Chapter

9

American National, Unified Screw Threads

In this chapter, you will learn the following to World Class standards:

- **Why Use Fasteners**
- **The Text Designation for the Unified National Thread**
- **Drawing and Making an External Thread**
- **Drawing and Making an Internal Thread**
- **Drawing and Making a Blind Sided Internal Thread**
- **Fastener Head Types and Purposes**
- **Drawing a Hexagon Head Screw**

Why Use a Threaded Fastener

In this chapter, we will discuss many of the common types of fasteners that we will use to bring different parts together into an assembly. We might ask ourselves, "why use a fastener" and that question should always be brought to the forefront when considering an issue where more than one part is coming together. We would have to say that we would use of fastener when ever we wish to disassemble the components or we have dissimilar materials they cannot be welded together. Whatever our circumstances, we will discover that fasteners are everywhere in our lives and we seldom have to look very far to see an application where we can learn from other architects, designers and engineers. When we want to examine the history, statistics and application methods of the use of fasteners, there are thousands of references, textbooks and examples to follow. This chapter will examine the most common applications that we expect to see in our industries, so we will have good foundation in understanding the use of screws, lock washers, washers and part preparation and order to bring more than one component together. Our expectations in this textbook, World Class CAD's Computer Aided Mechanical Design, is that we are both able draw and instruct machinist and construction workers in the science of using fasteners.

As we can see in Figure 9.1, there is more than one fastening method. Many in the list represent permanent joining methods, such as welding in gluing. We use welding, soldering, brazing and gluing when we never expect to take the mechanisms apart. For an example, when we place a cover on a computer system unit, we anticipate that we will need to open the cover again in order to service the electrical components attached to the motherboard, so we would never consider a system that would hold the cover in place perpetually. When we examine different styles of fasteners for any situation, their design lends themselves to certain attributes. Some fasteners are permanent and while others are not, then we should consider how many times we need to join and disassemble the part from the main assembly. In some instances, manufacturers select locking or pinning fasteners to hold the cover in place, but we can find that this technique may be difficult to use after the assembly ages and the parts are no longer align perfectly. So most computer manufacturers will use threaded fasteners to hold the plates on the system unit. The clearance holes in the cover plates will allow for alignment issues as the assembly gets older.

In the list of fastening methods in Figure 9.1, we see that the lower the numbered item on the list the more permanent the connecting method. As the numbered choice goes higher, we can expect to disassemble the components numerous times in their service life.

Assorted Fastening Methods

1. Soldering	**7. Crimping**
2. Brazing	**8. Taping**
3. Welding	**9. Pinning**
4. Gluing	**10. Banding**
5. Riveting	**11. Locking**
6. Nailing	**12. Screwing**

Figure 9.1 – Fastening Methods

But we can see for ourselves that a 24 foot tall light pole fastened to a concrete pedestal is using four threaded fastener to secure the steel structure to the ground. Why is that? Well when the materials are dissimilar, as in this case, a concrete pedestal and steel assembly, we are unable to place internal threads in the concrete, so instead we cast threaded steel anchor bolts in the concrete to mate with the steel hex nuts. After the pedestal cures, we erect the light pole on the concrete, setting the pole on the base. The steel anchor bolts will protrude through the base's clearance holes. Now the technician will add a flat washer, and hex nut. The worker will tighten the hex nuts using a torque wrench and follow a pattern to evenly join the two components, the pedestal and the light pole. In this circumstance, we never plan to remove the light pole from the concrete base.

How do we determine every technical detail about the threaded fastener application, such as what size threaded fastener do we use, from what type of material the fastener will be made, how many threads per inch, and many more decisions which need to be made to securely hold two or more parts together. We would think that the number one consideration in selecting a threaded fastener would be size and that magnitude was determined by a strength consideration, so that the forces acting on the parts will not break the fastener. But that is not necessarily so. In many cases, a threaded fastener made economically from steel, will withstand forces in tension or shear in the thousands of pounds. Let us consider the covers on the computer system unit which we see daily at home or at work where the fasteners could be significantly smaller and still hold the steel plates into position. In this instance, the designer is using a screw that is the same as the fastener holding the expansion cards in position. If we disassemble a typical computer system unit, we will discover two or possibly three different sizes of screws in the assembly. This is a very common design strategy, since fasteners cost only pennies in the overall cost of the product so we look for convenience and simplicity to build the product.

In cases where the threaded fastener is safely holding the assembly together, there is a totally different strategy. Here we calculate the maximum possible force and torque on the combination of components and after applying a safety factor, we select a threaded system to secure the system. Other attributes come into play such as temperature, environmental hazards like acids, ice or sand, anodic corrosion and vibration. Very rarely do we come upon an application where we cannot research a previous threaded fastener example and acquire knowledge from studying how a designer preceding us handled the design. We can go into any library or engineering college and find examples of how to assemble two or more parts together using threaded fasteners, how to calculate for the size of fasteners and how to create a pattern to safely hold the components together. When we are working at an architectural or engineering firm, the company may also have examples of threaded fasteners systems that have already been calculated and we use them repeatedly since they have a history of success in that businesses applications. Mechanical designers and engineers use the Machinist and Engineering handbooks as references every day to search through tables and retrieve information such as drill sizes, thread tap sizes, threads per inch and the style of the fastener head. Since the procedure to obtain data regarding any type of fastener application is extremely easy, our challenge is to practice going through the actions, so we can efficiently research, select and illustrate the threaded fastener in the assembly drawing.

So the first area in which will begin our training will be to draw an external threaded fastener. The Unified National form is very common and we will begin with this thread

The Text Designation for the Unified National Thread

A very familiar thread to draw is the Unified National thread, which is very similar to the metric thread, where the thread angle is 60°. The United States standard uses inches and the European standard uses millimeters. Figure 9.2 displays the text callout for a Unified National course thread. The first wording in the phraseology is 0.5, which is the nominal major diameter of the external thread. If we measure the screw's diameter, we will get a measurement very close to the nominal major diameter. In a Unified National Screw chart, we will read the exact maximum and minimum dimensions for the outside diameter of the fastener.

The number that comes after the nominal major diameter is 13, which is the number of threads per inch. There will be many times in our career that we will place a screw next to a ruler and count the threads along a one inch distance. This technique will give us the threads per each. Since the thread that we draw has the standard United States thread angle of 60°, we know that this is the Unified National form. By placing the letter C after the UN, we are stating that this is a course thread. If we purchase the 0.5 – 20 threaded fastener at the hardware store, this thread would be a UNF or fine thread. The fine definition in the Unified National standard means that we will measure more threads per inch than in the course screw.

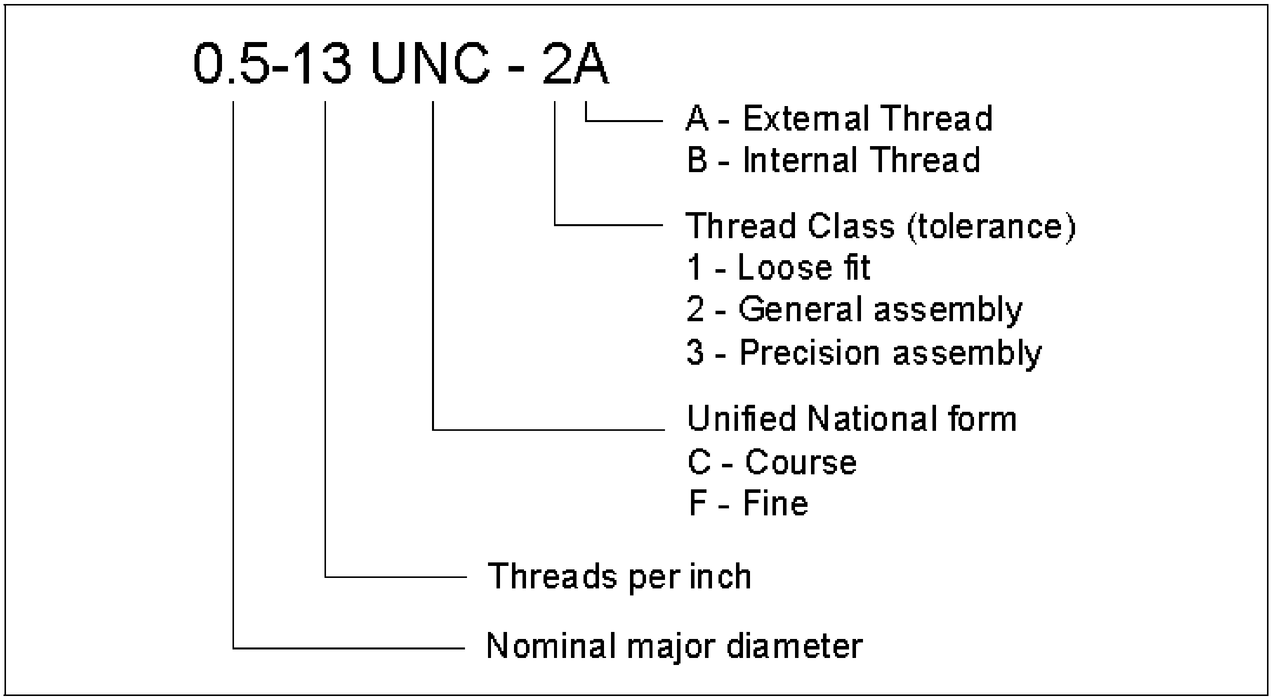

Figure 9.2 – Terminology for a Unified National External Thread

Next part of the terminology is the 2, which denotes the thread class. Our choices are as follows:

1 Class one threads have a very loose tolerance between the internal and external thread. When we visit a hardware store, select a galvanized steel bolt and nut. The gray zinc plating coating the steel requires us to make the thread with a greater tolerance between

the mating nominal diameters. These styles of fasteners do well holding the assembly together, but we do not require a tight fit between the bolt and the nut.

