

## ANCHOR BOLT

A steel rod or bar with one end intended to be embedded in concrete and the other end threaded and projected for anchoring material to concrete. The end cast in concrete may be straight, bent hook, a forged head, or welded attachment to resist forces imposed on the anchor bolt.

## ANNEALING (การอบคลาย)

การอบคลาย (Annealing) มีความมุ่งหมายเพื่อต้องการให้เหล็กอ่อนตัวลง (softening) หรือเพื่อ ทำให้เหล็กเหนียวขึ้น (Toughening) ส่วนใหญ่เหล็ก ที่ผ่านการขึ้นรูปเย็น (cold working) หรือการหล่อมา มักจะมีความแข็งเพิ่มขึ้นและไม่สม่ำเสมอ ทำให้เกิดการกลึงหรือไสยาก ดังนั้นจึงจำเป็นต้องทำลายความแข็งของเหล็กเพื่อจะได้กลึงหรือไสได้สะดวก

Describes the process of heating and cooling steel to soften hardness caused by manufacturing or previous heat treating.

## ASTM

American Society for Testing and Materials: is a leading standards development organization. Portland Bolt participates as a voting member on ASTM Committee F16 on Fasteners. This committee has jurisdiction on over 60 fastener standards.

## AVERAGE COATING THICKNESS

This is 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.

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## BAR

This describes carbon and alloy steel bar that is produced from hot rolled or cast billets with the cross sectional dimensions that have a relatively constant dimension.

## BEARING-TYPE CONNECTION

A bolted connection that assumes that shear forces are transmitted by the bolt bearing against the sides of the holes in the connected material. Often denote on drawings with an “X” (i.e. A325-X) which excludes threads from the shear plane or “N” (i.e. A325-N) which includes threads in the shear plane.

## BEND TEST

This test is meant to determine the toughness or ductility of a fastener. It is usually performed by bending the fastener through its axis or on a round mandrel.

## BOLT

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

## BRINELL HARDNESS TESTING

This is a common method of determining the hardness of metal products. A test is conducted by forcing a carbide ball indenter into the surface of the test specimen. The resulting indentation is measured and the brinell hardness number is calculated by using a formula that divides the test force by the indentation. Standards for this test are defined under ASTM E10.

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## CAP SCREW

A fastener manufactured by cold forming, with tighter dimensional tolerances than a hot forged bolt.

## CARBON STEEL (เหล็กกล้าคาร์บอน)

A metal alloy that principle elements are carbon and iron. Contains other trace elements in undetectable amounts.

เหล็กกล้าคาร์บอน (Carbon Steel) มีคุณสมบัติเด่นคือ สามารถชุบเพิ่มความแข็ง (hardness) หรือเปลี่ยนคุณสมบัติทางกายภาพอื่นๆ ได้ เหล็กกล้าที่มีปริมาณคาร์บอนต่ำจะเพิ่มหรือลดความแข็งได้ไม่ดีเท่ากับเหล็กกล้าที่มีปริมาณคาร์บอนสูง เหล็กกล้าคาร์บอนแบ่งได้เป็น 3 ชนิด คือ

1. เหล็กกล้าคาร์บอนต่ำ (Low Carbon Steel) เป็นเหล็กเหนียวแต่ไม่แข็งแรงนัก สามารถนำไปกลึง กัด ไส เจาะได้ง่าย เนื่องจากเป็นเหล็กที่อ่อน สามารถรีดหรือตีเป็นแผ่นได้ง่าย เหมาะกับงานที่ไม่ต้องการความเค้นแรงถึงสูงนัก ไม่สามารถนำมาชุบแข็งได้ แต่ถ้าต้องการชุบแข็งต้องใช้วิธีเติมคาร์บอนที่ผิวก่อน เพราะมีคาร์บอนน้อย (ไม่เกิน 0.2%) ตัวอย่างการใช้งาน เช่น เหล็กแผ่นหม้อน้ำ ท่อน้ำประปา เหล็กเส้นในอุตสาหกรรมก่อสร้าง เหล็กเคลือบดีบุก เช่นกระป๋องบรรจุอาหาร เหล็กอบสังกะสี เช่น แผ่นสังกะสีมุงหลังคา ทำตัวถังรถยนต์ ถังน้ำมัน งานย้ำหมุด ทำสกรู ลวด สลักเกลียว ชิ้นส่วนอะไหล่ เครื่องจักร ไซ้ บานพับประตู

