Fasteners are manufactured from a variety of materials such as steel, stainless steel, aluminum, brass, bronze, copper, nickel, titanium and other non ferrous metals, plastics and exotic materials. Material selection should be based on considerations such as – strength required, stresses, corrosive environment, weight, magnetic properties, electrical conductivity, coatings / platings required, reusability and expected life.

Over 90% of fasteners are made from steel because of its inherent strength properties, excellent workability and relative cheapness as compared to other materials. Steel that is used to manufacture fasteners falls into 3 types – low carbon, medium carbon and alloy steel.

**Low Carbon Steel** generally contains less than 0.25% carbon. It has outstanding ductility and toughness, is easily machined and welded and is relatively inexpensive to produce. It has a tensile strength of between 60,000 psi to 80,000 psi.

SAE Grade 2 (Metric class 4.6, 4.8 & 5.8) fasteners are generally made out of low carbon steel with AISI grades 1006, 1010, 1016, 1018, 1022 & 1035 falling into this category.

**Medium Carbon Steel** has a carbon content of between 0.25% to 0.60%. It is easily heat treated and has a tensile strength of between 100,000 psi to 120,000 psi.

SAE Grade 5 (Metric class 8.8) fasteners are generally made out of medium carbon steel with AISI grades 1038, 1541, 5132 & 5135 falling into this category.

**Alloy Steel** is carbon steel that has additives eg. boron, manganese, chromium, silicon etc. Additions of these elements improve the capacity of the alloys to be heat-treated, giving rise to a wide variety of strength to ductility combinations. Alloy steels have a tensile strength in excess of 150,000 psi.

SAE Grade 8 (Metric class 10.9, 12.9) fasteners are generally manufactured out of alloy steels with AISI grades 4137, 4140, 4340 & 5140 falling into this category.

**Stainless Steels** are alloy steels that have a minimum of 10.5 % chromium content. The presence of chromium creates an invisible surface film (chromium oxide) that resists oxidation and makes the metal “passive” or corrosion resistant. If the surface layer is damaged, it rebuilds itself (self-repairs) in the presence of oxygen. It is very important to understand this self-healing process because stainless steel when used in a low-oxygen or oxygen-free surrounding, is susceptible to aggressive influences, if the protective surface layer gets damaged.

Stainless Steels are divided into 3 classes - Austenitic, Martensitic and Ferritic.

**Austenitic Stainless Steel** have a chromium content of between 15% to 20% and nickel of between 5% to 19% and offers a higher degree of corrosion resistance than the other two types of stainless steels. The tensile strength of austenitic stainless steel varies between 72,000 psi to 115,000 psi. 18-8 stainless steel is a type of austenitic stainless steel that contains approximately 18% chromium and 8% nickel. This category includes AISI grades 302, 303, 304, 304L, 316, 321, 347 & 348.

**Martensitic Stainless Steel** contain between 12% to 18% chromium, can be hardened by heat treatment, have poor welding characteristics and are considered magnetic. The tensile strength of Martensitic stainless steel varies between 72,000 psi & 160,000 psi. This type of stainless steel should only be used in mild corrosive environments. Martensitic stainless steels include AISI grades 410, 416, 420 & 431.

**Ferritic Stainless Steel** contain between 15% to 18% chromium and is a non heat-treatable, magnetic and has very poor weld characteristics. The tensile strength of ferritic stainless steel is about 65,000 psi to 87,000. It should not be used in situations where the likelihood of corrosion is high and includes grades 430 & 430F.

**Aluminum** is a lightweight metal that has a high strength to weight ratio, good corrosion resistance in most environments, excellent electrical and thermal conductivity, is easily cold formed or hot forged and easily machinable. This is why aluminum is the most popular choice for fasteners amongst non ferrous metals. The tensile strength of aluminum is between 13,000 psi for pure aluminum up to 60,000 psi. Aluminum fasteners are usually manufactured from AISI grades 2024, 6061, 6262 & 7075.

**Copper** is used in fasteners that require a high degree of electrical & thermal conductivity and corrosion resistance. It is non magnetic and cannot be hardened other than by cold working. The tensile strength of pure copper is about 30,000 psi.

**Brass** which is a composition of copper and zinc, is the most common copper based alloy. It is highly corrosion resistant and electrically conductive, however, its use as a fastener is somewhat limited due to its relative softness. Used primarily for its appearance.

**Silicon Bronze** often referred to simply as bronze, is an alloy made mostly of copper and tin with a small amount of silicon. Manganese or aluminum is added for strength. Lead is added to make it free machining. Depending on its composition, silicon bronze possesses high tensile strength and is used primarily in marine applications for its high corrosion resistance, non magnetic properties, rich appearance and ability to resist the corrosive action of salt water.

**Nickel** & nickel base alloys have excellent strength properties, exceptional toughness and ductility and perform well in both high and low temperature extremes. Fasteners made from nickel-copper alloys have a tensile strength of 80,000 psi whilst those made from nickel-copper-aluminum alloys have a tensile strength of 130,000 psi. Nickel and high nickel alloy fasteners offer excellent performance and oxidation resistance at high temperatures but their use is restricted by the high cost.

**Titanium** as compared to aluminum has superior strength to weight ratios, excellent corrosion resistance, good high temperature performance and is therefore extensively used in the aerospace industry. Titanium is highly corrosion resistant to chemical agents and aggressive oxidizing substances used in the chemical industry. Fasteners manufactured from titanium can have tensile strengths in excess of 150,000 psi.