Designation: F3217 – 17

Standard Guide for Security Fasteners[1]

This standard is issued under the fixed designation F3217; 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.

1. Scope

1.1 The purpose of this guide is to provide technical information related to understanding the features, types of materials, and benefits of various types of security fasteners and provide guidance in the selection and application of security fasteners in detention and corrections facilities.

1.2 *Units*—The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *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, health and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASME Standard:*

ASME B1.1 Unified Inch Screw Threads (UN and UNR Thread Form)[2]

2.2 *British Standard:*

BS 1580–1 Unified Screw Threads. Screw Threads with Diameters ¼ in. and Larger. Requirements[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *bearing surface, n*—area that carries load across the face of the material.

3.1.2 *blind fastener, n*—fastener that can be placed with access to only one side of an application (for example, cage nuts, pop rivet®).

3.1.3 *blind side, n*—side of the joint that cannot be accessed (for example, the inside surface of a tubular or box section).

3.1.4 *body, n*—in blind fasteners, the portion of the rivet that expands into the parent material and in threaded fasteners, the unthreaded portion of the fastener under the head.

3.1.5 *bolt, n*—externally threaded fastener that requires a nut to secure the fastened joint.

3.1.6 *break stem, n*—fastener that is installed by gripping and pulling the end of the mandrel/stem; see Fig. 1.

3.1.6.1 *Discussion*—As installation is completed, the end of the stem fractures at the breaker groove and is discarded, leaving the head of the stem in the fastener body.

3.1.7 *breaker groove, n*—weakened groove in the stem or pin of a fastener allowing breakage at a predetermined load and length; see Fig. 2.

3.1.8 *bulbing, v*—physical action of the fastener body swelling (expanding radially) against the rear face of the joint when placed.

3.1.8.1 *Discussion*—Generally found in break stem fasteners and threaded inserts.

3.1.9 *case hardened, adv*—heat-treated fastener in which the surface is harder than the core.

3.1.10 *chemical-set anchor, n*—anchor designed for blind-hole installations that use a two-component structural grade catalyzing resin (usually epoxy) to bind the bolt securely in the substrate material.

3.1.11 *drive-pin expansion anchor, n*—blind-hole expansion anchor usually manufactured from a relatively soft alloy metal or plastic, but can also be of steel; see Fig. 3.

3.1.11.1 *Discussion*—The anchor is expanded into the blind hole by hammering in a supplied pin or nail into the center of the anchor.

3.1.12 *drive type, n*—the features of a fastener head that allows the fastener to be driven (installed or removed).

3.1.12.1 *Allen head, n*—hexagonal hollow socket drive design.

[1] This guide is under the jurisdiction of ASTM Committee F33 on Detention and Correctional Facilities and is the direct responsibility of Subcommittee F33.04 on Detention Hardware.

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[2] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, http://www.asme.org.

[3] Available from British Standards Institution (BSI), 389 Chiswick High Rd., London W4 4AL, U.K., http://www.bsigroup.com.

[4] See thread terminology, types of bolt and screw heads, and types of screw points for visual reference.

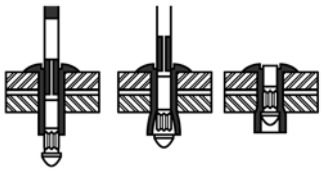

FIG. 1 Break Stem

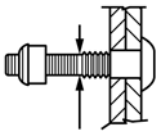

FIG. 2 Breaker Groove

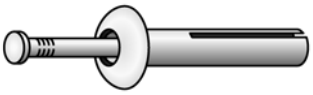

FIG. 3 Drive-pin Expansion Anchor

(1) Discussion—Security fastener versions have a center pin reject feature added.

3.1.12.2 *Key-Rex®, n*—custom-registered computer-designed hollow socket head design requiring a matching tool drive to install or remove; see Fig. 4.[5]

FIG. 4 Key-Rex®

(1) Discussion—Generally considered a maximum security fastener.

3.1.12.3 *McGard Intimidator®, n*—custom-registered computer-designed hollow socket drive design requiring a matching tool drive to install or remove; see Fig. 5.[5]

FIG. 5 McGard Intimidator®

(1) Discussion—Generally considered a maximum security fastener.

