discontinuities if within the limits specified in paragraph 4.6.

FIGURE 7—TYPICAL FOLDS

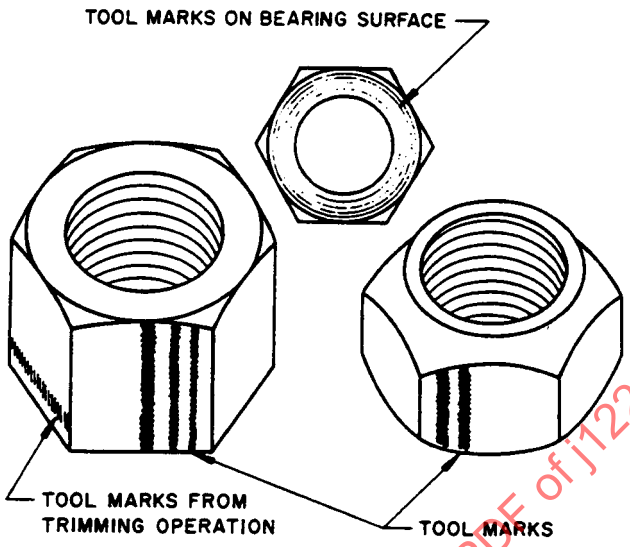
3.6 Voids—A void is a shallow pocket or hollow on the surface of the nut due to nonfilling of metal during forging. Typical voids are shown in Figure 8.



NOTE: Voids on the bearing surface of nuts are permissible if within the limits specified in paragraph 4.7.

FIGURE 8—TYPICAL VOIDS ON BEARING SURFACES

3.7 Tool Marks—Tool marks are longitudinal or circumferential grooves of shallow depth, produced by the movement of manufacturing tools over the surface of the nut. Typical tool marks are shown in Figure 9.



NOTE: Tool marks are permissible discontinuities if within the limits specified in paragraph 4.8.

FIGURE 9—TYPICAL TOOL MARKS

3.8 Nicks or Gouges—A nick or gouge is an indentation on the surface of a nut, produced by forceful abrasion or the impact of product coming into contact with other product or manufacturing equipment during manufacture.

4. Limits for Surface Discontinuities

4.1 Letter Definitions—Throughout the following requirements, D designates the nominal size (basic major diameter of thread of nuts). F designates the nominal flange diameter. For metric-series nuts use millimeter; for inch-series nuts use inch.

4.2 Cracks

4.2.1 QUENCH CRACKS—of any depth, any length, or in any location, are not permitted. (See 3.1.1 and Figure 1.)

4.2.2 FORGING CRACKS—are permissible discontinuities providing that nuts with forging cracks, in addition to meeting the dimensional requirements detailed below, can meet the requirements of the cone proof load test described in 5.3.

4.2.2.1 Forging cracks located in the top and bottom face of nuts are permissible discontinuities providing that (a) there are no more than two forging cracks which extend from the tapped hole across the full width of the faces; (b) no forging crack extends into the tapped hole beyond the first full thread; and (c) the width of any forging crack does not exceed 0.20 mm (0.008 in) +0.010 D.

4.2.2.2 Forging cracks located at the intersection of top or bottom face with the flat (these discontinuities are sometimes interpreted as bursts) shall not exceed 0.25 mm (0.010 in) +0.020 D. (See 3.1.2 and Figure 2.)

4.2.3 LOCKING ELEMENT FORMATION CRACKS—of any length or any depth, located on the external surface of prevailing torque nuts, are not permitted.

4.2.3.1 Locking element formation cracks located on the internal surface of prevailing torque nuts shall not exceed two thread pitches in length; shall not extend into the thread root; and the width of any crack shall not exceed the following: For metric-series nut, 0.18 mm for sizes 6.3 to 11 mm, inclusive, and 0.25 mm for sizes 12 to 25 mm, inclusive. For inch-series nuts, 0.007 in for sizes 1/4 to 7/16 in, inclusive, and 0.010 in for sizes 1/2 to 1 in, inclusive. (See 3.1.3 and Figure 3.)

4.2.4 WASHER RETAINER CRACKS—are permissible discontinuities. (See 3.1.4 and Figure 4.)

4.3 Seams—Seams are permissible discontinuities providing that nuts with seams, in addition to meeting the dimensional requirements detailed below, can meet the requirements of the cone proof load test described in 5.3.

4.3.1 Seams shall not exceed the following open width at the surface; for metric-series nuts, 0.13 mm for sizes 6.3 to 11 mm, inclusive, and 0.25 mm for sizes 12 to 25 mm, inclusive. For inch-series nuts, 0.005 in for nut sizes 1/4 to 7/16 in, inclusive, and 0.010 in for nut sizes 1/2 to 1 in, inclusive. (See 3.2 and Figure 5.)