2 Class two threads are very common in automobile and machine construction. If we take apart any assembly at work or at home, we will most likely find class two threaded fasteners. The tolerance between bolt and nut is much closer and assist in the alignment process of the parts.

3 Class three threads are used in precise assembles such as watches and fine machines. The designer of fasteners in this class will have a chamfer on the front of the thread to assist in aligning the screw and the internal thread.

After the class designation of 1, 2 or 3, we will type an "A" for an external thread or a "B" for an internal thread. All threads are commonly right handed, which means that we will turn the screw clockwise to tighten, and we do not write "RH" after the letter A or B. The text "LH" is written after the "A" or "B", if we desire to make a left handed thread.

If we desire to control the depth of the thread, we will type the distance next like "1.0 deep". If we leave any depth control off the terminology then the thread will be cut the entire length of the cylinder on an external fastener or through the entire length of a hole in a part with an internal thread.

At first this may be somewhat overwhelming, but with some practice, this terminology will become part of our vocabulary. Now we will draw the 0.5 – 13 UNC – 2A thread, where we will acquire the talent to draw two dimensional external threads initially.

Drawing and Making an External Thread

In our Computer Aided Design (CAD) program, we will start a new drawing using our mechanical template. From the Unified National Screw chart the end of this textbook, we find that the mean major diameter for a 0.5 – 13 UNC – 2A thread is 0.488. We draw an object line one inch to the left, another line 0.488 downward and a third line one inch to the right. We place a centerline at the midpoint as shown in the figure. *Note*: *We placed dimensions on our figures in the textbook, but this is not necessary for our drawing in the CAD program.*

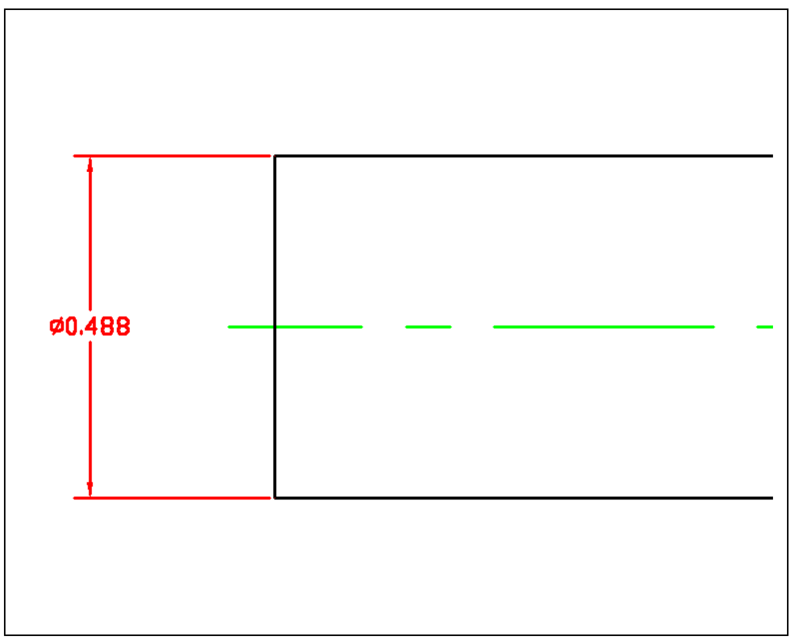

Figure 9.3 – Major Diameter for 0.5-13 Thread

Next, we will draw the pitch diameter, which is the theoretical center of the thread. We can compute this dimension from the maximum and minimum and find 0.446. Subtract 0.446 from 0.488 and divide by two to get 0.021. Offset the one inch lines 0.021 to obtain the pitch diameter as shown in Figure 9.4. Next, we will calculate the minor or root diameter of the external thread.

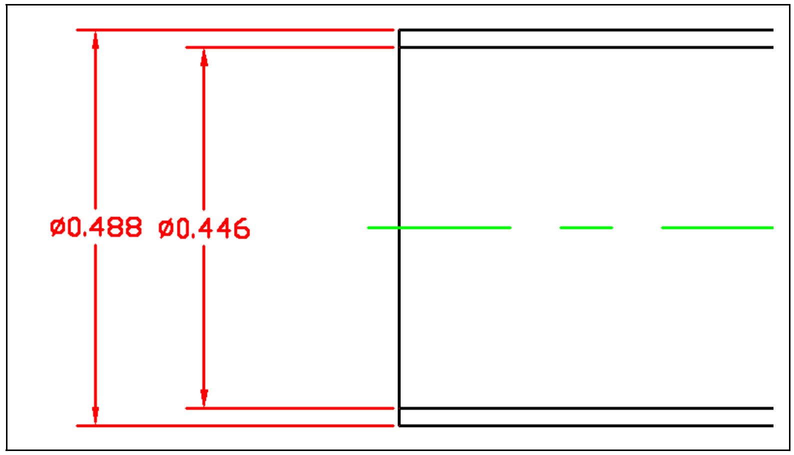

Figure 9.4 – Pitch Diameter for 0.5-13 Thread

Many charts do not give us the root diameter of the thread, but we can compute the dimension by using the following formula.

$H = 0.541266 \times P$

Where P is the thread pitch or one divided by the number of threads per inch. For our project, we want 13 threads per inch, so

$$H = 0.541266 \times \frac{1}{13} = 0.0415$$

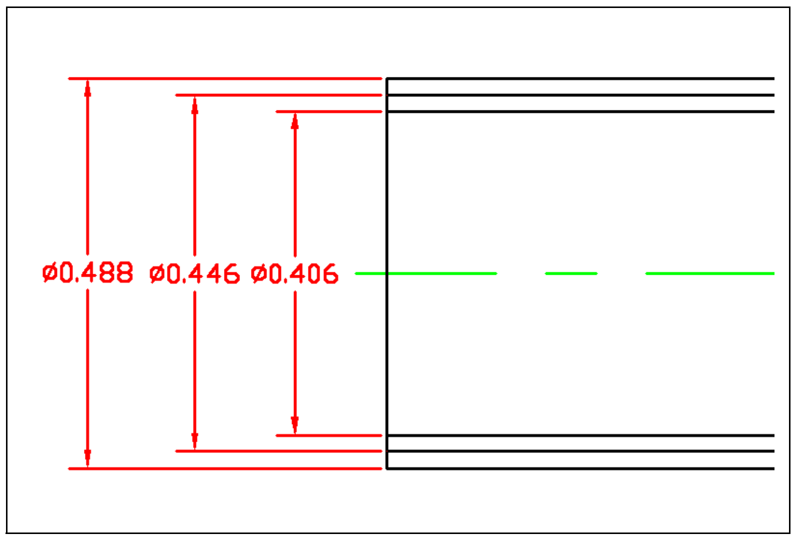

Figure 9.5 – Root Diameter for 0.5-13 Thread

Offset the two major diameter lines 0.415 to the inside to obtain the minor or root diameter as shown in Figure 9.5. Now, we will return to the pitch P, the distance between threads or one divided by the number of threads per inch.

$$P = \frac{1}{13} = 0.07692$$

Offset the vertical object line 0.03846, one half the thread pitch, 3 times as shown in Figure 9.6.

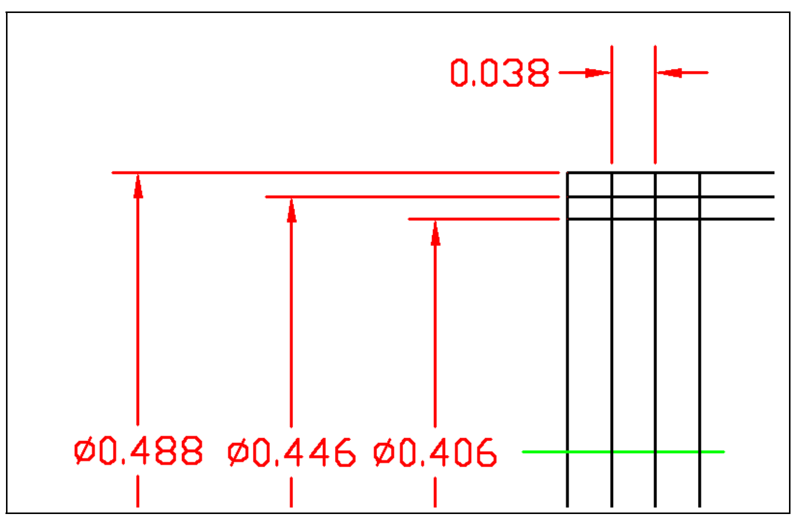

Figure 9.6 – 1/2 Pitch for 0.5-13 Thread

Rotate the first offset line at the intersection of the pitch diameter 30° counterclockwise and the second offset line 30° clockwise at the intersection of that line with the pitch diameter. Extend and trim lines to have the drawing appear as shown in Figure 9.7. With the thread form opening at 30° on each side, this will give us the 60° thread angle which is synonymous with the Unified National standard.

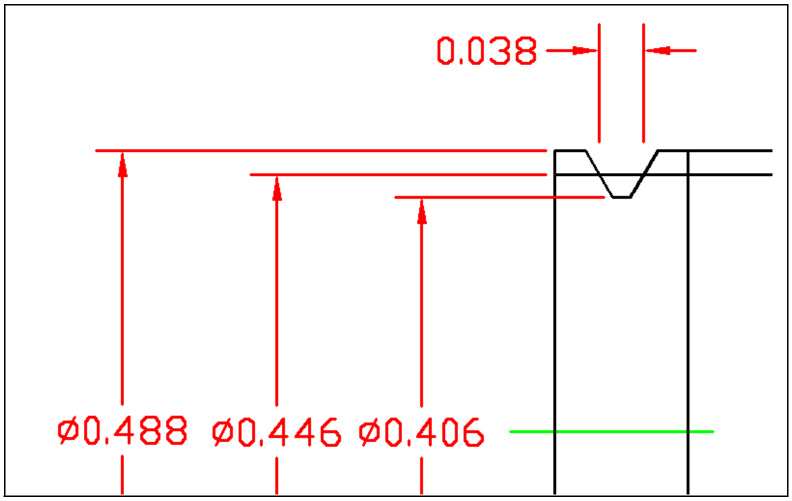

Figure 9.7 – 30º Rotation of Lines for Threads

Duplicate the complete thread as shown in Figure 9.7 using the Copy tool in our CAD program. Use the intersection of the third offset line and the line of the pitch diameter as a reference point to make the new thread. Our drawing should appear as shown in Figure 9.8. Then next we will want to mirror the two threads across the centerline to make duplicate threads on the bottom of the drawing.

