



Designation: F 2328 – 04

Standard Test Method for Determining Decarburization and Carburization in Hardened and Tempered Threaded Steel Bolts, Screws and Studs¹

This standard is issued under the fixed designation F 2328; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This test method covers procedures for measuring, classifying, and determining the presence of decarburization and carburization in the threaded section of hardened and tempered inch series steel bolts, screws, studs, and similar parts which have been heated to facilitate fabrication or to modify its mechanical properties. This test method is not intended to address products which are intentionally carburized to achieve specific results.

1.2 Two routine methods are described for measuring the limits of and determining the presence of decarburization or carburization—the optical method and the microindentation method 1. Either method is appropriate for routine examinations. The microindentation method 2 shall be considered the referee method.

1.3 For the purpose of these tests, there are three classes of hardened and tempered steel products for which specific measurements must be made with respect to their physical properties.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

- E 3 Practice for Preparation of Metallographic Specimens
- E 384 Test Method for Microindentation Hardness of Materials
- F 1789 Terminology for F16 Mechanical Fasteners

3. Terminology

3.1 *Definitions:*

¹ This test method is under the jurisdiction of ASTM Committee F16 on Fasteners and is the direct responsibility of Subcommittee F16.01 on Test Methods. Current edition approved July 1, 2004. Published July 2004.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.1.1 *carburization*—process or result of increasing the carbon content of the surface layers of the steel fastener product.

3.1.2 *decarburization*—in accordance with Terminology F 1789, is a loss of carbon from the surface layer of the fastener, normally associated with heat treatment.

3.1.3 *gross decarburization*—also known as *complete decarburization*, is characterized by a sufficient carbon loss to show only clearly defined ferrite grains.

3.1.4 *partial decarburization*—characterized as a loss of carbon sufficient to cause a lighter shade of tempered martensite than that of the immediately adjacent base metal, but as being of insufficient carbon loss to show clearly defined ferrite grains.

4. Class of Decarburization

4.1 *Class Determination*—These measurements by Class are predicated upon their relationship between the height (H) of the external thread at its maximum boundary, disregarding any surface coating, and N, which is the minimum thread height in the non-decarburized zone (see Figs. 1-3). The dimensions for N and H are listed in Table 2 for each Class. Dimension G (Table 1 and Fig. 1) represents the maximum depth of gross or complete decarburization.

NOTE 1—Refer to the product standard for specific requirements. When limits are not specified, use Table 1 as a suggested reference.

5. Preparation

5.1 The use of either the optical or microindentation method requires the finished product to be longitudinally cross-sectioned, approximately through the threaded axis, and mounted for grinding and polishing in any suitable medium which will provide edge retention of the specimen. This shall be performed in accordance with good metallographic practice. See Practice E 3.

6. Evaluation by the Optical Method

6.1 Etch the mounted specimen (Section 5) in a 2 to 4 % nital or picral solution to exhibit the microstructure. Examine the specimen at 100 \times magnification using a method capable of measuring distances to at least 0.001 in. resolution. The width of any light-etching band of martensite defines the depth of

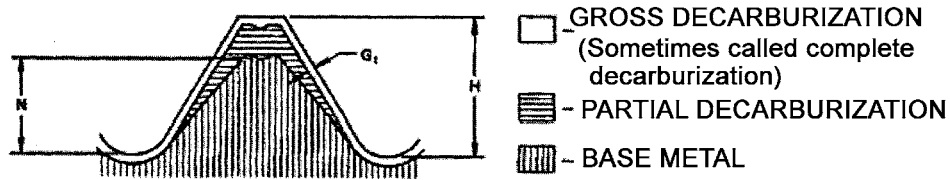
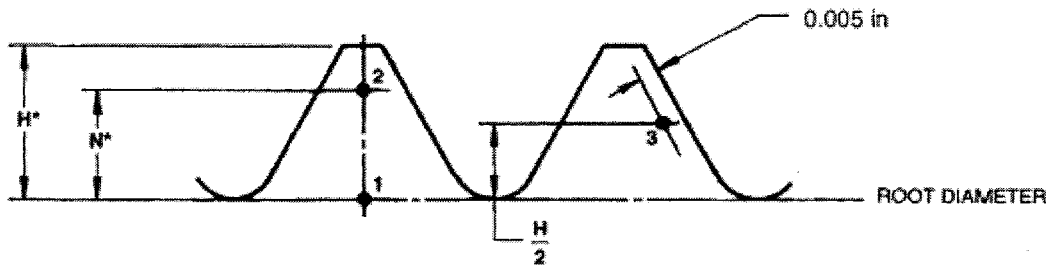