3.1.12.4 *one-way drive, n*—drive design that allows for installation but not removal. This is usually a one-way slotted head in which the slot shoulders are removed in the counter-clockwise direction.

(1) Discussion—This is not considered a security fastener with the possible exception of one-way slotted heads in which the slot shoulders are removed in the counterclockwise direction.

3.1.12.5 *Penta Nut™, n*—tapered nut with a hollow five-point socket that is used to tighten the nut; see Fig. 6.[5]

FIG. 6 Penta Nut™

3.1.12.6 *Penta-plus™, n*—five-sided hollow socket security fastener with center pin reject; see Fig. 7.[5]

FIG. 7 Penta-plus™

3.1.12.7 *Phillips head, n*—for threaded fasteners, a traditional hollow socket head design characterized by a four-lobed shape; see Fig. 8.

FIG. 8 Phillips Head

(1) Discussion—This is not considered a security fastener.

3.1.12.8 *Raptor™, n*—oversized head with anti-loosening serrations on the flat bearing surface, which increases the holding power of the fastener 20 % and eliminates the need for lock washers.[5]

(1) Discussion—This feature can be added to Key-Rex®, Penta-plus™, Zero™, or any style fastener.

3.1.12.9 *Robertson, n*—a square hollow socket drive often seen in woodworking fasteners.

3.1.12.10 *slotted head, n*—for threaded fasteners, a traditional head design characterized by a cross slot in the head face; see Fig. 9.

FIG. 9 Slotted Head

[5] The sole source of supply of the apparatus known to the committee at this time is Bryce Fasteners, 1230 N. Mondel Dr., Gilbert, AZ 85233. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

3.1.12.11 *spanner head, n*—for threaded fasteners, one with a head design characterized by horizontally opposed notches in the head circumference or round recesses within the head face; see Fig. 10.

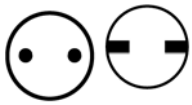

FIG. 10 Spanner Head

(1) Discussion—Such designs are not especially secure and tools for inserting or removing these types of fasteners are easily broken. They are often referred to as "snake eye" fasteners.

3.1.12.12 *Torx head, n*—multi-lobed hollow socket fastener bit design as patented and licensed by Camcar Textron and the design is characterized by a six-lobed shape with rounded lobes.[6] The security version has an added center pin; see Fig. 11.

FIG. 11 Torx Head

3.1.12.13 *Torx plus head, n*—multi-lobed hollow socket fastener bit design characterized by a six-pointed shape as patented and licensed by Camcar Textron and the design characterized by a six-lobed shape with truncated lobes.[6] The security version is a five-lobed version that has an added center pin; see Fig. 12.

FIG. 12 Torx Plus Head

(1) Discussion—This design has better mechanical properties than the standard Torx but is limited in available sizes.

3.1.12.14 *T-REVX®, n*—multi-lobed hollow socket fastener characterized by a seven-point shape as patented and licensed by Bryce Fastener; see Fig. 13.[7]

FIG. 13 T-REVX®

3.1.13 *endurance limit/strength, n*—maximum alternative stress that a fastener can withstand for a specified number of stress cycles without failure. This is not normally an issue in correctional/detention projects.

3.1.13.1 *Discussion*—See *static breaking strengths* (in pounds).

3.1.14 *expansion anchor, n*—anchor designed for blind-hole installations that use a specially designed sleeve, wedge or other device that, as the fastener is tightened, the sleeve or wedge expands into the available space locking the fastener in place.

3.1.15 *hardening, v*—changing the strength or durability characteristics of a fastener through heat treatment or work hardening.

3.1.15.1 *Discussion*—See case *hardening, induction hardening, and through hardening.*

3.1.16 *head form/head style, n*—characteristics of the fastener head and head styles include button, pan, truss, hex, hex flange, socket head large flange, low profile, and countersunk.

3.1.16.1 *button head, n*—for threaded fasteners, one with a low, rounded top surface and a large, flat bearing surface; similar to a round head machine screw; see Fig. 14.

FIG. 14 Button Head

3.1.16.2 *countersunk head, n*—for threaded fasteners, one with a level surface and a conical bearing surface; available in various nominal head angles; see Fig. 15.

