

10.9
USA



Earnest

EMP
170M

EMP
307A

FASTENER CONCEPTS

Head Markings for Bolts and Screws Explained

E8
USA

E8
H₂O

NAS310-4

150M PSI
E8

A325

EMP
8

E5

307B

10.9

170M
EMP
PSI

E8

E8.8

Head Markings for Bolts and Screws Explained

In the fastener industry, there are multiple organizations that specify the strength and marking requirements for inch (also known as imperial) and metric sizes of fasteners that are commonly sold in the U.S. and around the world.

When you are dealing with inch-size fasteners, commercially sold in the U.S., there are three main standards organizations that specify the material, hardness, strength level, and the head marking requirements for steel and alloy steel fasteners. Those standards organizations are:

- SAE (Society of Automotive Engineers)
- ASTM (American Society of Testing and Materials)
- Military Specs (commonly called Mil-Spec or Aircraft standards)

All three of these standards organizations include a marking that is designed to identify the strength of the fastener and require a manufacturer's identification marking to be included on the fastener. In the U.S., we have a Fastener Quality Act (FQA) that requires heat-treated and grade-marked fasteners to be marked with a manufacturer's marking that has been registered with NIST (National Institute of Standards and Technology) if it is to be sold in the U.S. The markings E5, E8, and EMP have all been registered by Earnest Machine Products for use on our inch-size fasteners.

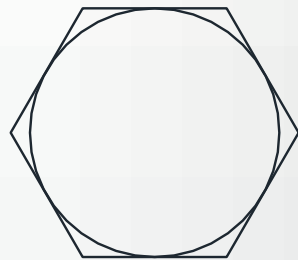
The term Grade is the word we use to identify the material, hardness, and strength level for inch-size fasteners. The purpose of the grade marking is to identify the strength level that the fastener has been manufactured to, and the manufacturer's marking is to identify who is responsible for the quality and testing of the fastener.

SAE Grades

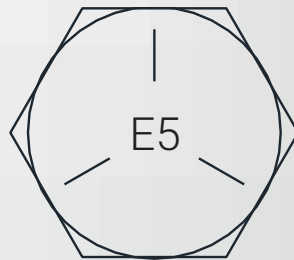
The SAE grade designations are the most common grades of fasteners sold in the U.S. Fasteners made to the SAE grades are used in the manufacture of equipment that moves, such as cars, trucks, buses, trains, agricultural, construction, and mining equipment.

The SAE specification that defines the material, hardness, and strength level of steel and alloy steel fasteners (SAE J429) specifies multiple strength levels and typically deals with diameters between 1/4" and 1-1/2". The three main strength levels that are used within our industry are Grade 2 (low strength), Grade 5 (medium strength), and Grade 8 (high strength).

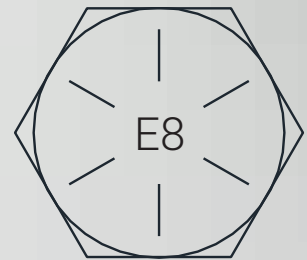
SAE Markings:



Grade 2



Grade 5



Grade 8

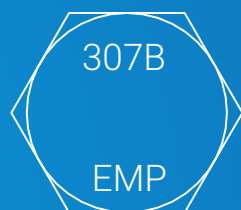
Grade Marking	No marking required	3 Radial Lines	6 Radial Lines
Tensile Strength (min)	74,000 psi*	120,000 psi*	150,000 psi*
Hardness	HRB 70/100	HRC 25/34	HRC 33/39
Material	Low Carbon Steel	Medium Carbon Steel	Alloy Steel

*Tensile strengths can vary depending on diameter, length, and head style.

ASTM Grades

The ASTM grades are more commonly used in structural applications (buildings, warehouses, bridges, cell towers) but are also used in construction and transportation applications when a heavy hex or diameters above 1-1/2" are specified. ASTM grades are commonly referred to as structural grade bolts because of their use in the construction of buildings.