2. เหล็กกล้าคาร์บอนปานกลาง (Medium Carbon Steel) เป็นเหล็กที่มีความแข็งแรงและความเค้นแรงถึงมากกว่าเหล็กกล้าคาร์บอนต่ำ แต่มีความเหนียวน้อยกว่า นอกจากนี้ยังให้คุณภาพในการแปรรูปที่ดีกว่าและยังสามารถนำไปชุบผิวแข็งได้ เหมาะกับงานที่ต้องการความเค้น ถึงปานกลาง ต้องการป้องกันการสึกหรอที่ผิวหน้า และต้องการความแข็งแรง แต่มีความแข็งบ้างพอสมควร เช่น ทำชิ้นส่วนเครื่องจักรกล ทำรางรถไฟ เพลารถือรถ เพือง หัวค้อน ก้านสูบ สปริง ชิ้นส่วนรถโกนา ไชคอง ท่อเหล็ก นอต สกรูที่ต้องการแข็งแรง

3. เหล็กกล้าคาร์บอนสูง (High Carbon Steel) เป็นเหล็กมีความแข็งแรง และทนความเค้นแรงถึงสูง มีเปอร์เซ็นต์คาร์บอน 0.5-1.5% สามารถทำการชุบแข็งได้แต่จะเปราะ เหมาะสำหรับ งานที่ต้องการความต้านทานต่อการสึกหล่อ เช่น ดอกสว่าน สกัด นรสิโร มัดคล้อง ใบเลื่อยตัดเหล็ก ดอกทำเกลียว (Tap) ใบมีดโกน ตะไบ แผ่นเกจ เหล็กกัด สปริงแหนบ ลูกบอล แบร็ริงลูกปืน

## CERTIFICATION

A procedure and action to verify in writing a process or material meets a set of applicable standards. This helps ensure consist products for both manufacturer and end users.

## CLAMP LOAD

Also called initial load or preload, is created when tension is applied on a bolt and results in equal force and measures of the compression of two parts. It is commonly calculated as 75% of minimum proof load.

## COLD FORMING

Processing material by forcing metal through various dies, below the recrystallization temperature. Most mass produced fasteners use this technique and require large production runs with long lead times.

## COMPRESSION LOAD

The load which tends to compress or shorten the member. The value for compressive strength may depend upon the degree of distortion.

## CORROSION RESISTANCE

This describes the ability of a fastener to resist corrosion under specified conditions. Hot dip galvanizing is a cost effective way to provide a high level of corrosion protection for a variety of applications and environmental conditions.

## CUT THREAD

A threading method produced by removing material from the surface with a form cutting tool.

## CADMIUM ELECTROPLATING

Coating of threaded fasteners with cadmium can provide the parts with excellent corrosion resistance. The appearance of the coating is bright silver or yellow if subsequently passivated. The friction values associated with this coating are also comparatively low. A chromate conversion coating is frequently applied to the surface to improve corrosion resistance. Cadmium is not now frequently used because of the environmental and worker health problems associated with the coating process and should not be used in applications above 250C or when contact with food is possible.

## CLAMPING FORCE

The compressive force which a fastener exerts on the joint.

## CLASS OF FIT

The Class of Fit is a measure of the degree of fit between mating internal and external threads. Three main Classes of Fit are defined for metric screw threads :

**FINE:** This has a tolerance class of 5H for internal threads and 4h for external threads.

**MEDIUM:** This has a tolerance class of 6H for internal threads and 6g for external threads.

**COARSE:** This has a tolerance class of 7H for internal threads and 8g for external threads.

For Unified threads, a similar designation as for metric threads is used. The thread classes used are 1A, 2A and 3A for external threads and 1B, 2B and 3B for internal threads.

## CLEVELOC NUT

A torque prevailing nut of all metal construction. The collar of the nut is elliptical in cross section and it is this that provides the flexible locking element. The nut is pre-lubricated to reduce the tightening torque. Cleveloc is a registered trade name of Forest Fasteners.

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## COEFFICIENT OF FRICTION

A dimensionless number representing the ratio of the friction force to normal force. Typically for threaded connections it is between 0.10 to 0,18 but can vary significantly depending upon the materials used and whether a lubricant has been used.

## COMMINGLING

A term used to describe the undesirable practice of mixing fasteners from different batches that are the same size and grade in the same container.

## CONE PROOF LOAD

This is an axial applied force applied to a nut when it is seated on a cone shaped washer which has an included angle of 120 degrees. Failure in this test is usually due to the nut splitting. The intention of the test is to introduce a nut dilation operation which will assess the potential detrimental effects of surface discontinuities. This type of test is sometimes applied to nuts which are intended for high temperature service.

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## DESTRUCTIVE TEST

A test to determine the mechanical properties of a material or the behavior of an item which results in the destruction of the sample or item.