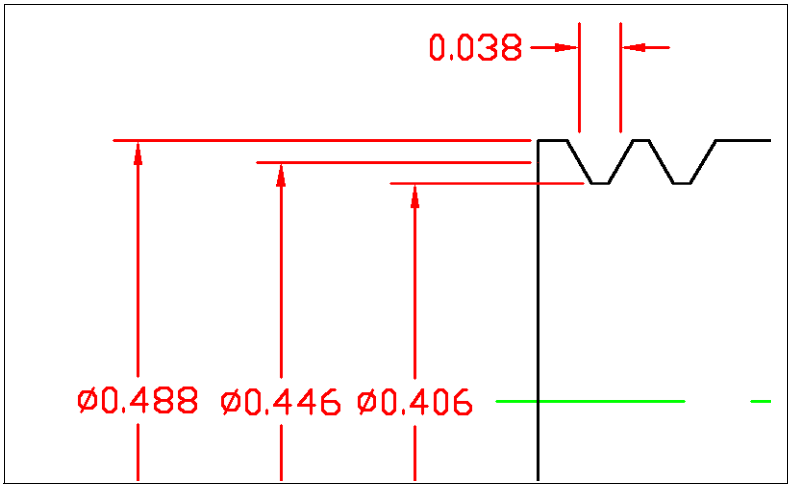

Figure 9.8 – Copy the Thread

After we mirror the threads to the bottom of the screw, we need to move the two threads 0.03846 to the right as shown in Figure 9.9. We can use either the Move or the Stretch tool to move all of the entities one half of the distance of the thread. This should make sense, since at the top of the screw, the threads are one full pitch distance apart. The threads at the bottom will be half the distance from the one on top.

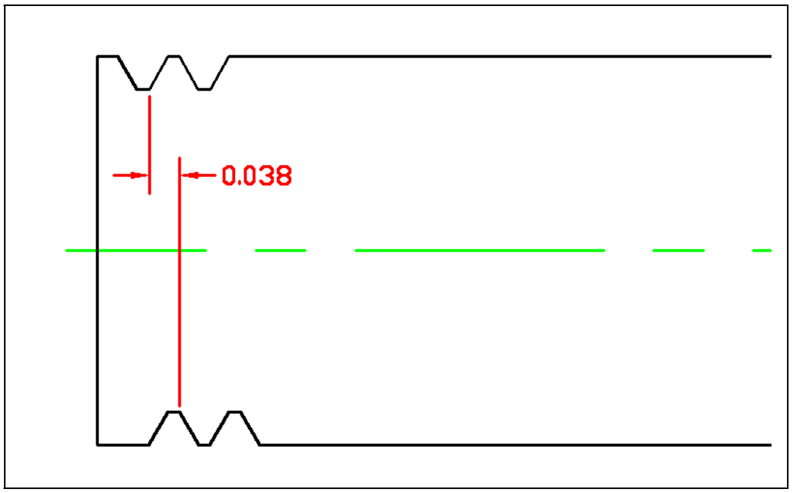

Figure 9.9 – Mirror the Thread

Now we need to draw lines connecting the thread which to our relief when drawing a thread for the first time appears as the screws which we have seen. Draw eight line form the top thread forms to their matching forms on the bottom of the screw as shown in Figure 9.10. Now this is a good start, but we need threads down the entire length of the screw, which is one inch long.

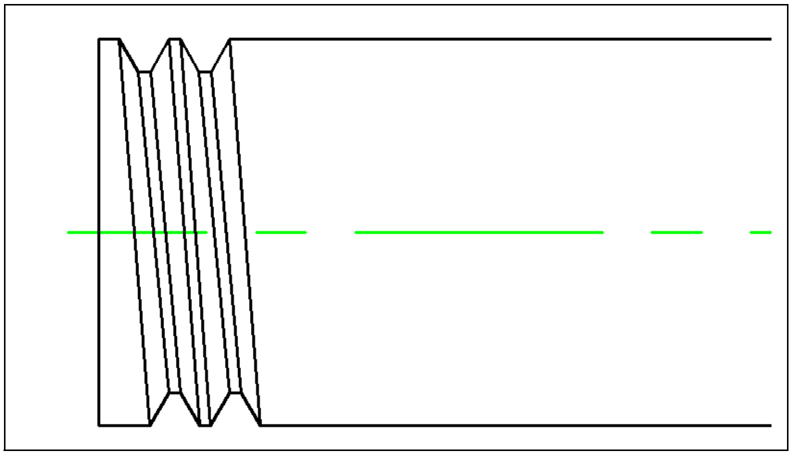

Figure 9.10 – Draw the Thread

We can offset the first vertical object line, one inch to the right. We can use Copy Multiple or the Array tool to finish the thread down the one inch length. For short distances such as shown in Figure 9.11, we will Array, by selecting 12 entities representing the complete thread and in the Array window, select 12 columns, and distance between columns at 0.07692. Erase lines that go completely past the vertical line on the right. Trim or Extend lines to obtain a graphic as shown in Figure 9.12.

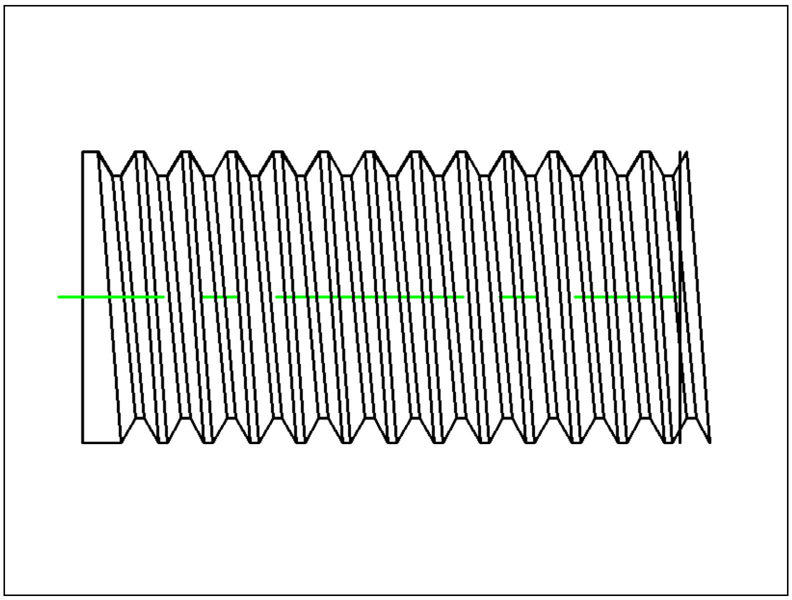

Figure 9.11 – Copy the Thread for a 1" Length

Copy the thread on the far left, one pitch distance, 0.07692 to the left to complete the entire one inch thread. Erase lines that go completely past the vertical line. Trim or Extend lines to obtain a graphic as shown in Figure 9.12. After the one inch thread is drawn, we will draw a 0.063 x 0.406 diameter area that is unthreaded before a vertical line which will be part of the screw head as shown.

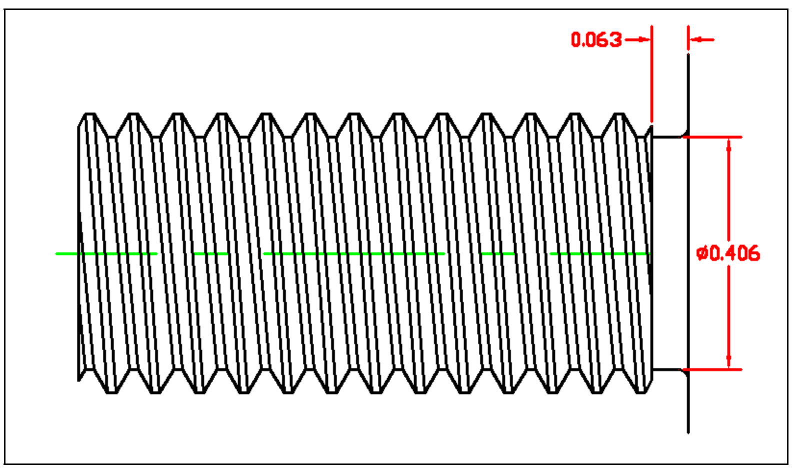

Figure 9.12 – End Thread at 1" Line

At the intersection of the root diameter and the vertical line on the left, draw two lines projecting at 45° as shown in Figure 9.13. Erase lines that go completely past the 45° line. Trim or Extend lines to obtain a graphic as shown in the figure. Our finished drawing will appear as shown in Figure 9.14, and for our benefit, the last figure has the terminology labelled. We can check our drawing time and see if we are less than 5 minutes. If not, start a new drawing a practice the procedure again.