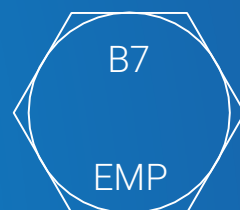
Structural Heavy Hex Markings:



A307 Grade B



A325



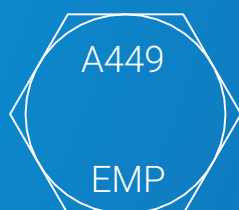
A193 Grade B7



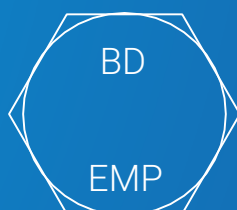
A490

Grade Marking	307B	A325	B7	A490
Tensile Strength (min)	60,000 psi	120,000 psi*	125,000 psi	150,000 psi
Hardness	HRB 69/100	HRC 25/34	HRC 35 max	HRC 33/39
Material	Low Carbon Steel	Medium Carbon Steel	Alloy Steel	Alloy Steel

Structural Regular Hex Markings:



A449



A354 Grade BD

Grade Marking	A449	BD
Tensile Strength (min)	125,000 psi*	150,000 psi*
Hardness	HRC 25/34	HRC 33/39
Material	Alloy Steel	Alloy Steel

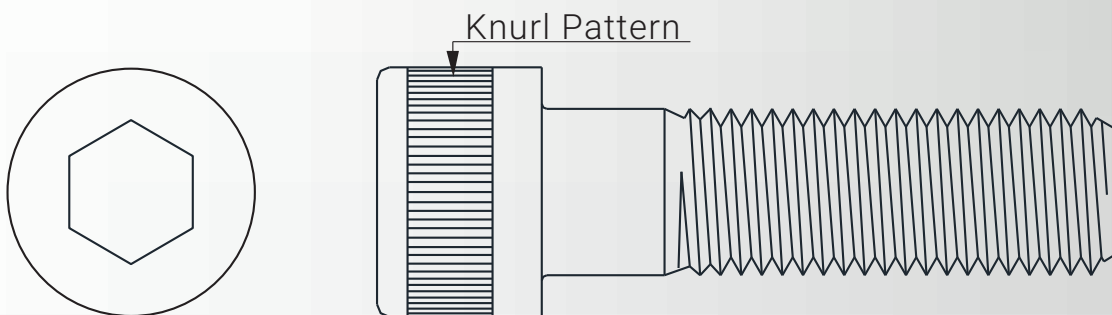
*Tensile strengths can vary depending on diameter, length, and head style.

Socket Head Cap Screws

Socket head cap screws, in inch sizes, are also made to ASTM material, hardness, and strength requirements. Socket heads are used in the manufacture of stationary equipment that is typically bolted or anchored to the ground (stamping presses, plastic injection molding machines, assembly line fixtures, and CNC machinery).

However, socket heads do not come in various strength levels like hex head bolts. Standard socket heads are made to the requirements of ASTM A574 and are often marketed and sold under the designation "alloy steel." ASTM A574 does not require a grade or manufacturer's marking. Socket manufacturers will often create a distinctive knurl pattern on the side of the head to make them unique and identifiable to their company.

Socket Head Cap Screw Markings:



Grade Marking

Tensile Strength (min)

Hardness

Material

Sizes up to 1/2"

No marking required

180,000 psi

HRC 39/44

Alloy Steel

Sizes over 1/2"

No marking required

170,000 psi

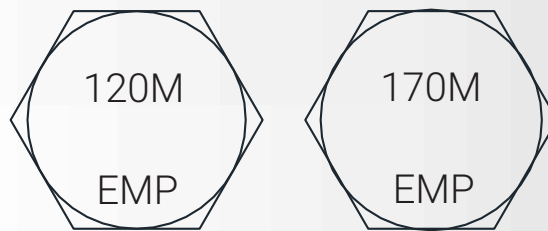
HRC 37/44

Alloy Steel

Special Grades

Earnest also utilizes our own special markings for product that is manufactured to special strength levels or heat-treat requirements per our own procurement standards.

Special Grade Markings:



Grade Marking	120M	170M
Tensile Strength (min)	120,000 psi	170,000 psi
Hardness (core)	HRC 25/34	HRC 37/42
Material	Carbon Steel	Alloy Steel

Mil-Spec or Aircraft Grades

Military standards is another standards organization that specifies the material, hardness, and strength of inch-size fasteners. As the name implies, Mil-Spec fasteners are commonly specified by the U.S. government for military and Department of Defense applications but are also used in a wide variety of government applications. Mil-Spec fasteners can be made to SAE or ASTM strength and marking designations, but they also include some of their own uniquely marked fasteners for specific applications or industries.