## DUCTILITY (EXTERNALLY THREADED FASTENERS)

The measure of a fastener's ability to deform prior to the point of fracturing. Machined test pieces are made to evaluate the metal's elongation and reduction of area. The lower the ratio of its specified minimum yield strength to its specified minimum tensile strength, the greater the fastener's ductility.

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## ELONGATION

Measures the change in length based on a percentage of the original size.

## EXENSOMETER

This device measures the linear deformation of a fastener to sense the elongation under tensile stress in a controlled test environment.

## EYE BOLT

A bolt having one end which is a closed or open ring with a threaded shank.

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## FASTENER

A mechanical device that holds or joins two or more components in definite positions with respect to each other and is often described as a bolt, nut, rivet, screw, washer, or special formed part.

## FASTENER IDENTIFICATION MARKING

A stamp, paint, or other permanent identifier that may include manufacturer information and applicable grade markings for certification purposes.

## FASTENER QUALITY

A fastener's adherence to its specification for dimensional tolerances, mechanical properties, and other requirements stated under applicable standards.

## FASTENER SPECIFICATION

A precise statement of set requirements to be satisfied by a fastener, its material, or its processing. It also indicates the procedure used to determine whether the requirements given are satisfied. This would include specifications like ASTM A194, A449, F1554 and SAE Grade 2.

## FASTENER STANDARD

A document which details the attributes of a finished fastener and includes such characteristics as geometry, material or chemistry, heat treatment, finish, testing lot size, and packaging. Examples would include organization like: Industrial Fastener Institute (IFI) and American National Standards Institute (ANSI).

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## FASTENER TESTING

A determination or verification that the fastener meets its specification requirements.

## FORGING

The process of forming raw steel into specified shapes. Some examples of forged products would be hex bolts, clevises, and barrier pins.

## FORGING CRACKS

This may occur during fastener manufacturing at the cutting or forging operations and are located on the top of the head or on the raised periphery of indented head bolts.

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## GALLING

This can happen when a stainless steel fastener is tightened; the thin oxide layer on the surface of the steel may scrape off resulting in the nut and washer welding together. When disassembled, the welded material may be torn and pitted.

## GIMLET POINT

A term that describes a cone point that is threaded completely along the 45 to 50 degree point and is commonly found on lag screws.

## GRADE IDENTIFICATION SYMBOLS

Permanent markings denoting the specification used to manufacture a fastener. This would indicate the appropriate material, mechanical properties and other criteria used to produce the bolt.

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## HEAT ANALYSIS

A chemical analysis of a given heat by the producer, which determines the percentages of its elements.

## HEAT RESISTANCE

This describes the extent to which a bolt retains specified properties as measured by exposure of the material to a certain temperature and environment for a specified time.

## HEX BOLT

This refers to a bolt made to ANSI B18.2.1 and has different tolerances than hex cap screw.

## HIGH STRENGTH BOLTS

A term which is used commercially to denote ASTM A325 or A490 bolts which are primarily used in construction applications.

## HIGH TEMPERATURE BOLTS

Bolts specifically manufactured from high temperature alloys to maintain tensile loads at temperatures between 500°F and 1800°F. Refer to ASTM A193 for more information.

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## HOT-DIP GALVANIZING

The process of the immersion of fasteners in a bath of molten zinc for a controlled time period to obtain specified coating weight or thickness. This is a cost effective method for creating highly corrosive resistant steel products.

## HYDROGEN EMBRITTLEMENT

The process by which high strength steel becomes brittle and fractures following absorption of hydrogen. There is a danger of this occurring when attempting to zinc coat high strength bolts (e.g. ASTM A490, ASTM A354 BD). This can occur during the acid washing process prior to galvanizing.

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## MACHINED SPECIMEN

This is a test specimen machined from a full-size fastener to specific dimensions to standardize test results; often specified when a full-size fastener cannot be reasonably or practically tested. This test is used to determine elongation and reduction of area.

## MATERIAL TEST REPORT

A document verifying the raw material meets specified requirements and includes results of mechanical tests and chemical analyses.

## MECHANICALLY GALVANIZED

Describes a coating technique of applying cold zinc powder to bolts by either cold welding or barrel finishing.

## MECHANICAL PROPERTIES

The fastener characteristics which relate to its reaction to applied loads; these properties may be those of the basic raw material or result from the manufacturing process.

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## NUT

An internally threaded product intended for use on external or male screw threads such as a bolt or a stud for the purpose of tightening or assembling two or more components.

