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Standard Terminology for F16 Mechanical Fasteners[1]

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1. Scope

1.1 This terminology standard provides a compilation of definitions for terminology used for mechanical fasteners.

1.2 Terms in this terminology are organized alphabetically. In Appendix X1 they are listed under fastener characteristic.

1.3 Additional definitions are shown in ANSI/ASME B18.12; IFI Glossary of Terms, IFI-139 and IFI-140; and SAE J412.

2. Referenced Documents

2.1 *ASTM Standards:*

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products[2]

A 563 Specification for Carbon and Alloy Steel Nuts[3]

E 456 Terminology Relating to Quality and Statistics[4]

2.2 *ANSI/ASME Standard:*

B18.12 Glossary of Terms for Mechanical Fasteners[5]

2.3 *IFI Standards:*

Glossary of Terms Relating to Aerospace Fasteners[6]

IFI-139 Quality Assurance Requirements for Fastener Testing Laboratories[6]

IFI-140 Carbon and Alloy Steel Wire, Rods, and Bars for Mechanical Fasteners[6]

2.4 *SAE Standard:*

SAE J412 General Characteristics and Heat Treatments of Steels[7]

3. Mechanical Fastener Definitions

alloy groups—an alloy group includes alloys considered to be chemically equivalent for general purpose use in specifying stainless steel bolts, hex cap screws, studs and nuts.

alloy steel—steel is considered to be alloy when the maximum range given for manganese exceeds 1.65 % or a definite minimum quantity for any of the following elements is specified or required within the limits of the recognized field of constructional alloy steels: chromium, molybdenum, nickel, or any other alloying element added to obtain a desired alloying effect.

alter—to change fastener properties such as hardness, tensile strength, surface finish, length, or other characteristics of the fastener through such processes as heat treatment, plating, and machining.

anchor bolt—a steel rod or bar, one end of which is intended to be cast in concrete while the opposite end is threaded and projects from the concrete for anchoring other material to the concrete. The end cast in concrete may be either straight or provided with an anchor, such as a bent hook, forged head, or a tapped or welded attachment to resist forces imposed on the anchor bolt as required.

annealing—a general term applied to a variety of thermal treatments applied to fasteners for the purpose of softening or homogenizing material properties. The specific types of annealing are:

full annealing—heating steel above the upper critical transformation temperature, holding it there long enough to fully transform the steel to austenite, and then cooling it at a controlled rate, in a furnace, to below a specified temperature. A full anneal refines grain structure and provides a relatively soft, ductile material that is free of internal stresses.

intercritical annealing/isothermal annealing—heating a steel above the lower critical transformation temperature, but below the upper-critical transformation temperature, to dissolve all the iron carbides, but not transform all the ferrite to austenite. Cooling slowly from this temperature, through the lower critical temperature, produces a structure of ferrite and pearlite that is free of internal stresses. In *intercritical annealing*, the steel continues to cool slowly in the furnace, similarly to full annealing. In *isothermal annealing*, cooling is stopped just below the lower critical, assuring complete transformation to ferrite and coarse pearlite, and eliminating the potential for bainite formation. The coarse pearlite structure greatly improves machinability of medium carbon steels.

normalizing—a variation of full annealing in which steel is heated above the upper critical temperature and is then air cooled in air, rather than in a furnace. Normalizing relieves

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[2] *Annual Book of ASTM Standards*, Vol 01.01.

[3] *Annual Book of ASTM Standards*, Vol 01.08.

[4] *Annual Book of ASTM Standards*, Vol 14.02.

[5] Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

[6] Available from Industrial Fasteners Institute, 1717 E. 9th Street, Suite 1105, Cleveland, OH 44114.

[7] Available from Society of Automotive Engineers, 400 Commonwelath Drive, Warrendale PA 15096.

the internal stresses caused by previous working, and while it produces sufficient softness and ductility for many purposes, it leaves the steel harder and with a higher tensile strength than full annealing. To remove cooling stresses, normalizing if often followed by tempering.

process annealing—sometimes called subcritical annealing or stress relieving, performed at temperatures just below the lower critical temperature. Process annealing neither refines grains nor redissolves cementite, but does improve the ductility and decreases residual stress in work-hardened steel.

solution annealing—heating an austenitic stainless steel to a temperature that puts the carbides into solution. The steel is held at this temperature long enough to achieve grain growth. It is then quenched in a medium for fast cooling, which prevents most of the carbides from reprecipitating. The process achieves optimum creep strength.

