Fastener Materials and Finishes

MATERIALS

Steel

Alloy Steel—Contains enough alloying elements (other than carbon) to affect properties such as tensile strength; generally more responsive to heat and mechanical treatments than plain carbon steels. Classified by Grade (for SAE) or Property Class (for metric):

- Grade 1/Property Class 4.6—Low strength
- Grade 5/Property Class 8.8—Medium strength
- Grade 8/Property Class 10.9—High-strength alloy steel
- Grade 9/Property Class 12.9—High-strength alloy steel

Blue Tempered Steel—Used in tool and die fields for templates and shim applications where toughness and high fatigue strength are required. Made from high carbon 1095 hardened and tempered spring steel.

Carbon Steel (or Plain Steel)—Contains only carbon and residual amounts of any other elements. It is magnetic and malleable and can be cast, wrought, or forged.

- 1018 Steel is a low carbon steel with higher manganese content, higher mechanical properties, and better machining characteristics than other low carbon steels (such as AISI 1020)
- Low Carbon Steel, also called Mild Steel, contains 0.10% to 0.25% carbon content and has the same properties as iron
- Medium Carbon Steel contains 0.25% to 0.45% carbon content, which gives it superior ductility and durability under stress
- High Carbon Steel, often simply referred to as plain steel, contains only carbon and residual amounts of any other impurities. It is magnetic and malleable and can be cast or wrought. High carbon content makes material harder and more brittle

Chrome-Vanadium—Medium carbon steel contains chromium and vanadium for increased hardness and tensile strength. The preferred steel for springs requiring heavy use and highly repetitive operating cycles

Free-Cutting Steel—A higher sulfur content makes this low-to-medium carbon steel very easy to machine. Mechanical properties increase with increasing carbon concentration.

Spring Steel—A high carbon or alloy steel used in the manufacture of springs or where high tensile properties are required.

Stainless Steel

Contains a minimum 12% chromium for the ability to withstand corrosion and extreme environments. Not affected by scratching, but not as strong as common alloy steels. May be mildly magnetic.

17-7 PH Stainless Steel—Precipitation hardened for high strength and hardness. Excellent fatigue properties, good formability, minimum distortion upon heat treatment, and good corrosion resistance. Excellent for flat springs at temperatures up to 600°F.

18-8 Stainless Steel—Contains approximately 18% chromium and 8% nickel. Provides excellent protection against rust and corrosion. Can be used with ACQ treated wood and is the material of choice for prolonged outdoor use. Comparable to AISI 300 Series and ISO A2.

301 Stainless Steel—A highly ductile stainless steel; ideal for forming. Good wear resistance and fatigue strength.

302 Stainless Steel—Has excellent strength properties and toughness at extremely low temperatures.

303 Stainles Steel—Used interchangeably with 18-8 stainless steel, which provides excellent protection against rust and corrosion during prolonged exposure to salt spray and chemical fumes. May be mildly magnetic.

304 Stainless Steel—The most widely used stainless steel. Has good resistance to high temperatures and corrosion.

316 Stainless Steel—Contains a minimum of 2% molybdenum for superior corrosion resistance and reduced risk of pitting in extreme environments. Nonmagnetic. Cannot be heat treated or hardened. Comparable to ISO A4.

410 Stainless Steel—Low-cost, general-purpose stainless steel contains the lowest alloy content of the basic stainless steels. Typical applications include highly stressed parts where corrosion is not severe.

416 Stainless Steel—Stronger and harder than 18-8 stainless steel, but not as corrosion-resistant. Magnetic.

420 Stainless Steel—Offers good shear strength.

Other Metals

Aluminum—Corrosion- and moisture-resistant material provides the strength of mild steel at only one-third the weight. Excellent for outdoor use. Nonmagnetic.

Brass—Copper-zinc alloy resists rust and moderate atmospheric corrosion. Not high in strength, but is durable and conducts electricity. Often used for appearance. Nonmagnetic.

Copper (#110)—Corrosion-resistant copper alloy has high thermal and electrical conductivity. Utilized for surface appearance, strength, and fatigue resistance. Very ductile and easy to fabricate. Magnetic.

Iron—A ferrous metal that exhibits considerable ductility and toughness.

Lead—Strong yet pliable material that can be molded to fill a space. Lead is not affected by chemicals or moisture.

Nickel Copper Alloy—Corrosion-resistant alloy has excellent thermal conductivity, but slightly decreased electrical conductivity compared to copper. Strong and fatigue-resistant.

Silicon Bronze—Copper-tin alloy has higher strength and hardness than brass; silicon is diffused into the metal at an elevated temperature. Exhibits good ductility and high resistance to repeated stresses, corrosion, and fatigue.

Nonmetallic

Nylon—Used extensively in electronics applications. Nonconductive, durable, and ductile material resists heat, corrosion, and nonacidic chemicals. Has excellent insulating properties, but dimensions can be affected by moisture absorption.

Synthetic Rubber—Used for applications requiring water resistance. Types include EPDM and Neoprene.

Thermoplastic—Types include acetal, Kapton™, phenolic, polycarbonate, UHMW polyethylene, polypropylene, and PVC (polyvinyl chloride).

FINISHES

Black Oxide—Chemically induced, uniform black conversion coating for steel won't chip or rub off. Not for outdoor use or corrosive environments.

Black Phosphate—Diluted phosphoric acid treatment forms a protective layer of crystalline phosphate that extends plain carbon steel shelf life and protects against rust.

Ceramic Coating—A hard, brittle, porcelain-like coating produced from nonmetallic minerals by firing at high temperatures.

Chrome Plating—Decorative, mirror-like coating is used for aftermarket decoration and provides no additional protection to the base material.

Furnace Black—A coating of carbon powder produced by incomplete combustion of liquids or gases at high temperatures.

Galvanized—A metallurgical bonding of corrosion-resistant zinc-iron alloy to a steel surface by cold welding zinc powder to the steel.

Hot Dipped Galvanized—Molten zinc dip provides heavier coating to protect steel from corrosion in harsh environments.

Passivated—An oxidizing solution such as nitric acid is applied to the surface to remove foreign substances and strengthen the fastener's normal protective film. Helps stainless steel surfaces resist corrosion.

Phosphate and Oil—Applied to locknuts for added corrosion resistance. The oil serves as a rust inhibitor and lubricant.

Plain—The finish on "as produced" carbon steel. An oil residue provides shelf-life but no corrosion protection.

Ultra Coat—Provides better corrosion resistance than zinc, hot dipped galvanized, or cadmium plating.

Yellow Zinc Dichromate—Chemical dip reduces oxidation and provides good-to-excellent corrosion resistance.

Zinc, Cadmium, or Nickel Plating—Thin coating is applied mechanically or by electroplating. Provides corrosion resistance and moderate protection against rust.