Mil-Spec or Aircraft Markings:



Metric Fasteners

When you are dealing with metric sizes of fasteners, the standards organization ISO (International Standards Organization) is the main organization that specifies the material, hardness, and strength for metric fasteners. The main three U.S. standards groups (SAE, ASTM, and Mil-Spec) also include standards for metric size fasteners, but all of these organizations have consolidated their specs to be uniform in the requirements for the main strength levels that metric steel and alloy steel fasteners are made to.

When dealing with metric fasteners, we use the term Property Class to define the material, hardness, and strength (instead of the word grade that is used to describe inch fasteners). Unlike the inch strength level marking requirements of arbitrarily using lines or a combination of letters and numbers on the head, the metric strength level or Property Class marking has a specific meaning. The first number listed is the strength in megapascals and the second number (after the dot) identifies the yield strength of the material that was used to make the fastener.

Metric fasteners also fall under the requirement of the U.S. FQA and heat-treated sizes are required to be marked with a manufacturer's marking that is registered for sale in the U.S.

There are four main strength levels that are used in the industry for metric fasteners: Property Class 4.6 (low strength), Property Class 8.8 (medium strength), Property Class 10.9 (high strength), and Property Class 12.9 (extra high strength).

Metric Fasteners (cont.)

Metric Fastener Markings:



Property Class 4.6



Property Class 8.8



Property Class 10.9



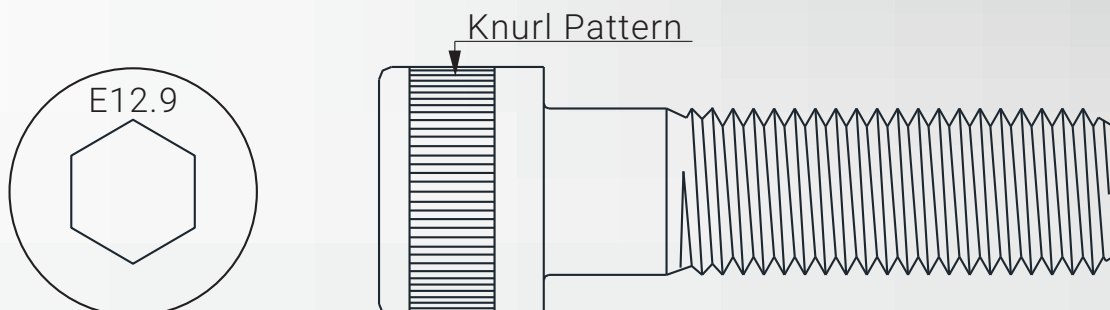
Property Class 12.9

Class Marking	4.6	8.8	10.9	12.9
Tensile Strength (min)	400 MPa	800/830 MPa	1040 MPa	1220 MPa
Hardness	HRB 71/995	HRC 22/34	HRC 32/39	HRC 39/44
Material	Low Carbon Steel	Medium Carbon Steel	Alloy Steel	Alloy Steel

Metric Socket Head Cap Screws

Metric socket head cap screws are offered in more than one strength level (unlike inch sizes that only come in one strength level). Metric socket heads are most commonly stocked in the Property Class 12.9 strength level and require a manufacturer's marking.

Metric Socket Head Cap Screw Markings:



Summary of this Technical Bulletin

The term Grade (used when referring to inch products) and the term Property Class (used when referring to metric products) are the words used within our industry to identify the material, hardness, and strength level for fasteners.

The standards organizations that specify the material, hardness, strength level, and the head marking requirements for steel and alloy steel fasteners are:

- SAE (Society of Automotive Engineers)
- ASTM (American Society of Testing and Materials)
- Military Specs (commonly called Mil-Spec or Aircraft standards)
- ISO (International Standards Organization)

Generally speaking, if a fastener has:

- Lines on the head, it's an inch fastener made to an SAE Grade
- Letters and numbers on the head, it's a structural fastener made to an ASTM Spec
- Numbers on the head, it's a metric fastener made to ISO Property Classes

For questions on the material used, hardness level, strength level, or fastener head markings, please contact us at:



+1 (800) 327-6378
inquiry@earnestmachine.com



+44 (0) 1902 711041
ukenquiry@earnestmachine.com