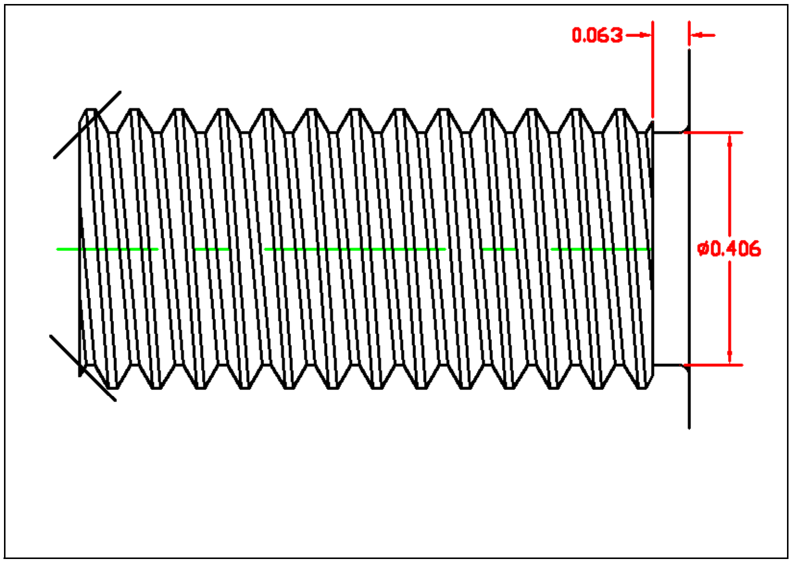

Figure 9.13 – Drawing a 45º Chamfer on the Thread

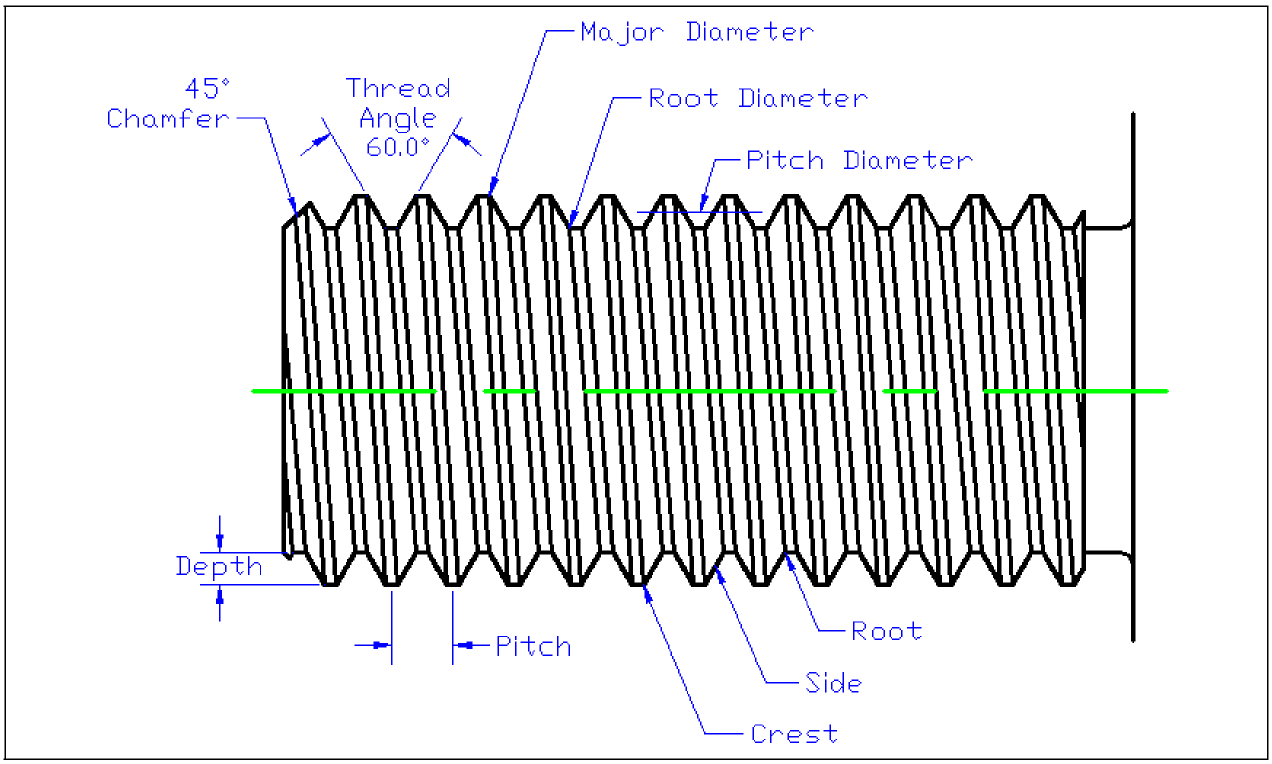

Figure 9.14 – Finished 0.5-13 x 1.0 Long Thread with Terminology

*** World Class CAD Challenge 8-40 * - Draw a 0.5 – 13 UNC – 2A x 1.0 long external thread with a 45º chamfer and a 0.063 thread relief before the line representing the bearing surface screw head in 5 minutes. Save the drawing as Screw Thread 1/2 - 13.dwg.**

Continue this drill four times using some other size screw threads from Unified National Screw Thread Table in this textbook, each time completing the drawing under 5 minutes to maintain your World Class ranking.

Drawing and Making an Internal Thread

At the drawing the external threaded fastener, we will draw four 0.5-13 UNC – 2B internal threaded holes on a 1.0 thick, 4.0 x 6.0 plate. In Figure 9.15, we see how the internal thread terminology differs from the external thread. There is only one difference, the letter A is now B.

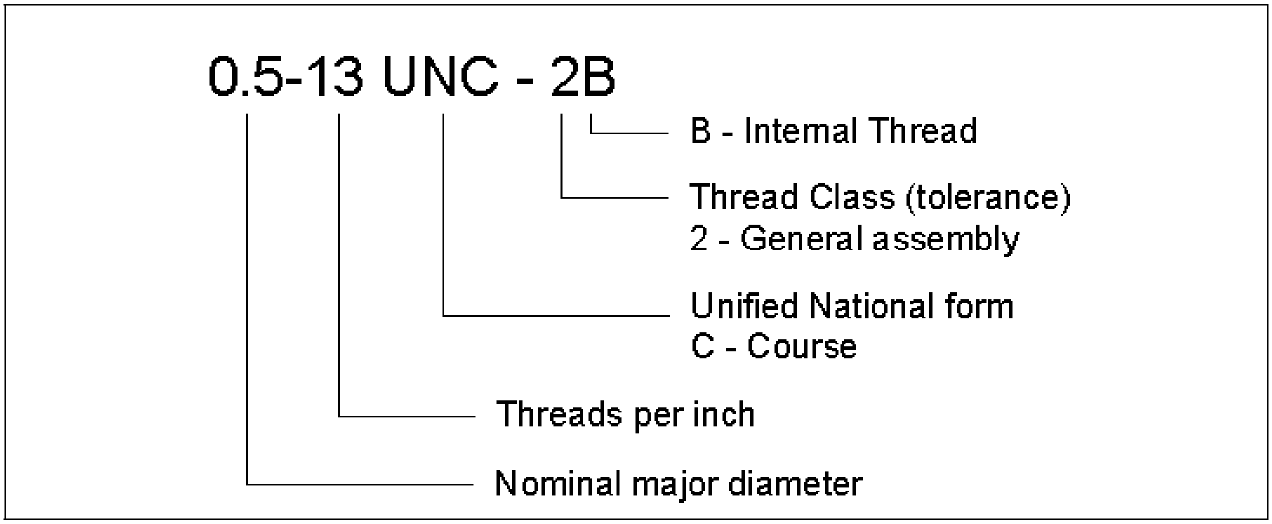

Figure 9.15 – Terminology for an Internal Unified National Thread

In some CAD programs, there are applications which will place threads onto solids such as we see in the four threaded holes in the 1.0 x 4.0 x 6.0 plate. Those routines make the process of creating threaded fasteners or threaded holes in solid parts extremely easy, since we only have the master the actions in the tool. In this section, we will continue to learn how to present threads in two dimensional drawings, but instead of using a graphical representation of the real thread, we will learn a simplified method to show the thread.

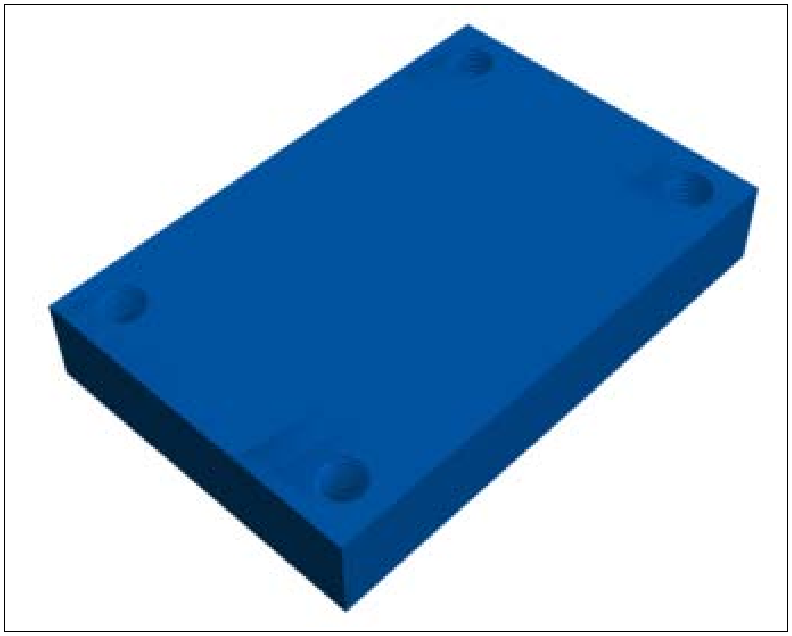

Figure 9.16 – Four Internal Threads in a Plate

In many drawings that we read, we will see that thread designation with the terminology that we have seen in this chapter, but the orthographic view will have hidden lines that represent the tapped thread. This is very common in the industry and is used widely by architects, designers and engineers to quickly portray a threaded fastener or hole.