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## PASSIVATION

The process of forming an oxide film on the surface of stainless steel by chemical treatment to improve corrosion resistance of stainless steel fasteners. This process is usually done after the steel has been subjected to thermal treatment (i.e. hot forging).

## PICKLE

The process of removing surface oxides by chemical means.

## PLAIN

Describes a fastener that is free of additional coatings or finishes like zinc, hot-dip galvanizing, or paint. Also referred to as "black."

## PROOF LOAD (EXTERNALLY THREADED FASTENER)

The tension applied load that a fastener must withstand without any indication of permanent deformation or failure. Proof load is typically calculated at 90–93% of the minimum yield strength.

## PROOF LOAD (INTERNALLY THREADED FASTENER)

The axially-applied load using a bolt or threaded mandrel that must be supported by a nut without indication of thread stripping or failure.

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## PROOF STRESS LOAD

The proof stress is the amount of stress (on a stress –strain curve) where a material will exceed the elastic/plastic limit. In other words, it begins to get a permanent set on further stressing. The 0.2% is the offset from the normal stress/strain curve ( a line drawn parallel to the normal curve – offset 0.2% of strain).

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## QUENCH

The process during heat treatment of submerging steel in a liquid medium to rapidly cool it, typically in water or oil.

## QUENCH CRACKS

Surface discontinuities in an irregular or erratic pattern on the surface of the fastener which may occur because of excessive thermal or transformation stresses during fastener heat treatment.

## REDUCED DIAMETER BODY

A fastener having a body diameter not less than the minimum pitch diameter of its thread nor more than its minimum full body diameter.

## REDUCTION OF AREA

The difference between the original cross sectional area of a tensile test specimen and its minimum cross section after the test sample has fractured.

## ROLL THREAD

The threading method that uses dies to displace rather than remove material in order to create threads. Often used in conjunction with reduced diameter body.

## ROTATIONAL CAPACITY TEST “ROCAP”

A test in which a bolt is assembled in a steel joint or tension measuring device with a lubricated nut, and tightened to not less than 10% of the bolt proof load. After initial tightening, the nut is rotated through specified degrees of rotation, and torque values are obtained to assure proper performance.

## SAE

Society of Automotive Engineers specification's cover fasteners typically used in automotive, equipment, and machinery applications.

## SCREW

A mechanical fastener designed to thread by turning the head into a tapped hole or to form its own threads during installation.

## SHEAR STRENGTH

A maximum load applied to a fastener's axis that can be withstood prior to failure.

## SHEAR STRESS AREA

An area perpendicular to the fastener axis which is based on the root diameter (minor diameter) of an externally threaded bolt or screw.

## SLIP-CRITICAL CONNECTION

The high-strength bolt clamps the connected parts in such a way that the shearing force is resisted by the friction between the parts, not by the shear on the body of the bolts. This is often denoted on drawings as "SC" (i.e. A325-SC).

## STAINLESS STEEL

A steel which has as its primary alloying element, chromium ranging from 10% to 30%. Other alloying elements such as nickel and molybdenum may also be added.

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## STRAIN HARDENING

An increase in strength and hardness resulting from the cold working of steel. This is also referred to as work hardening.

## STRESS RELIEF ANNEALING

A heating process applied to forged/headed fasteners to relieve any mechanical stresses generated during the forming process.

## STRUCTURAL BOLT

A heavy hex head bolt intended for use in structural applications. Most commonly graded as ASTM A325 or A490.

## SURFACE DISCONTINUITIES

Irregularities of a fastener. These may include cracks, head bursts, shear bursts, seams, folds, thread laps, voids, tool marks, and nicks or gouges.

## TAP BOLT

A bolt that is threaded to the under the head. ANSI compliant tap bolts are made to the same tolerances as hex cap screws.

## TENSILE STRENGTH

The maximum tensile-applied load a fastener can hold prior to fracture.

## TEST REPORT

A written or electronic document provided by the authorized party to certify that a tested fastener's chemical and mechanical properties conform to the specification required.

## THREAD GALLING

The displacement of material between mating threads during tightening, which causes contact points to shear, producing friction, increased resistance to tightening, and even seizing of the threads. Thread galling is most common with fasteners made of materials that self-generate an oxide surface film such as stainless steel.

## TIE ROD

A piece of steel typically threaded on each end used in an assembly with clevises and turnbuckles, often used to support canopies, awnings and other building structures.

## TRACEABILITY

The capability to authenticate manufacturing history by documentation of raw material, heat number, locations, or application of the product.

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## ULTIMATE TENSILE LOAD

The maximum tensile-applied load a fastener can support prior to fracture, and normally expressed in terms of pounds per square inch (psi) or pounds-force (lbf).

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