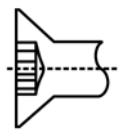

FIG. 15 Countersunk Head

(1) Discussion—See *flat head.*

3.1.16.3 *fillister head*—for threaded fasteners, one with a rounded top, cylindrical sides, and flat bearing surface; see Fig. 16.

3.1.16.4 *flat head, n*—for threaded fasteners, one with a level surface and a conical bearing surface; available in various nominal head angles; see Fig. 17.

(1) Discussion—See *countersunk head.*

[6] The Torx head is covered by a patent. If you are aware of an alternative(s) to the patented item, please attach to your ballot return a description of the alternatives. All suggestions will be considered by the committee. If alternatives are identified, the committee shall reconsider whether the patented item is necessary. The committee, in making its decision, shall follow Regulation 15.

[7] The T-REVX® is covered by a patent. If you are aware of an alternative(s) to the patented item, please attach to your ballot return a description of the alternatives. All suggestions will be considered by the committee. If alternatives are identified, the committee shall reconsider whether the patented item is necessary. The committee, in making its decision, shall follow Regulation 15.

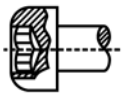

FIG. 16 Fillister Head

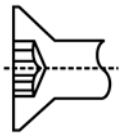

FIG. 17 Flat Head

3.1.16.5 *hexagon flange head/hex flange head, n*—hex head with an integral circular collar connected to the base of the hexagon by a conic section; see Fig. 18.

FIG. 18 Hexagon Flange Head/Hex Flange Head

(1) Discussion—Normally, the flanged diameter is larger than the width across the corners of the hexagon.

3.1.16.6 *hexagon head/hex head, n*—for threaded fasteners, one with a flat or indented top surface, six flat sides, and a flat bearing surface; see Fig. 19.

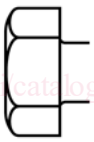

FIG. 19 Hexagon Head/Hex Head

3.1.16.7 *hexagon washer head/hex washer head, n*—hex head with an integral, formed washer at the base of the hexagon and the washer diameter may be equal to or greater than the width across the corners; see Fig. 20.

FIG. 20 Hexagon Washer Head/Hex Washer Head

3.1.16.8 *oval head, n*—for threaded fasteners, one with a rounded top surface and a conical bearing surface with a head angle of nominally 82° (90° for metric); see Fig. 21.

3.1.16.9 *pan head, n*—for threaded fasteners, one with a flat bearing surface and a flat top surface rounding into a cylindrical side surface; see Fig. 22.

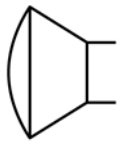

FIG. 21 Oval Head

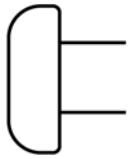

FIG. 22 Pan Head

(1) Discussion—On recessed pan heads, the top surface is semi-elliptical, rounding into a cylindrical side surface. Pan headed screws normally do not provide enough depth for the tool cavity to develop reasonable strength so it is seldom used in security fastener designs. See *button head* or *fillister head*.

3.1.16.10 *round head, n*—one with a semi-elliptical top surface and a flat bearing surface.

(1) Discussion—This term is also used to describe a fastener head designed without a driving surface or recess; see Fig. 23.

FIG. 23 Round Head

3.1.16.11 *socket head, n*—for threaded fasteners, one with a flat chamfered top surface with a smooth or knurled side surface and a flat bearing surface; see Fig. 24.

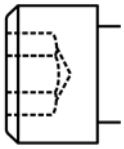

FIG. 24 Socket Head

(1) Discussion—A hexagon or spline (formerly known as "fluted") socket is formed in the center of the top surface.

3.1.16.12 *truss head, n*—for threaded fasteners, one with a rounded top surface and a flat bearing surface; the diameter of the truss head is larger in comparison to the fastener size than the diameter of the corresponding round head; see Fig. 25.

(1) Discussion—The design has improved mechanical properties to Torx having higher torque and the ability to stick to the installation tool. It is more secure because only licensed installation tools can remove it. Not all sizes are in stock.

3.1.17 *induction hardened, adj*—heat-treated fastener that has undergone a selective hardening process, using induction coils, to strengthen further a part of the fastener (usually the initial 1⁄16 in. (1⁄6 mm) of the surface).