We will begin this problem by drawing a 4.0 x 6.0 rectangle with right hand orthographic view that is 1.0 inch wide as shown in Figure 9.17. Next draw two circles, a 27/64 (0.421875) inch diameter circle and a 1/2 (0.5) inch diameter circle on the lower left intersection of the 4.0 x 6.0 rectangle. Move the two circles a half an inch to the right and an half an inch up into the rectangular shape.

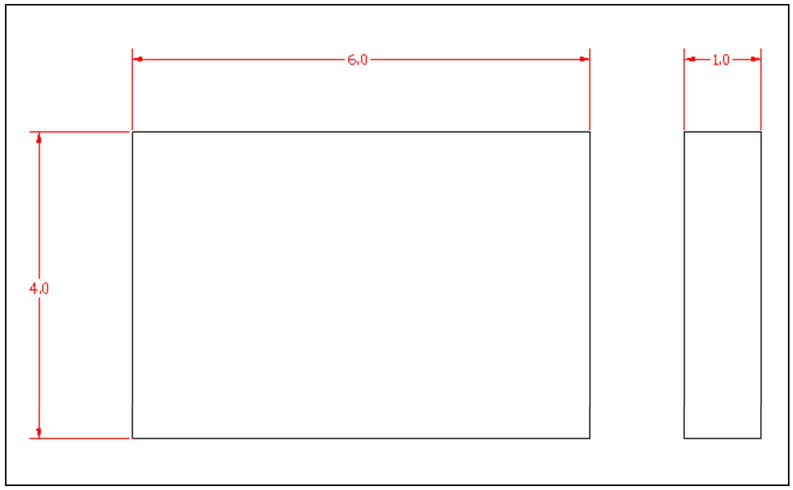

Figure 9.17 – Four Internal Threads in a Plate

Now to create a 0.5-13 UNC tapped hole in a plate, we first drill a hole clear through the part with 27/64 drill. The inside circle is shown with a continuous line in the simplified method. In the machining of the screw thread, a 0.5-13 UNC tap is twisted in the 27/64 diameter hole, cutting the thread in the part. The outside circle is shown with a hidden line in the simplified method. Place a center mark inside the two circles as shown in Figure 9.18.

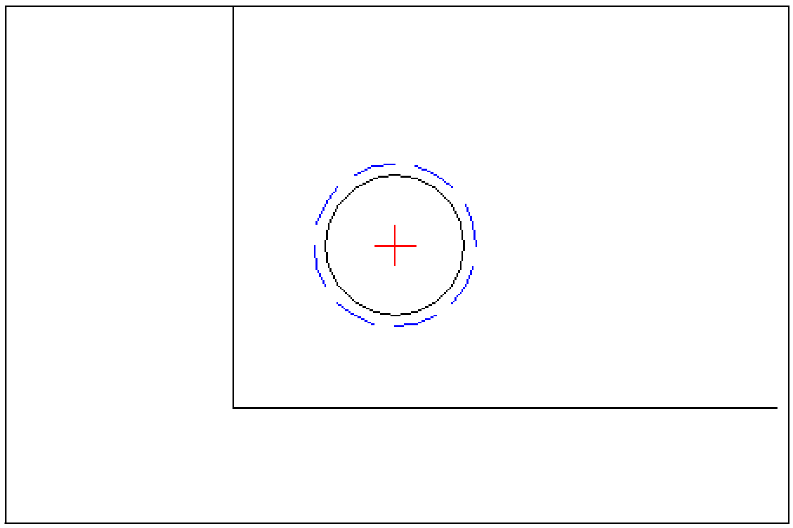

Figure 9.18 – An Internal Thread in a Plate

Now, we will array the two circles and the center mark representing the 0.5-13 UNC tapped hole in a bolt pattern of 5.000 x 3.000. The tolerance between holes is ±0.003, so we will dimension the holes with three decimal places. A common practice in the industry is to space the tapped or clearance hole at least the same distance as the size of the hole or tap, so the horizontal and vertical is dimensioned at 0.50.

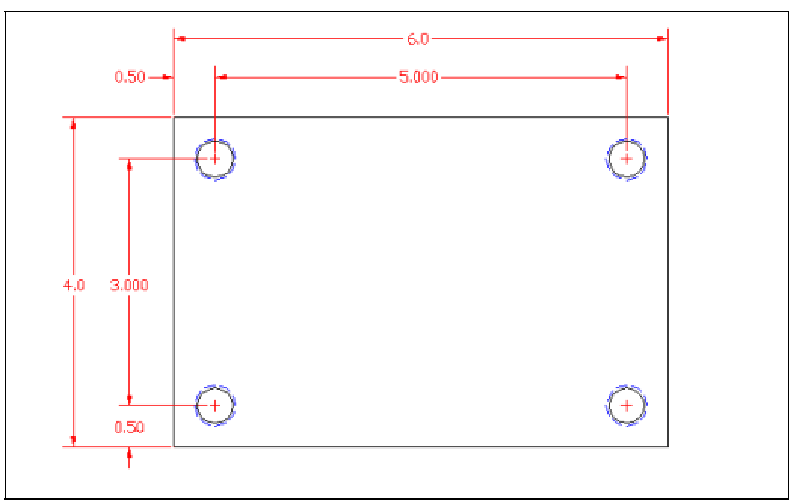

Figure 9.19 – Four Internal Threads in a Plate

We want enough material around the hole, so the corner does not break out. The tolerance between holes is ±0.03, so we will dimension the holes with two decimal places. The tolerance from the hole to the outside of the plate typically does not have to just as exact as the hole to hole dimensions where alignment is critical for easy assembly.

Now, we want to project the lines off the tapped holes to the right orthographic view. A centerline is projected off the center mark and four hidden lines are projected off the north and south quadrants of the tapped hole as shown in Figure 9.20. Since the right handed view is revealed as solid, both the 27/64 and 1/2 diameter circles projected in the right view are shown with hidden lines. This is the correct technique to display threads in the simplified method.

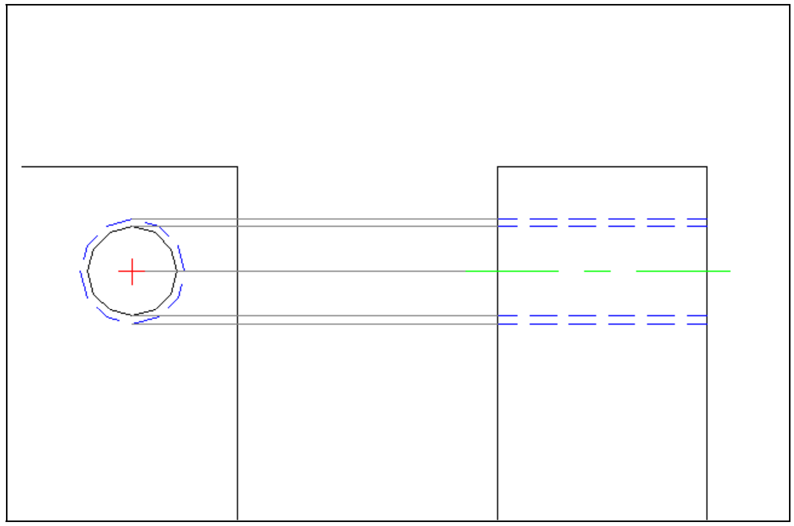

Figure 9.20 – Tapped Holes in a Hidden View

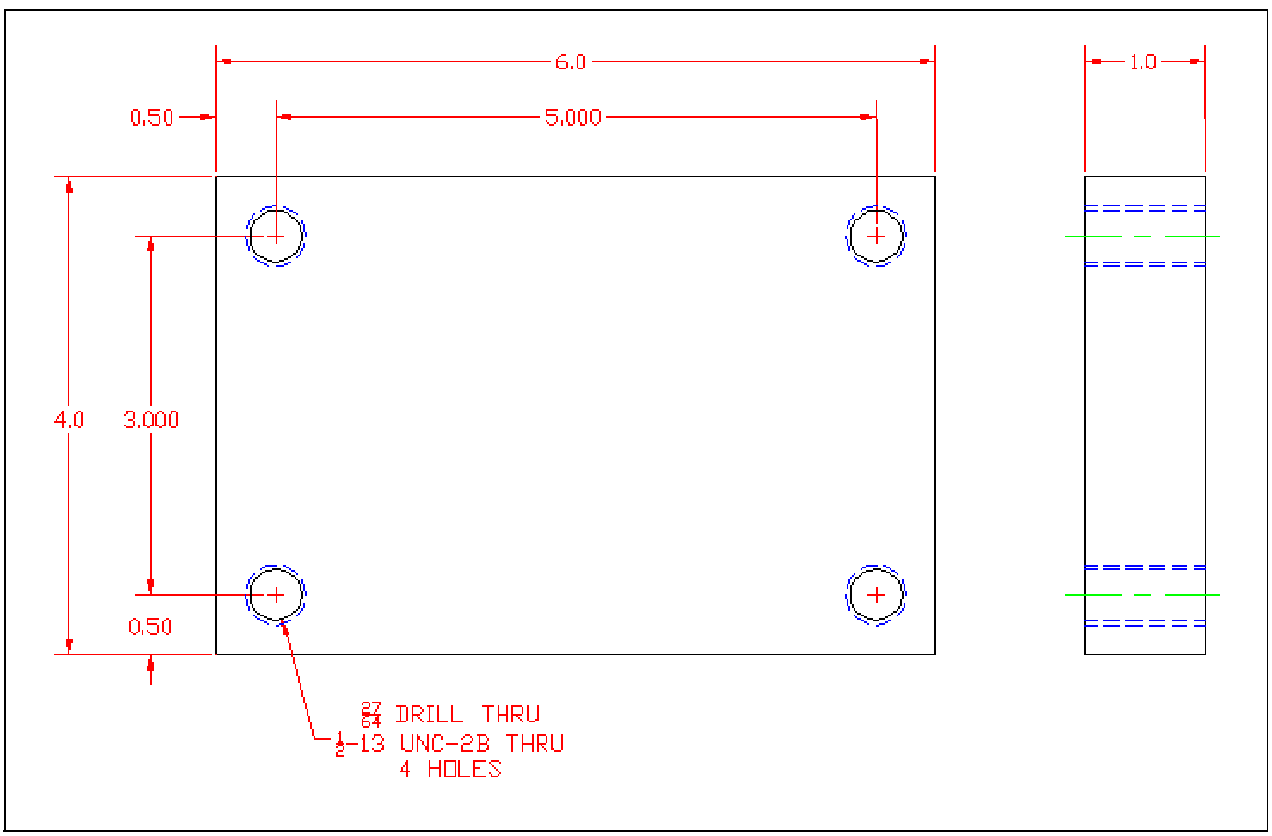

Figure 9.21 – Four Internal Threads in a Plate

Mirror the center and four hidden lines across the midpoint to show the tapped hole on the bottom of the right orthographic view. Our finished drawing will appear as shown in Figure 9.21. We can check our drawing time and see if we are less than 5 minutes. If not, start a new drawing a practice the procedure again.