spheroidize annealing—a type of subcritical annealing used to soften steel and improve machinability. Heat treating fine pearlite for a long time just below the lower critical temperature of the steel, followed by a very slow cooling, produces a spheroidal or globular form of the pearlite.

stabilization annealing—heating an austenitic stainless steel used in severe aqueous corrosion environments by first solution annealing and then reheating to about 1600°F, and holding at that temperature. The treatment causes grain boundary precipitation of carbides, but also the hold time permits the chromium remaining in the austenite solution to redistribute within the grains, restoring corrosion resistance, even adjacent to the grain boundaries.

applicable standards—those having the capability of being applied in some fashion to the host standard.

arbitration hardness location—a prescribed location on the fastener, such as at mid-radius, using 90° intervals taken through the cross section; one diameter from the threaded end for bolts and screws.

assembly lot—an assembly lot may consist of a combination of different products. As long as the products that make up the assembly are in accordance with *lot*, the quantity of assemblies determine the sample size. Example: ten assemblies consisting of a bolt, nut, and a washer would have a lot size of ten if the bolts, nuts, and washers meet the criteria of *lot*. However, if any of the components in the assembly are not in accordance with *lot* then the ten assemblies will have to be separated into lots that meet all the requirements of *lot*.

austenitic stainless alloys—steel alloys that contain a minimum of 15 % chromium and from a residual to 20 % nickel. Some alloys may contain as much as 18 % manganese. The metal is predominantly face centered cubic in structure and hardenable only by cold working. Essentially nonmagnetic in its wire form, it may become slightly magnetic from cold working. Austenitic stainless steels can be grouped into three categories: 300 series alloy, Cr-Ni-Mn alloys, and Cr-Ni-Mo-Ti.

average coating thickness—determined as either the value obtained by analytical methods or the mean value of a specified number of local thickness measurements that are evenly distributed over the significant surface.

baking duration—the time measured from when the plated product reaches a specified temperature in the baking furnace or oven until it is removed.

bar—a solid rolled or forged section that is long in relationship to its cross-sectional dimensions with a relatively constant cross-section throughout its length. Carbon and alloy steel bars are produced from hot rolled or cast billets, or from blooms rolled single strand into coils.

barrel-plating process—a fastener-coating process which employs a containment vessel called a barrel that is designed to move a given batch of fasteners together through each of the process steps, allowing ready ingress and egress of processing solutions and rinses. As the barrel moves through the process steps, it is rotated or oscillated, causing the fasteners to cascade over one another, and in the electrocleaning and electroplating steps, and electric current is applied.

barrel-plating process—a fastener coating process which employs a containment vessel called a barrel which is designed to move a given lot of fasteners together through each of the process steps, allowing ready ingress and egress of processing solutions and rinses. As the barrel moves through the process steps it is rotated causing the fasteners to cascade over one another and in the electrocleaning and electroplating steps an electric current is applied.

batch average thickness—the calculated average thickness of a coating if it were uniformly distributed on the surfaces of the items.

bend test—various tests in which a fastener is bent through its axis or on a round mandrel to determine the toughness and ductility of the fastener.

bendable bolts—bolts furnished with an altered section at some location at which the bolt will bend.

bolt—a headed and externally threaded fastener designed to be assembled with a nut.

bolt load - elongation behavior— when tensile loaded, a bolt will elongate elastically until stressed beyond its proportional limit where it will behave plastically.

break loose torque—torque applied in a removal direction necessary to start the fastener in motion from its fully preloaded installed position.

breakaway torque—torque necessary to start a fastener in motion after the axial load of the mating components has been reduced to zero.

burst—an open break in the metal during forging located on the flats or corners of bolt and screw heads, or at the periphery of a flanged or circular headed bolt or screw, or on the flats or corners of the nut.

carbide precipitation "sensitization"—a condition which affects some austenitic stainless steels which have been subjected to temperatures in the critical range, typically 800° to 1400°F. Complex chromium carbides precipitate and reside primarily at the grain boundaries, causing deterioration of its corrosion resistance by depleting its adjacent areas of chromium.

carbon steel—steel for which no minimum content is specified or required for chromium, molybdenum, nickel, or any other element added to obtain a desired alloying effect; or steel for which maximum content specified for manganese does not