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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Specification for Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series¹

This standard is issued under the fixed designation F 788/F 788M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

1. Scope *

1.1 This specification establishes allowable limits for the various types of surface discontinuities that may occur during the manufacture and processing of bolts, screws, and studs, including heat-treated machine screws, tapping screws, and sems (the washers of screw-washer assemblies are excluded). This specification covers metric series products with nominal diameters of 4 mm and larger and with specified minimum tensile strengths of 800 MPa and greater; and inch series products with nominal diameters of No. 5 (0.1250 in.) and larger and with specified minimum tensile strengths of 90 000 psi and greater.

1.2 The values stated in either SI (metric) or inch-pound units are to be regarded separately as standard. The values stated in each system are not exact equivalents, therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

1.3 When the engineering requirements of the application necessitate control of surface discontinuities on bolts, screws, or studs, the purchaser shall specify conformance to ASTM Specification F 788/F 788M, in the original inquiry and purchase order.

1.3.1 When the engineering requirements of the application necessitate that surface discontinuities on bolts, screws, and studs be controlled within limits closer than those specified in this specification, the purchaser shall specify the applicable limits in the original inquiry and purchase order.

1.4 The allowable limits established in this specification for metric bolts, screws, and studs with nominal diameters from 4 to 24 mm inclusive, are essentially identical with requirements given in ISO 6157/I. There are no ISO standards for surface discontinuities on any inch-series products.

2. Referenced Documents

2.1 ASTM Standards:

¹ This specification is under the jurisdiction of ASTM Committee F-16 on Fasteners and is the direct responsibility of Subcommittee F16.93 on Quality Assurance Provisions for Fasteners.

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E 340 Test Method for Macroetching Metals and Alloys²

2.2 ISO Standard:³

ISO 6157/I Fasteners, Surface Discontinuities on Bolts, Screws and Studs

3. Ordering Information

3.1 Orders for bolts, screws, and studs requiring discontinuity control shall include the following:

3.1.1 ASTM designation and date of issue of this specification.

3.1.2 Special requirements, for example, closer discontinuity limits (1.3.1) and inspection sampling plan (6.2).

4. Types of Surface Discontinuities

4.1 *Crack*—A crack is a clean (crystalline) fracture passing through or across the grain boundaries and may possibly follow inclusions of foreign elements. Cracks are normally caused by overstressing the metal during forging or other forming operations, or during heat treatment. Where parts are subjected to significant reheating, cracks usually are discolored by scale.

4.1.1 *Quench Cracks*—Quench cracks may occur due to excessively high thermal and transformation stresses during heat treatment. Quench cracks usually traverse an irregular and erratic course on the surface of the fastener. Typical quench cracks are shown in Fig. 1. Limits are specified in 5.2.

4.1.2 *Forging Cracks*—Forging cracks may occur during the cutoff or forging operations and are located on the top of the head and on the raised periphery of indented head bolts and screws. Typical forging cracks are shown in Fig. 2. Limits are specified in 5.3.

4.2 *Burst*—A burst is an open break in the metal. Bursts occur during the forging operation and are located on the flats or corners of heads or at the periphery of flanged or circular head products or on the raised periphery of indented head bolts and screws. Typical bursts are shown in Fig. 3. Limits are specified in 5.4.

4.2.1 *Shear Burst*—A shear burst is an open break in the metal located at approximately a 45° angle to the product axis.

² Annual Book of ASTM Standards, Vol 03.01.

³ Available from American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036.

*A Summary of Changes section appears at the end of this standard.