*** World Class CAD Challenge 8-41 * - Draw four 0.5 – 13 UNC – 2B x 1.0 long internal threads on a 1.0 thick, 4.0 x 6.0 plate in 5 minutes. Save the drawing as Plate with Internal Thread.dwg.**

Continue this drill four times using some other size screw threads from Unified National Screw Thread Table in this textbook, each time completing the drawing under 5 minutes to maintain your World Class ranking.

Drawing and Making a Blind Sided Internal Thread

We will begin this problem by drawing another 4.0 x 6.0 rectangle with right hand orthographic view that is 1.0 inch wide. Next draw two circles, a 27/64 (0.421875) inch diameter circle and a 1/2 (0.5) inch diameter circle on the lower left intersection of the 4.0 x 6.0 rectangle. Move the two circles a half an inch to the right and an half an inch up into the rectangular shape.

Now to create a 0.5-13 UNC tapped hole only 0.50 deep in the plate, we first drill a hole 0.77 deep in the part with 27/64 drill. This is called a blind hole since the drill will not break through the wall of the plate. The inside circle is shown with a continuous line in the simplified method. In the machining of the screw thread, a 0.5-13 UNC bottom tap is twisted in the 27/64 diameter hole, cutting the thread 0.50 in the part. The outside circle is shown with a hidden line in the simplified method. Place a center mark inside the two circles. At this moment, we will array the two circles and the center mark representing the 0.5-13 UNC tapped hole in a bolt pattern of 5.000 x 3.000.

We want to project the lines off the tapped holes to the right orthographic view. A centerline is projected off the center mark and four hidden lines are projected off the north and south quadrants of the tapped hole. What is different about this side view is that the thread is 0.50 deep and the drill depth is 0.77 deep. We will offset two lines, one 0.50 and a second 0.77 off the top of the blind hole, turning them into hidden lines. Trim lines as shown. Draw two more hidden lines 30° off the 0.77 hidden line to form the shape of the drill flute as in Figure 9.22

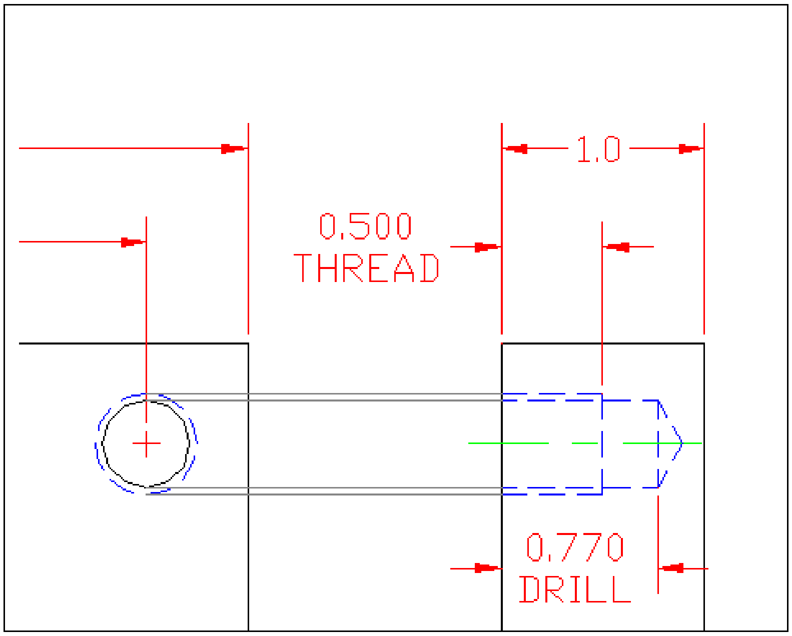

Figure 9.22 – Four Internal Threads in a Plate

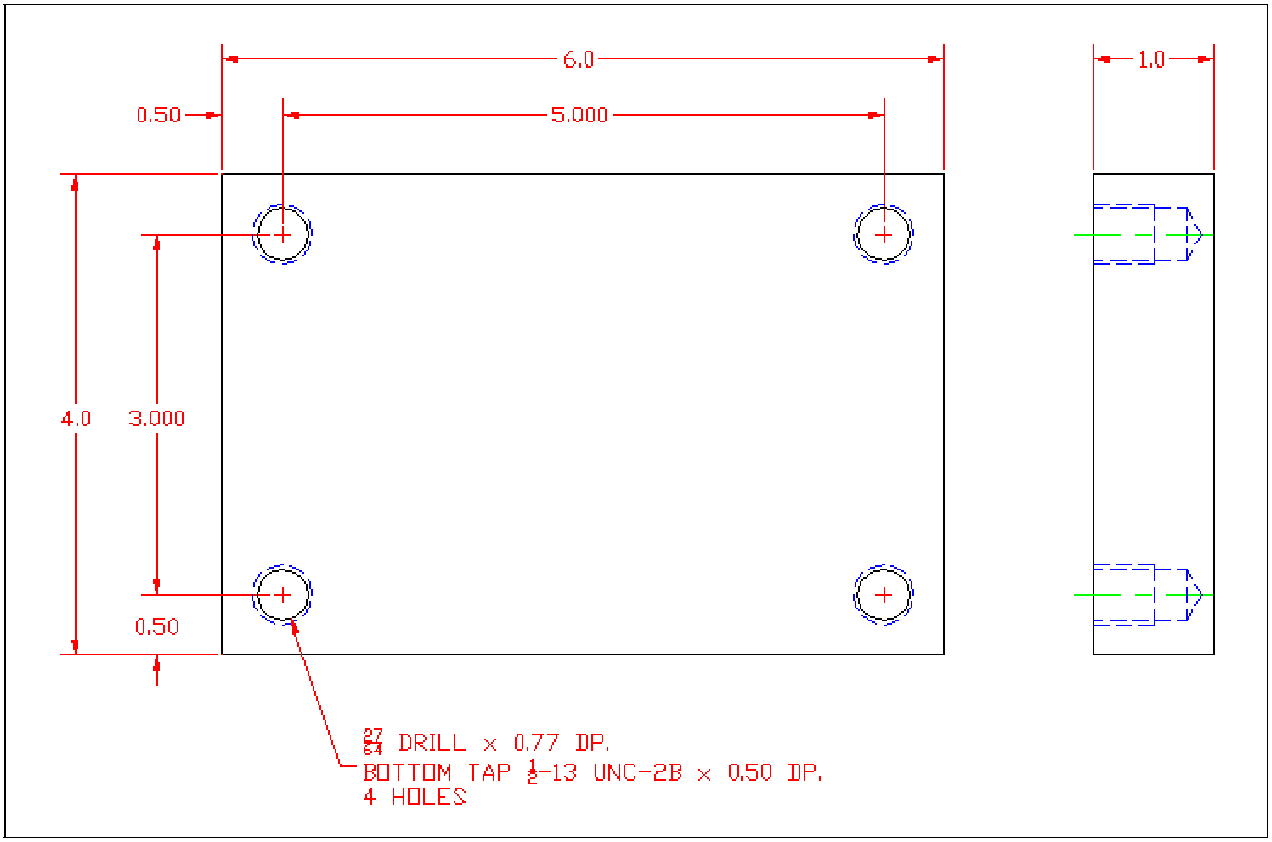

Figure 9.22 – Four Internal Threads in a Plate

Mirror the center and four hidden lines across the midpoint to show the tapped hole on the bottom of the right orthographic view. Our finished drawing will appear as shown in Figure 9.22. We can check our drawing time and see if we are less than 5 minutes. If not, start a new drawing a practice the procedure again.

*** World Class CAD Challenge 8-42 * - Draw four 0.5 – 13 UNC – 2A x 0.50 deep internal threads on a 1.0 thick, 4.0 x 6.0 plate in 5 minutes. Save the drawing as Plate with Blind Internal Thread.dwg.**

Continue this drill four times using some other size screw threads from Unified National Screw Thread Table in this textbook, each time completing the drawing under 5 minutes to maintain your World Class ranking.

Fastening Head Types and Purposes

To drive a fastener into a threaded hole, there are different head types for different applications. The many variety of heads but the most common shapes are:

Hexagon head or Hex head
Fillister head
Flat head
Pan head
Round head
Truss head

HEXAGON HEAD
In heavy construction such as civil engineering this head type is very common for screw, bolt heads and nuts. In the textbook, Introduction to Computer Aided Civil Design, we will observe the markings in the top of the bolt head which will indicate the strength of the fastener. We would select this fastener for assembly using a 1/4, 3/8 or 1/2 drive socket that fits over the entire hexagon shape. We should specify the torque setting for the bolt and any specific pattern for tightening the assembly together.