4.4 Bursts—Bursts in flanged nuts shall not exceed a width of 0.13 mm (0.005 in) +0.020 F or an open depth of 0.08 mm (0.003 in) +0.012 F, except that one burst may have a width no greater than 0.25 mm (0.010 in) +0.040 F, or an open depth no greater than 0.15 mm (0.006 in) +0.024 F. (See 3.3 and Figure 6.)

4.5 Shear Failures—Shear failures on flanged nuts shall not exceed a width of 0.020 F or a depth of 0.030 F. (See 3.4 and Figure 6.)

4.6 Folds—Folds located at the intersection of the flange periphery and bearing surface of flanged nuts shall not project below the bearing surface. (See 3.5 and Figure 7.)

4.7 Voids—Voids on the bearing surface of nuts shall not exceed a depth of 0.25 mm (0.010 in), and the combined area of all voids on the bearing surface shall not exceed 5% of the specified minimum area of the bearing surface. (See 3.6 and Figure 8.)

4.8 Tool Marks—Tool marks on the bearing surface shall not exceed a surface roughness measurement of 2.8 μm (110 μin) determined as the arithmetic average deviation from the mean surface. Tool marks on other surfaces are permissible discontinuities. (See 3.7 and Figure 9.)

4.9 Nicks and Gouges—Nicks and gouges are permissible discontinuities; however, the manufacturer shall exercise due care during the manufacture and handling of nuts to minimize the number and magnitude of nicks and gouges. (See 3.8.)

5. Inspection Procedure—Nuts shall be inspected in accordance with the procedures outlined in 5.1, 5.2, and 5.3, unless otherwise specified by purchaser.

5.1 Visual Inspection—A representative sample[1] shall be picked at random from the lot. The sample shall be examined visually for quench cracks, locking element formation cracks, width of seams, bursts, shear failures, forging cracks, folds, voids on the bearing surface, and tool marks on the bearing surface.

5.1.1 If any nuts are found with quench cracks, or if any prevailing torque nuts are found with locking element formation cracks located on the external surface, the lot shall be subject to rejection.

1. See Appendix.

5.1.2 If any nuts are found with locking element formation cracks located on the internal surface, seams, bursts, shear failures, forging cracks, folds, voids, or tool marks which exceed the allowable limits as specified for the applicable type of discontinuity under Section 4, the lot shall be subject to rejection.

5.2 Magnetic Analysis Inspection—The same sample (if acceptable by visual inspection) shall then be further examined by magnetic inspection techniques (Magna-glo, Magna-flux, eddy current, etc.). (NOTE: Other examining procedures may be used providing they have an equivalent ability to detect discontinuities of the size specified under Section 4.) All nuts showing indications that could be interpreted as seams, and all nuts showing strong indications of forging cracks with potentially significant depth, shall be set aside. From this group a secondary sample[1] shall be picked at random. Each nut in this sample shall be cone proof load tested as outlined in 5.3. If any nut fails to meet the requirements of this test, the lot shall be subject to rejection.

5.3 Cone Proof Load Test—The purpose of the test[2] is to detect the presence of detrimental seams or forging cracks. The use of a conical washer and threaded mandrel, as illustrated in Figure 10, exaggerates the influence of such discontinuities on the load carrying ability of the nut by introducing a simultaneous dilation and stripping action on the nut.

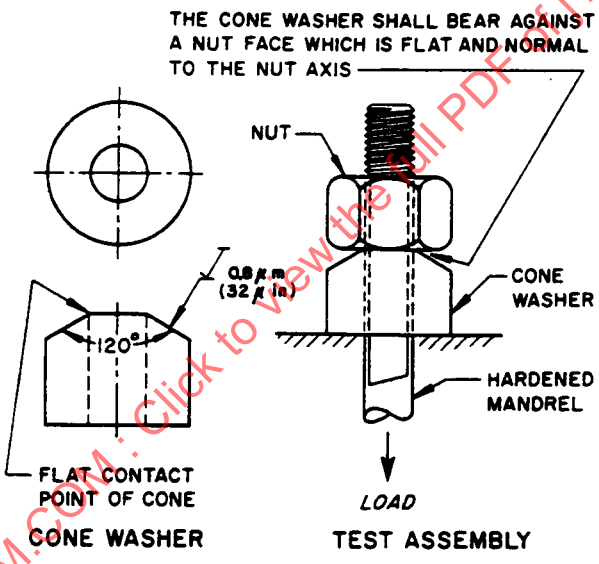


FIGURE 10—USE OF CONICAL WASHER AND THREADED MANDREL

2. Same as test specified in ASTM A 194, Steel Nuts for High Pressure and High Temperature Service.