

# How to Choose the Right Fastener

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In the process industries, such as oil, gas, and petrochemicals, the selection of the right fastener in the right application can be critical. The bolts used to connect companion flanges, for example, or the screws used to connect a pipe standard to a load bearing wall, or the nuts and bolts used to connect the dished ends of a reactor are all critical to production. Picking the right fastener is also critical to safety, both for the process and for the plant workers. Picking the right fastener will not be noticed. But failing to pick the right fastener for an application may cause problems from a small leak to a disastrous failure, and that will be noticed for sure. We are going to look at how to pick the right fastener every time.

## Know the Application

Before you call your fastener supplier, you need to know what the application is. There are so many applications for industrial fasteners that even a list is out of the scope of this paper, but the kinds of fasteners and their suitability for applications and service are often the same in many applications. Whether you use mild steel or Chrome Moly, or even something exotic will depend of the requirements of the application. You should also know how to use the standards that cover fasteners and their uses. ASTM A307, for example, covers carbon steel bolts, studs, and threaded rod up to 60,000 PSI tensile strength. ASTM F593 covers stainless steel bolts, hex cap screws and studs. ASTM A193/A193M covers alloy steel and stainless steel bolting for high pressure or high temperature service and other special applications. You can often find your application, or an application that is quite similar to your own, mentioned in these and other standards.



## Select the Right Type of Fastener for the Application

There are some basics here. Will your fastener fit? Sometimes more than one type of fastener will appear to work. That's where your experience and that of your fastener supplier will help you decide on the right fastener for the application. Typically, a bolt consists of a head, a shaft of some length, and a threaded end.

The head of the bolt can be hex, screw head, socket head, or have another design. The design of the bolt head can be important for the amount of torque the bolt will take, and other issues, so it is important to select the bolt head properly. The length of the bolt is based on the application. For example, a flange bolt needs to be long enough to hold a washer, the flange, the flange gasket, the companion flange, another washer and the nut, with several threads left over for safety.

Threads are part of the application, too. Whether coarse (UNC), fine (UNF), or 8 thread (UN—mostly used in oilfield applications) the threads need to be chosen to provide the

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**Fasteners are often the smallest part of a project, both in size and cost. However, they can be the most critical to a projects success. If the parts aren't connected properly a breakdown may occur. Selecting the right bolt or nut for the job can be the difference between success and failure.**

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best load handling characteristics. There are also Metric standard threads, BSW (British Standard Whitworth), and others. Thread selection is important: coarse threads will allow for quicker assembly. Fine threads take longer to assemble, due to the number of revolutions required to travel the same distance as a coarse thread. However, they provide better thread engagement, and more of the mating surfaces are in contact, which provides a more secure connection that can accommodate greater tension in the connection.



### Materials of Construction

Nearly all fasteners use carbon steel. It has the widest range of workability and range of strength properties. There are even low carbon steels such as ASTM 307 Grade B, which are used for heavy hex bolts and studs intended for flanged joints in piping systems with cast iron flanges. Medium carbon steels can be heat treated to increase their load carrying capability. The ASTM A193 standard covers alloy steel and stainless steel bolting materials for high temperature or high pressure service. This specification includes fasteners intended for use in pressure vessels, valves, flanges, and fittings.

The most common fasteners in use are the hex head Grades 2, 5, and 8. Grade 2 is a standard hardware-grade steel. This is the most common grade of steel fastener, and is the least expensive. Grade 2 bolts are typically used where high strength is not a concern, such as handrail installation, and on pipe clamps and hangers. Grade 5 hex head bolts are hardened to increase strength and are the most common bolts found in automotive applications. Grade 8 bolts have been hardened more than grade 5 bolts. Thus they are stronger and are used in demanding applications such as automotive suspensions, and equipment assembly.

Socket head bolts are typically an alloy steel. Alloy steel bolts are made from a high strength steel alloy and are further heat treated. Alloy steel bolts are typically not plated, resulting in a dull black finish. Alloy steel bolts are extremely strong but very brittle. Care should be taken with socket heads if a zinc plating is required. Hydrogen embrittlement may occur when plating these fasteners, which can cause failure of the fastener. Alloy steels that have more than about 1.5% of manganese, 0.6% of copper, and where the chromium is lower than 4% are extremely useful in a wide range of strength versus ductility ranges. Alloy steels that have appropriate concentrations of molybdenum, or vanadium, or other elements can be used in areas where corrosion is possible, such as heaters, boilers, and other devices.

Stainless steels can be austenitic (commonly SS 302, 304, 316 and others of low strength cannot be heat treated), martensitic (410, 416 can be heat treated), or ferritic (SS 430 magnetic and lower corrosion resistance), and each of these has specific properties for use in special applications. The 300 series are the most common stainless steel alloys used for fasteners. These are used in a wide variety of applications from high moisture level areas such as water treatment plants, to food storage areas, and in plants where chemical exposure is possible. While most stainless fasteners will not have the overall strength of heat treated carbon steel bolt, the 400 series can provide a higher strength without losing too much corrosion resistance. Machinists' handbooks, such as the Marks' Standard Handbook for Mechanical Engineers, have tables of properties of metals that can be used to determine the appropriate applications.