FILLISTER HEAD
These fasteners work best in applications where the head of the screw will be set in a counterbored hole. The round head and the counterbore hole will control the alignment of the screw, especially with pattern of four or six fasteners, so even if we have a larger tolerance on the clearance hole with the thread, the recessed head in the part will most probably restrict the positioning of the thread. The cylindrical head and the counterbore will control alignment, so tolerance control in the hole pattern of the mating parts is critical.

FLAT HEAD
Flat head screws, like the fillister head screw, are used in recessed applications, but in this use, the head an 82° angle cut in the part to receive the fastener. The countersink is typically 82°, but there is an optional 100° flat head screw that can be in the company's inventory, so be careful to verify the flat head screw we are using. The angled head and the countersink will also control alignment, as we see in the fillister head application, so tolerance control in the hole pattern of the mating parts is critical.

ROUND HEAD
We have told designers for years that when an assembly does not require critical alignment or holding power, the round head fastener is the choice. We do not get the bearing surface under the head that the pan or truss head furnishes, but the head type is common and inexpensive.

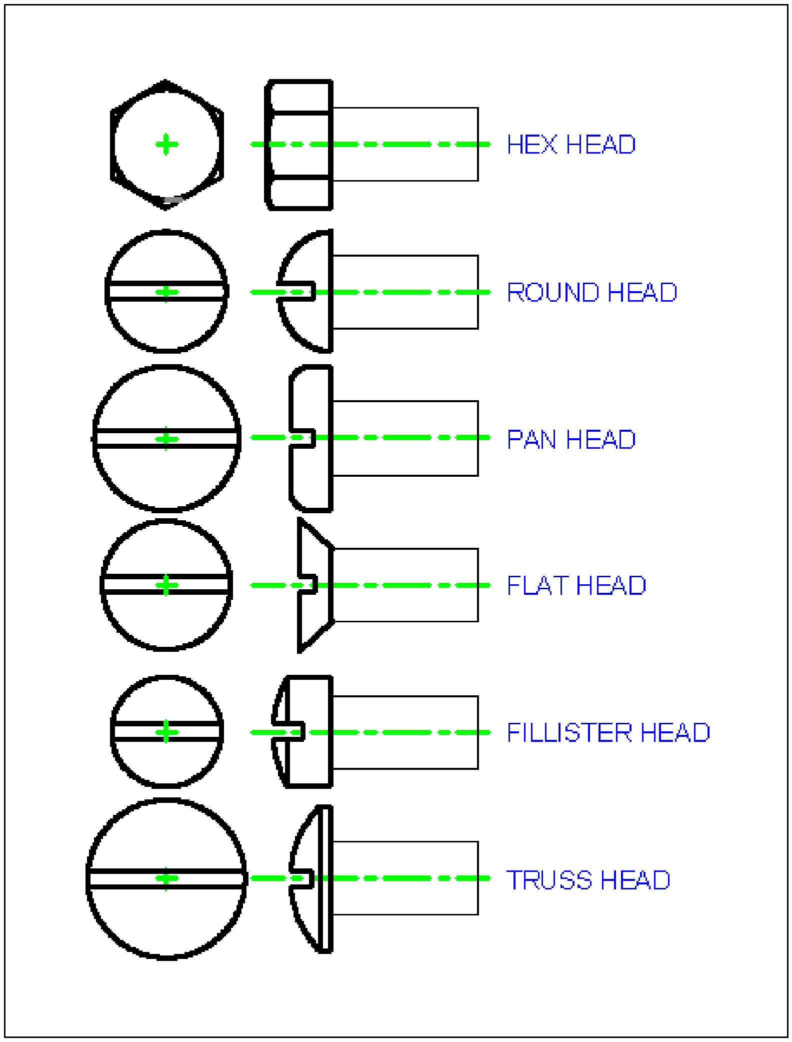

Figure 9.23 – Four Internal Threads in a Plate

PAN HEAD
The larger bearing surface on the bottom of the pan head screw gives the technician a better in assembling parts. Many manufacturers will open the size of the clearance holes accommodate the tolerance of the hole pattern, so a round head screw's bearing surface may not be adequate in the application. The larger diameter of the pan head design is the preferable form in many manufacturing companies.

TRUSS HEAD
This fastener head type is used when we are looking for a lower profile shape and the form has a wider body than the pan head screw.

Drawing a Hexagon Head Screw

When drawing the commonly used hexagon head shape that we see in Figure 9.24 in two dimensions for the 0.5-13 UNC screw, we will start by drawing a circle that has a 0.75 diameter as shown in Figure 9.25. This feature is then circumscribed by a hexagon, which has six sides.

In our CAD program, we select the Polygon tool to draw geometric shapes. Then at the query for the number of sides, we answer with 6. Next pick the center of the hexagon as the center of the circle using the Center osnap. Type a C for circumscribed and Enter. Next type the radius of the circumscribed circle as 0.375 and Enter. A hexagon will appear in the graphical display as shown in Figure 9.26.

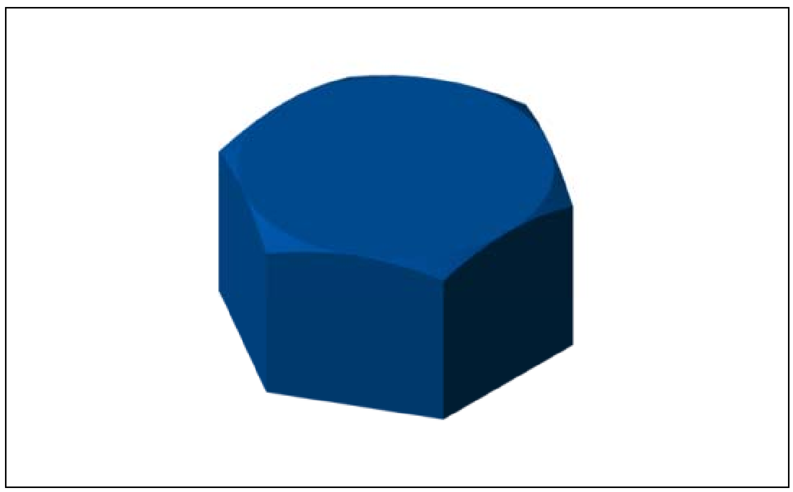

Figure 9.24 – Hexagon Head

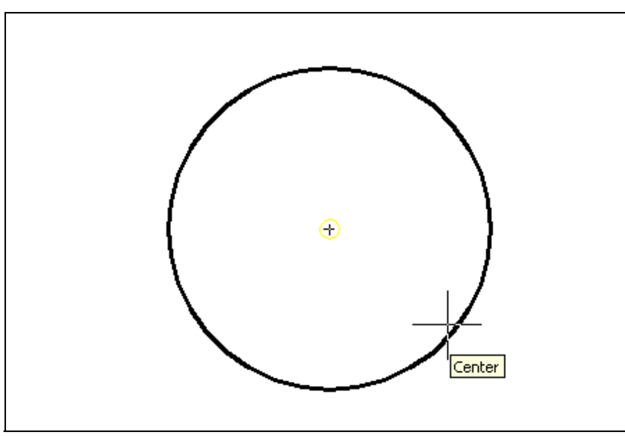

Figure 9.25 – A 0.75 Diameter Circle

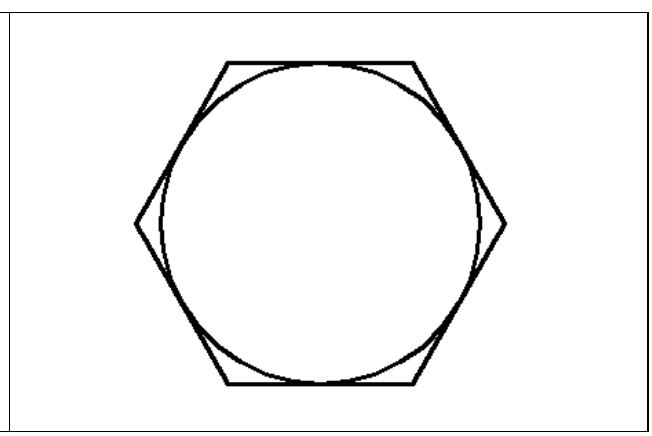

Figure 9.26 – A Circumscribed Hexagon

To place the hexagon or hex head screw head in top view typically shown, we rotate the top view 30° as shown in Figure 9.27. We want to project the lines off the top view of the hex head form to the right orthographic view. Draw a single vertical line about 0.25 from the right side of the top view and offset a line 0.4375, the width of the hex head screw for a 0.5-13 hex head screw.

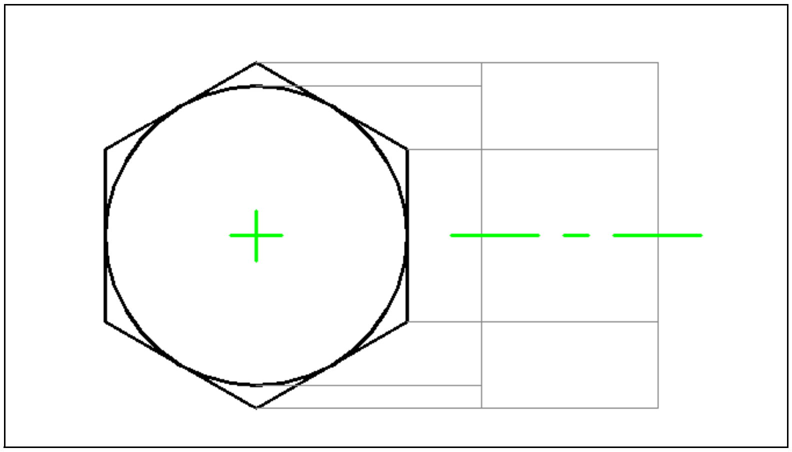

Figure 9.27 – Making a Right Orthographic View

Draw a center mark on the top view and project a centerline off to the right as shown. Now, two lines are projected off the north and south quadrants of the circle to the first vertical line and four lines off the intersecting points of the hexagon to the second vertical line as shown in Figure 9.27.

