OPTIMA
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OVERVIEW

- Bolts are a critical, sometimes overlooked, component in a refiner plate assembly.
- Understanding a bolt's features simplifies the process of bolt selection and ensures the right specifications for various applications.
- J&L's catalog system is an efficient method of determining the features of specific bolts.

Choosing the Right Refiner Plate Bolts: a Practical Guide

Developed by the Technical Group, J&L Fiber Services

Bolts are deceptively simple, which is why they are often taken for granted. However, bolts are a highly engineered and critical component in refiner plate technology.

Every flat refiner plate on the market is held in place with bolts, and whether or not they stay in place depends upon the type and the condition of bolts used. This latter point – the condition of the bolts – is why J&L recommends new bolts with every refiner plate change.

Essential criteria, such as material type, material strength, torque, bolt size and the amount of thread engagement, must be considered during joint design. This article explains basic bolt terminology, outlines the J&L method of describing bolt types, and provides some practical examples of bolt designations.

Bolts...the basics

Bolts are manufactured to meet specific industry-wide standards. The terms used to describe bolts and their features are also industry-wide. Some of the most common terms are listed below, along with descriptions:

Bolt length – In most cases, bolt length is determined by measuring from the underside of the head to the end of the thread. There are some exceptions, however. For example, a plow bolt is measured from the flat side of the head to the end of the thread, which is actually its overall length (*Fig. 1*).

Understanding the details of bolt measurement and length specification are important when determining bolt requirements.

Bolt diameter – This measurement refers to the nominal outside diameter of the threaded portion of the bolt (*Fig. 2*).

Thread designation – It is important to recognize that thread designation differs between the English measuring system and metric. In the English system, threads are specified as threads per inch. In the metric system, they are specified by "pitch,"

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which refers to the distance, in millimeters, between the crowns of the threads (*Fig. 2*). Typically, there are two standard pitches – coarse and fine – which are available for all bolt sizes (*Fig. 3*).

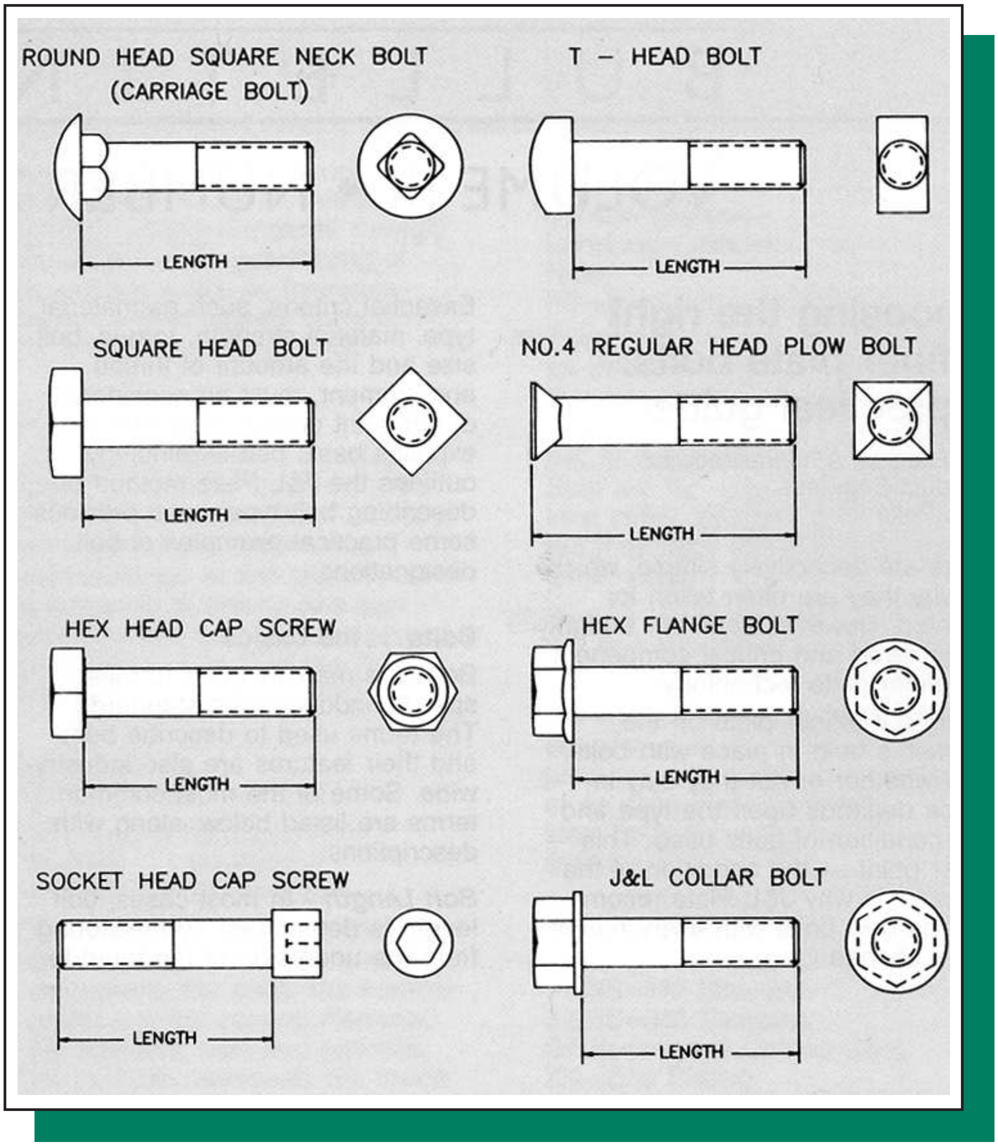
Thread length – Thread length and bolt length may not be the same for a given bolt. Thread length is governed by certain standards, depending upon bolt length. In general, any bolt longer than 1 1/2 inches would not be fully threaded, with some exceptions.