FIG. 25 Truss Head

3.1.18 *length of engagement, n*—length of full-sized fastener threads that engage in the nut material.

3.1.18.1 *Discussion*—The length of the lead thread is not counted in the length of engagement since its reduced size minimizes any performance benefits. The length of engagement is usually expressed in relationship to the nominal diameter of the screw (for example, 2 to 2½ diameters of engagement).

3.1.19 *left-hand thread, n*—standard thread design; winds clockwise in a receding direction; see Fig. 26.

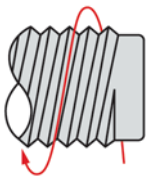

FIG. 26 Left-hand Thread

3.1.20 *maximum torque, n*—see *ultimate torque.*

3.1.21 *minimum torque, n*—see *torque (recommended).*

3.1.22 *passivation/passivated, n/v*—process to remove contaminants from the surface of stainless steel.

3.1.22.1 *Discussion*—Also a name for the chromatic process applied to some metallic finishes to enhance corrosion resistance.

3.1.23 *pilot point, n*—cylindrical point with a diameter somewhat smaller than the shank diameter, which aids alignment and starting during installation; see Fig. 27.

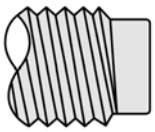

FIG. 27 Pilot Point

3.1.23.1 *Discussion*—Also called a "dog point" (applies normally to set screws).

3.1.24 *pinned head fastener, n*—hollow socket drive design enhancement in which a central pin is introduced into the design to render the fastener less prone to removal using makeshift tools by eliminating adequate bearing surface in which to exert force to the fastener; see Fig. 28.

3.1.24.1 *Discussion—Pinned Allen, pinned Torx,* and *pinned Torx Plus* are examples of such designs common to the detention and correctional industry.

FIG. 28 Pinned Head Fastener

3.1.25 *proof load, n*—amount of load a fastener can withstand before permanent plastic deformation will occur.

3.1.25.1 *Discussion*—See *yield strength.*

3.1.26 *pull out, n*—minimum force required to remove a fastener axially away from the parent material.

3.1.27 *pulling force, n*—axial force the tool applies during the installation of rivets.

3.1.28 *right-hand thread, n*—standard thread design; winds counter-clockwise in a receding direction; see Fig. 29.

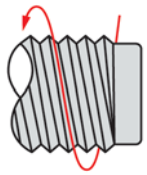

FIG. 29 Right-hand Thread

3.1.29 *Rockwell Hardness Test, n*—test designed to measure the hardness of the fastener based on an alphanumeric scale.

3.1.29.1 *Discussion*—The higher the number, the harder the fastener. Rockwell tests are used to test for decarburization and carburization and determine the amount of resistance to permanent deformation during the testing procedure. They also ensure that heat treating was performed to specification.

3.1.30 *screw, n*—externally threaded fastener that does not require a nut to secure the fastened joint.

3.1.31 *seating torque (recommended), n*—recommended value in inch-pounds or foot-pounds to which a particular threaded fastener should be tightened.

3.1.32 *shank, n*—portion of a fastener under the head; see Fig. 30.

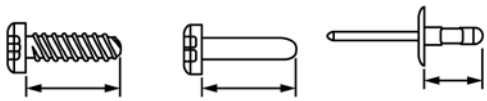

FIG. 30 Shank

3.1.33 *shear, n*—force that tends to divide an object along a plane parallel to the opposing stresses.

3.1.33.1 *Discussion*—Usually measured in lbf/in.^{2}, psi, MPa, or N/m^2.

3.1.34 *shear strength, n*—resistance to transverse loading. Maximum load that can be withstood prior to rupture when loads are applied normal to the fastener's axis.

3.1.34.1 *Discussion*—Usually defined as a force in Newtons (N) or foot-pounds (lbf).

3.1.35 *stem, n*—part of a break stem fastener that is retained within the body.

3.1.35.1 *Discussion*—Also known as the mandrel.

3.1.36 *stem retention, n*—force required to separate the stem from the body of an uninstalled break stem fastener.

3.1.37 *tensile strength, n*—amount of longitudinal load/elongation a fastener can withstand without failure of the fastener or joint.