There is a 30° chamfer on the top of the hex head screw as we can view in the three dimensional, Figure 9.24. We will draw a line at a 30° angle from the intersection of the vertical line and the line projected off the north quadrant. Next, we mirror the angled line across the centerline as shown in Figure 9.28. We then use the fillet radius "0" to form a perimeter as shown in Figure 9.29.

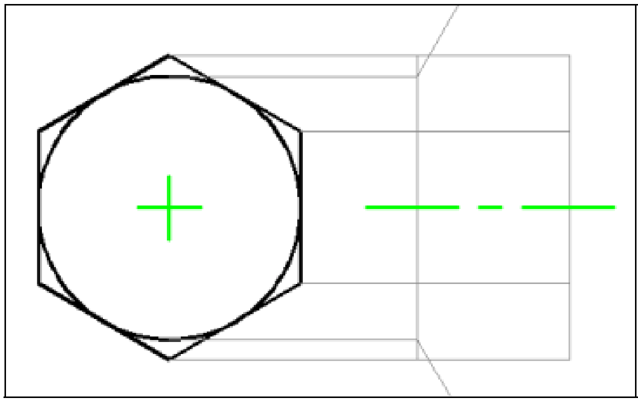

Figure 9.28 – Forming the 30° Chamfer

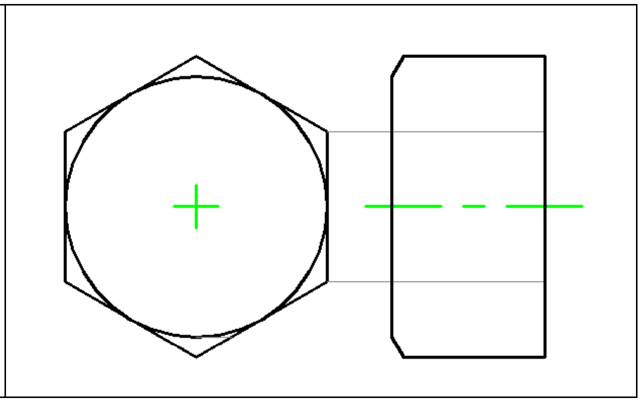

Figure 9.29 – Forming the 30° Chamfer

As we can observe by looking at a solid hex head screw head is that there are three arcs appearing at the top of the screw head which are formed when the manufacturer makes the 30° chamfer on the top of the head. When we draw a two dimensional representation of the hex head, we will draw these arcs.

Figure 9.30 – Solid Hex Head Side View

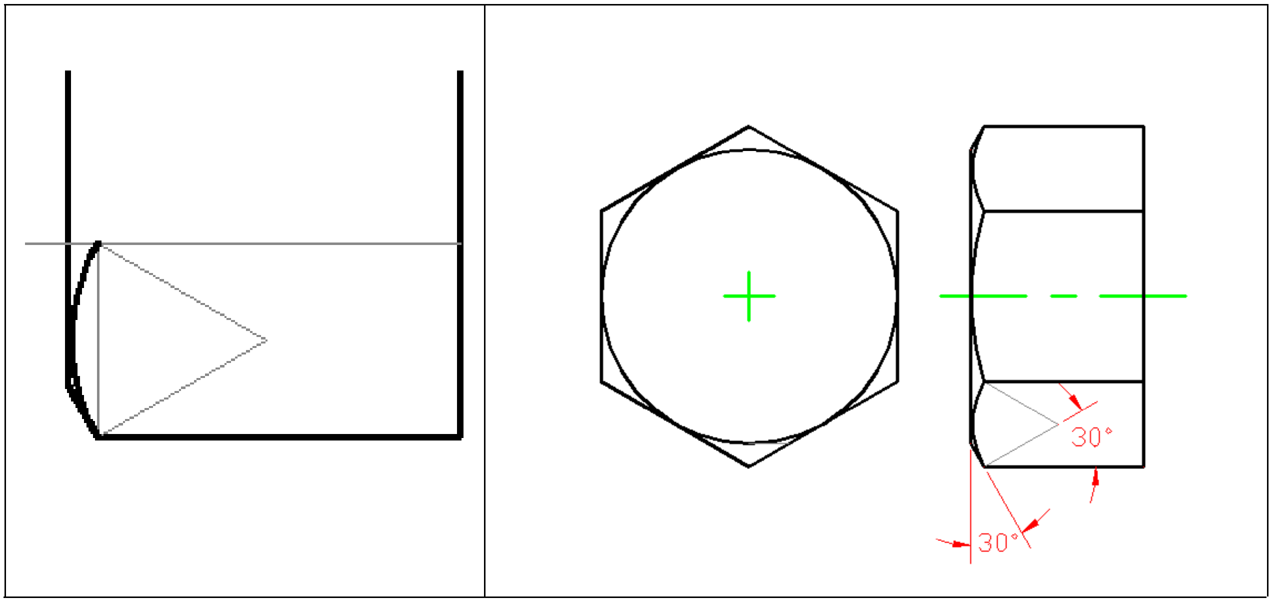

Figure 9.31 – Finished 2D Hexagon Head with Arcs in the Right Orthographic View

As we can see in Figure 9.31, we draw a short vertical line off the 30° chamfer as we see in the picture to the left. Project 30° angled lines to find the center point of the radius we will want to draw in the small bottom section of the right orthographic view. We used the Arc tool beginning by defining the Start Point at the top of the arc, then the Center Point and finally the End Point. Remember that an arc is drawn counterclockwise. Mirror the finished arc across the centerline to the top section. Use the Arc tool to draw a 3 point arc for the middle arc, staring at the top for the Starting Point, the Midpoint for the second point and the bottom will be the endpoint.

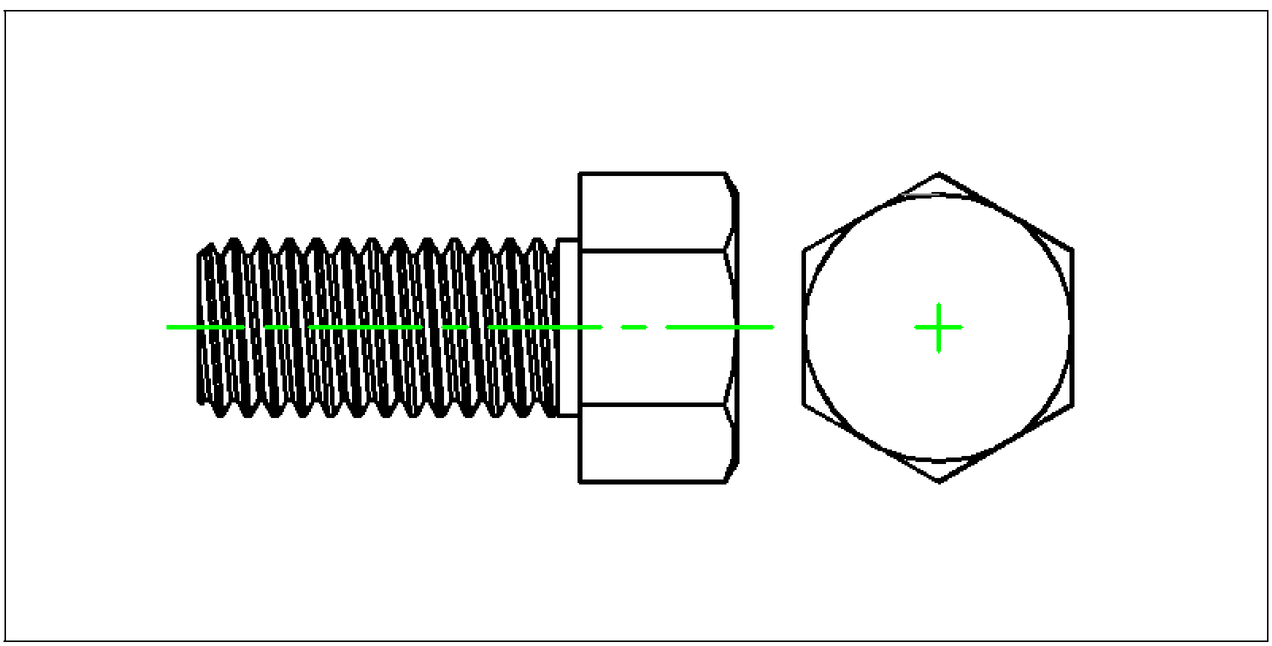

Figure 9.32 – A 0.5-13 UNC -2A x 1.0 Long Hex Head Screw

We went ahead a placed the screw thread on the base of the hex head and made a 0.5-13 UNC – 2A x 1.0 long Hex head screw. With practice this will become an easy task just taking a few minutes. Although there are many fastener libraries and programs available to supply us with details of common fasteners, architects, designers and engineers need to remember how to create threaded fasteners and to customize them for their applications. Custom fasteners still only costs pennies compared to more expensive parts and for us to require specialized machining in the field, their use will be greatly appeciated. At World Class CAD, we recommend to any professional in the field to have the ability to research fastener dimensions and how to create them in their computer aided design program.

*** World Class CAD Challenge 8-43 * - Draw a hexagon head screw with 0.5 – 13 UNC – 2A x 1.0 external threads in 5 minutes. Save the drawing as Screw, Hex Head 0.5-13 x 1.0.dwg.**

Continue this drill four times using some other size screw threads from Unified National Screw Thread Table in this textbook, each time completing the drawing under 5 minutes to maintain your World Class ranking.