Bolt strength – Bolt strength is a function of a number of different variables. The three most important are material, heat treatment and cold working. *Material* as a factor requires little explanation, since it is common knowledge that certain alloys are stronger than others.

In heat treating, material is heated to a certain point, and then cooled at a controlled rate. Various methods can be utilized to attain a particular hardness and strength.

Some materials are cooled at a fast rate, using a "quenching" process that involves plunging the heated material into a liquid immediately after removal from an oven. Other methods involve leaving

Fig. 1: Common refiner plate bolts and the method of measuring bolt length



the material in the oven to cool, or removing it from the oven to cool at room temperature.

Cold working is the process of forming material when it is below a certain temperature. Some materials become stronger when cold worked, while others do not. Bolt materials that increase in strength when cold worked include carbon steel, 304 stainless steel and 316 stainless steel. The common cold working operations performed on the bolts described in this article include forming the heads and shanks, and rolling the threads instead of cutting them. *(See Fig. 4 for general material properties.)*

Bolt length increments – The increments of bolt length can vary, depending upon the overall length of the bolt and the bolt type. At times it may be necessary to use a nonstandard bolt length, but this usually means a higher cost and a longer lead time for delivery. In general, the only time J&L encounters a need for nonstandard bolts is for plates with drilled and tapped backsides, or when plates are mounted to plate holders.

Magnetism – Although it is commonly assumed that stainless steel is non-magnetic, this is not always the case. The austenitic stainless steels, which include 304 and 316, are *not* magnetic. The martensitic stainless steels, which include 410, are magnetic under *all* conditions.

Fig. 2: Bolt diameter and thread

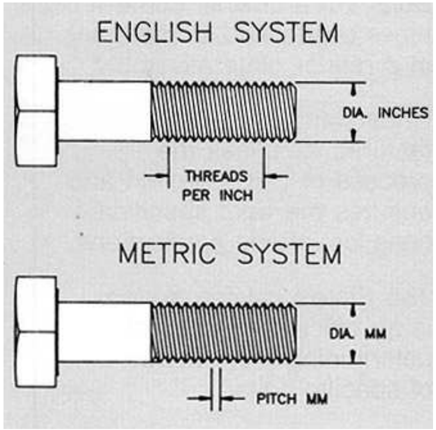


Fig. 3: Coarse and fine thread pitches for various bolt diameters

BOLT DIA.	COARSE TPI/PITCH	FINE TPI/PITCH
1/2 IN.	13	20
5/8 IN.	11	18
3/4 IN.	10	16
12 MM	1.75 MM	1.25 OR 1.50 MM
16 MM	2.00 MM	1.5 MM

Fig. 4: General material properties

MATERIAL	CONDITION	YIELD	TENSILE x1000 PSI	CORROSION RESISTANCE
304 SS	ANNEALED	30,000	75 TO 100	GOOD
	COLD WORKED	65,000	100 TO 150	
316 SS	ANNEALED	30,000	75 TO 100	BEST
	COLD WORKED	65,000	100 TO 150	
410 SS	H (HEAT TR.)	90,000	110 TO 140	GOOD
	HT (HEAT TR.)	120,000	160 TO 190	
CARBON STEEL	GRADE 2	57,000 MIN.	74 MIN.	POOR NEEDS PLATING
	GRADE 5	82,000 MIN.	120 MIN.	
	GRADE 8	130,000 MIN.	150 MIN.	

Plating

While most of the bolts used for mounting refiner plates are stainless steel, carbon-steel bolts are sometimes utilized. To protect it from a corrosive environment, carbon steel must be “plated.” *Plating* is the process of depositing a metal onto the surface of a base metal, such as carbon steel. Three types of plating will be discussed: electroplating, hot-dip galvanizing and mechanical deposition.

In *electroplating*, the bolts are immersed in a water-based solution containing ions of the plating metal. An electric current is passed through the solution, which causes the plating metal ions to come out of the solution and adhere to the bolts.

In *hot-dip galvanizing*, the bolts are placed into a bath of molten zinc, which is at approximately 950F. This creates an iron-zinc alloy on the carbon-steel surface, which gradually turns to pure zinc at the exterior.

Mechanical deposition is the process of impacting particles of the plating metal onto the parent material. This cold welds the coating onto the bolt surface.

One of the most popular bolt coatings is zinc. Zinc is inexpensive, can be applied at varying thicknesses, has good to excellent corrosion resistance, and is relatively non-toxic. Since pure zinc develops a corrosion of its own, bolts plated with zinc are normally given a chromate treatment, which covers the zinc surface with a hard, non-porous film. This seals the bolt surface, protects it from premature tarnishing and increases corrosion resistance.

Because the plating process adds material to the outside surface of a bolt, it is important to verify that the bolt has not become too large to be utilized. Manufacturers have certain specifications they must adhere to, and the customer can also request that bolts meet certain size requirements.

When high-strength bolts are electroplated, caution must be taken to avoid *hydrogen embrittlement*. During the plating process, atomic hydrogen is absorbed into the bolt, where plating entraps it. When the bolt is installed and tightened, the hydrogen migrates towards the points of highest stress. Pressure builds up in these areas until the strength of the parent material is exceeded, and minute cracks occur. Hydrogen enters these cracks and creates additional pressure. This process repeats itself until the bolt fails. To prevent hydrogen embrittlement, the manufacturer will “bake” the bolts at a certain temperature to allow hydrogen to “bleed” through the coating.

Mechanical deposition is not electrolytic, so the threat of hydrogen embrittlement is virtually nonexistent. Engineering standards strongly discourage hot-dip galvanizing of high-strength bolts, so hydrogen embrittlement is usually not a concern with this process, either.

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