3.1.37.1 *Discussion*—Measured in lbf/in.^{2}, psi, MPa, or N/m^2. See *ultimate tensile stress*.

3.1.38 *thermoset, n*—polymer characterized by extreme stiffness and undergoes a chemical change when heated. Once molded and cured "set" (hard and solid) the material cannot be melted and re-molded.

3.1.38.1 *Discussion*—Normally used on chemical set anchors.

3.1.39 *thread-cutting shank, n*—portion of a screw of bolt with longitudinal cut(s) in the tip of the threaded portion intended to cut or chase threads in untapped material or clean out threads in the nut or tapped receiver (most common use in this guide); see Fig. 31.

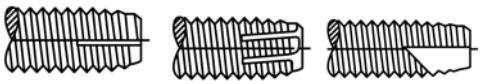

FIG. 31 Thread-cutting Shank

3.1.40 *thread engagement, n*—amount of thread tooth that is filled by the application material.

3.1.40.1 *Discussion*—This measurement is usually expressed as a percentage and is used to determine optimal hole size.

3.1.41 *threaded fastener, n*—any screw/bolt (external threads), nut (internal threads), or combination with machine/standard or engineered threads and does not include custom stamped or formed components with internal or external threads or both.

3.1.42 *threaded insert, n*—fastener that provides load-bearing threads in materials too thin or brittle to accept regular standard fasteners.

3.1.43 *through hardened, adv*—heat-treated fastener with uniform hardness from the surface to the core.

3.1.44 *torsion, n*—twisting force applied to a fastener.

3.1.45 *twist-off head, n*—head design that incorporates a weak shear plane whereby a torque limit is reached and the head shears off leaving a cone or bulb rendering the fastener non-removable; see Fig. 32.

FIG. 32 Twist-off Head

3.1.46 *ultimate tensile stress, n*—peak longitudinal load before rupture.

3.1.46.1 *Discussion*—Usually measured in lbf/in.^{2}, psi, MPa, or N/m^2.

3.1.47 *ultimate torque, n*—amount of force at which a threaded fastener begins to strip or otherwise fail in a joint or strip the threads of an insert or nut.

3.1.47.1 *Discussion*—For threaded inserts and clinch fasteners, it may also be referred to as supported torque.

3.1.48 *Unified Coarse Thread (UNC), n*—inch thread form (60°) standard defined by ANSI/ASME.

3.1.48.1 *Discussion*—Usually used in reference to machine screws. It is covered by ASME B1.1 and British Standard BS 1580.

3.1.49 *Unified Fine Threat, UNF, n*—imperial thread form standard defined by ANSI/AMSE.

3.1.49.1 *Discussion*—Usually used in reference to machine screws. It is covered by ASME B1.1 and British Standard BS 1580.

3.1.50 *washer face, n*—circular boss on the bearing surface of a cap screw or nut.

3.1.50.1 *Discussion*—The only bolt that has a washer face is the heavy hex structural bolt; see Fig. 33.

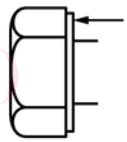

FIG. 33 Washer Face

3.1.51 *wedge anchor, n*—anchor designed for blind-hole installations that use a specially designed wedge or spade that, as the fastener is tightened, the wedge (usually a soft alloy) expands into the available space locking the fastener in place.

3.1.51.1 *Discussion*—Similar to expansion anchors.

3.1.52 *work hardening/cold working, v*—increase in metal hardness that is the result of forming processes such as elongation, rolling, heading, and so forth.

3.1.52.1 *Discussion*—This is particular pronounced in steels, copper, and aluminum alloys.

3.1.53 *yield strength, n*—measure of the resistance of material to plastic deformation. This relates to the point where a fastener will yield before it reaches a point it will not return to its original state.

3.1.53.1 *Discussion*—When a fastener is stretched, yield strength is the point at which the fastener will not return to its original length following testing. It is measured in terms of psi or MPa.

4. Significance and Use

4.1 This guide is intended to be informative in terms of the types and uses of security fasteners in detention and corrections facilities. Useful information related to products and types of fasteners, materials in which fasteners are fabricated and other technical information that will give owners, architects, and end