Other materials can also be used for fasteners: brass, bronze (especially for marine and offshore applications), and occasionally aluminum. These are often chosen for the same reasons as stainless steel. These metals and alloys have good corrosion resistance. In the case of brass and bronze they may also have an aesthetic appeal. With aluminum, you also have a very light weight fastener. Similar to stainless, these fasteners lack the strength of most carbon steel bolts. Their strength is typically that of an un-hardened Grade 2 fastener.

Softer metals have a danger of thread galling or stripping. During the tightening of the fastener, pressure builds between the contacting thread surfaces, the metal high points of the threads are exposed to one another, which increases friction. The combination of these two events can generate enough heat to fuse and seize the nut and bolt together.

There are some ways to prevent galling and stripping. Mating parts, for example, a nut and bolt both made of the same alloy will have a greater tendency to gall than those of dissimilar alloys. One typical set of dissimilar alloys is a 400 series stainless steel nut with a 316 series bolt. This, however, will cause a reduction in the overall corrosion resistance of the assembly.

The smoother that the mating surfaces are, the less galling will occur. Rolled threads usually offer smoother surfaces than cut threads, thus reducing the friction that causes galling. And of course, proper installation torque must be used. If the fastener is over-tightened, the threads can begin to yield which will induce friction between the mating surfaces.

The corrosion resistance of fasteners can be extremely important because of the environments that these materials are used in. Sometimes, a special coating is necessary for the fastener. Zinc is the most common coating used today. It offers a reasonable amount of corrosion resistance at an affordable price. Hot-dipped galvanized coatings offer a greater degree of resistance and are typically used where they are exposed to high moisture and/or salt, such as coastal areas. Due to the thickness of the coating, a galvanized nut must be

tapped oversized. This means that an uncoated or zinc plated nut will not work on a galvanized bolt. PTFE or PFA Teflon is a specialty coating often used in areas where resistance to chemicals is necessary. Teflon coated fasteners will have a high operating temperature, a low coefficient of friction, fair abrasion resistance and good chemical resistance. This coating is normally used where a dry lubricant, low friction, or corrosion resistant coating is necessary. It is very important to select fasteners based on the widest resistance to corrosion that the material of construction produces.



The level of vibration and the amount of heat (or cold) that the fastener will be exposed to are important considerations for selection. In high vibration areas the use of a prevailing torque locknut might be necessary. These nuts can help prevent the fastener from vibrating loose. Extreme changes in temperature can cause the fastened joint to expand and contract. This movement in the joint can be enough to cause the connection to loosen.

If the device or pipe or flange for which you are selecting a fastener has a specification for the fasteners, you should always adhere to that specification. Otherwise, you need to understand the parameters of the application and select the fasteners accordingly. Most of the information you need can be found in the ASTM specifications. The most common bolting specifications are:

- ASTM A193 - Alloy steel and stainless steel bolting materials for high temperature or high pressure service.
- ASTM A307 Carbon steel bolts and studs, 60,000 psi tensile strength.
- ASTM A354 Quenched and tempered alloy bolts, studs, and other externally threaded fasteners.
- ASTM A449 Quenched and tempered steel bolts and studs for general use.
- ASTM F593 Stainless steel bolts, hex cap screws, and studs.
- ASTM F1554 Anchor bolts designed to anchor structural supports to concrete foundations.
- ASTM F3125 New, unified structural bolt specification replacing A325, A325M, A490, A490M, F1852, and F2280
- ASTM A194 Carbon and alloy steel nuts for bolts for high pressure and high temperature service.
- ASTM A563 Standard specification for carbon and alloy steel nuts.
- ASTM F594 Stainless steel nuts.

### Selecting the Right Vendor

Selecting the right fastener is greatly eased by having a vendor with the broad knowledge and application expertise to be able to help you. The proliferation of vendors online, from low cost of manufacture countries, and even the very real potential for counterfeit materials argue for having a close relationship with a vendor you know and trust. It is this relationship that you can depend on at three in the morning when you need a special fastener because the plant is down. Selecting the right vendor is every bit as important as selecting the right materials and serviceability of the fastener. Make sure that your vendor is experienced, has a reputation for quality materials, and is responsive to your needs in a timely fashion.

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#### ABOUT BAYOU CITY BOLT & SUPPLY CO.

##### Reputation for Service

Since 1962 Bayou City Bolt & Supply Co., Inc. has built a solid reputation for service throughout the Gulf Coast. It was founded on the principle of providing the customer with the fasteners they need, when they need them. This reputation is reflected in our motto:

**“To Spec - On Time - In Budget”**

Bayou City Bolt keeps more types, sizes, and styles in stock than any other distributor in our area. From the smallest machine screws to the largest hex nut, Bayou City Bolt can fulfill your fastener needs.