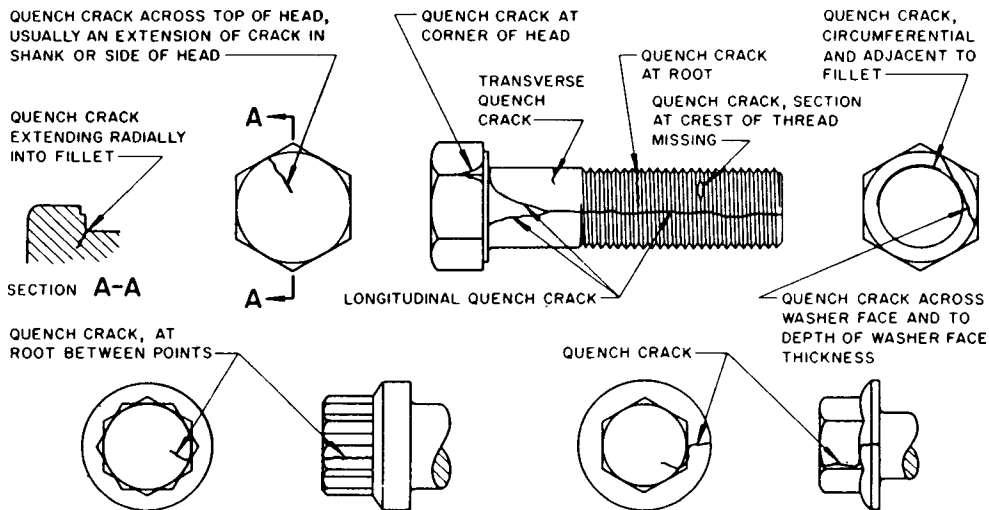


FIG. 1 Typical Quench Cracks

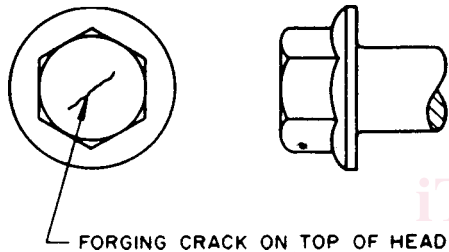


FIG. 2 Typical Forging Cracks

Shear bursts occur most frequently at the periphery of products having flanged or circular heads. Shear bursts may also occur on the sides of hex-head products. Typical shear bursts are shown in Fig. 3. Limits are specified in 5.4.

4.3 *Seam*—Seams are generally inherent in the raw material from which the fastener is made. Seams are usually straight or smooth-curved line discontinuities running longitudinally on thread, shank, and head. Seams in raw material used for forged or formed fasteners may lead to the formation of bursts. Typical seams are shown in Fig. 4. Limits are specified in 5.5.

4.4 *Fold*—A fold is a doubling over of metal which occurs during the forging operation. Folds may occur at or near the intersection of diameter changes and are especially prevalent with noncircular necks, shoulders, and heads. Typical folds are shown in Fig. 5 *a*, *b*, and *c*. Limits are specified in 5.6.

4.5 *Thread Lap*—A thread lap is a doubling over of metal which occurs during roll threading. Limits are specified in Supplementary Requirement S.1.1.

4.6 *Void*—A void is a shallow pocket or hollow on the surface of a bolt or screw due to nonfilling of metal during forging. Voids are produced by marks or impressions of chips (shear burrs) or by rust formation on the raw material. They are not planished during forging. Typical voids are shown in Fig. 6. Limits are specified in 5.7.

4.7 *Tool Marks*—Tool marks are longitudinal or circumferential grooves of shallow depth produced by the movement of manufacturing tools over the surface of the bolt or screw. Typical tool marks are shown in Fig. 7. Limits are specified in 5.8.

4.8 *Nick or Gouge*—A nick or gouge is an indentation on

the surface of a bolt, screw, or stud produced by the forceful abrasion or the impact of a product coming into contact with another product or manufacturing equipment during manufacture, handling, or transport. Limits are specified in 5.9.

5. Allowable Limits

5.1 *Letter Definitions*—Throughout the following requirements, *D* designates the nominal size (basic major diameter of thread) of bolts, screws, and studs, except for products with shoulders, in which case *D* designates the largest shoulder diameter; and *D_c* designates flange diameter (specified maximum) or head diameter (specified maximum) of circular head products. For metric series products, *D* and *D_c* are in millimeters; for inch-series products, *D* and *D_c* are in inches.

5.2 *Quench Cracks*—Quench cracks of any depth, any length, or in any location are not permitted.

5.3 *Forging Cracks*—Forging cracks on the top of the head of bolts and screws are permitted, provided that (a) no crack shall have a length exceeding $1.0 D$, and (b) no crack shall have a width or depth exceeding $0.04 D$.

5.4 Bursts and Shear Bursts:

5.4.1 For hex-head bolts and screws, bursts and shear bursts are permitted, provided that (a) no burst or shear burst in the flats extends into the crown (chamfer) circle on the top of the head or into the underhead bearing circle, (b) no burst or shear burst located at the intersection of two wrenching flats reduces the width across corners below its specified minimum, and (c) no burst or shear burst has a width or depth greater than $.06D$ but not to exceed $.062$ in. (1.6 mm).

5.4.2 For flange bolts and screws and products with circular heads, bursts and shear bursts at the periphery of the flange or head are permitted, provided that (a) not more than one burst or shear burst has a width greater than $0.04 D_c$ and (b) the width of the one burst or shear burst that exceeds a width of $0.04 D_c$ does not have a width greater than $0.08 D_c$.

5.4.3 For indented head bolts and screws, bursts and shear bursts in the raised periphery of the indented head are permitted, provided that (a) no burst or shear burst has a width greater than $0.06 D$ and (b) no burst or shear burst has a depth extending below the indented portion.