FIG. 1 Decarburization Zones



*See Figure 1

Decarburization // Carburization

FIG. 2 Position for Microindentation Measurements

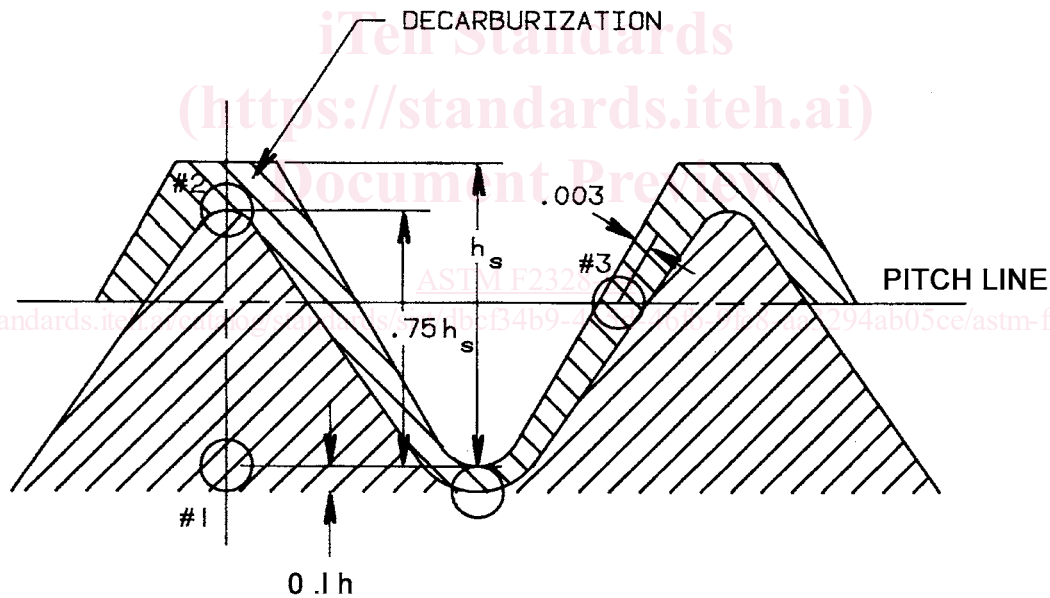


FIG. 3 Microindentation Measurements for Class 3 Products

decarburization. Compare the image with Fig. 1 for the maximum limits for G by taking a measurement on a line perpendicular to the flank of the thread midway between the thread crest and root (pitch diameter).

6.2 Interpretation of Results:

6.2.1 Allowable limits for partial decarburization shall be in accordance with 3.1.4 and Fig. 1, and the measured values shall be in accordance with Table 2, when measured in accordance with the illustrations in Figs. 2 and 3.

6.2.2 Allowable limits for gross decarburization (G) shall be in accordance with 3.1.3 and the measured values as defined in Table 1. The optical method is the only valid method for

TABLE 1 Classes of Decarburization: Guide

Class	N	G. max	Typical Applications
1	1/2 H	0.0006 in.	For heat treated products which have tensile strengths up to 120 000 psi and those with a specified minimum tensile strength of 120 000 psi or a hardness range of 24 to 34 HRC, or both.
2	3/8 H	0.0006 in.	For products with a minimum tensile strength of 150 000 psi or a hardness range of 33 to 39 HRC, or both.
3	3/4 H	none permitted	For products with a minimum tensile strength of 170 000 psi or a minimum specified hardness of 37 HRC, or both.