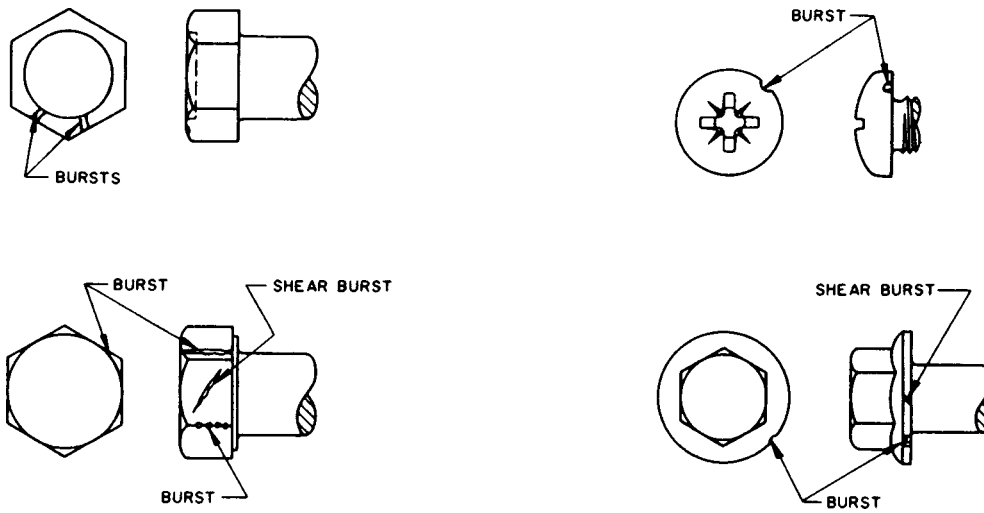


FIG. 3 Typical Bursts and Shear Bursts

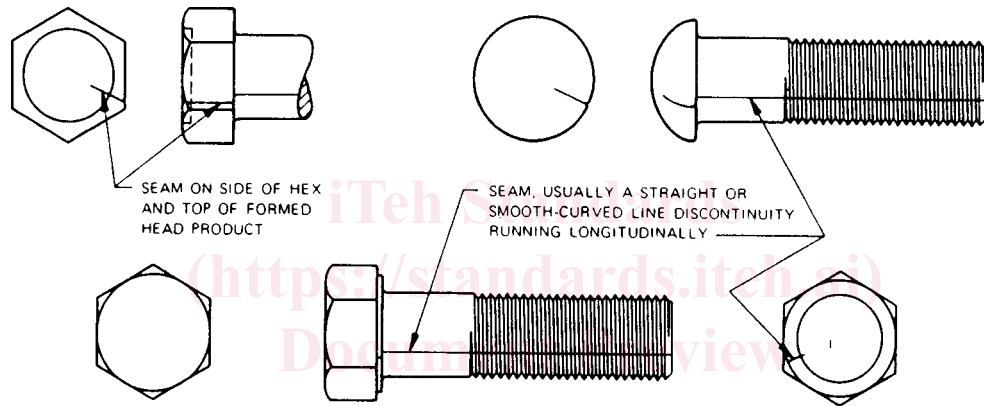


FIG. 4 Typical Seams

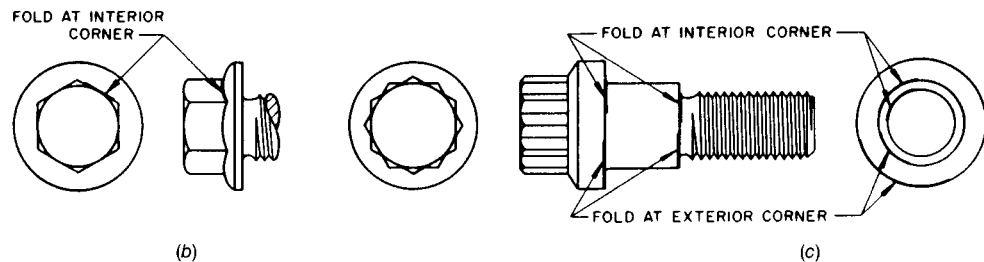
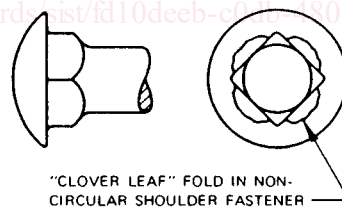


FIG. 5 Typical Folds

5.5 Seams:

5.5.1 Seams in the shanks of bolts, screws, and studs are permitted provided that no seam has a depth greater than 0.03 *D*.

5.5.2 Seams extending into the heads and flanges of bolts and screws are permitted, provided that they do not open

beyond the limits specified for bursts and shear bursts in 5.4.

5.6 Folds:

5.6.1 Folds located at interior corners that are at or below the underhead bearing surface, for example, at the junction of head to shank, are not permitted, except for cloverleaf folds occurring at the intersection of non-circular shoulders with