TRANSFR Inc. Blueprint Reading
General Standard Symbols, Screw Callouts and Thread Symbols - Simulation Outline

Diagram: https://app.diagrams.net/#G1iGxCqY024nN2ugGGznV1I6Hm2eaziLcn

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Resources

- Standard Dimensioning: https://www.youtube.com/watch?v=DpNWrwWsUL8

Learning Objectives

- Trainee will identify common dimensioning symbol and interpret screw callouts within the context of a technical drawing.

Prerequisites: Technical Drawings Simulations1-3

Animated Tutorial

Setting the Scene (about 15 seconds)

[Trainee is sitting at a drafting desk. On the desk are several items: rolled up blueprint, toy car, and small square of wood. Next to the desk is a globe.]

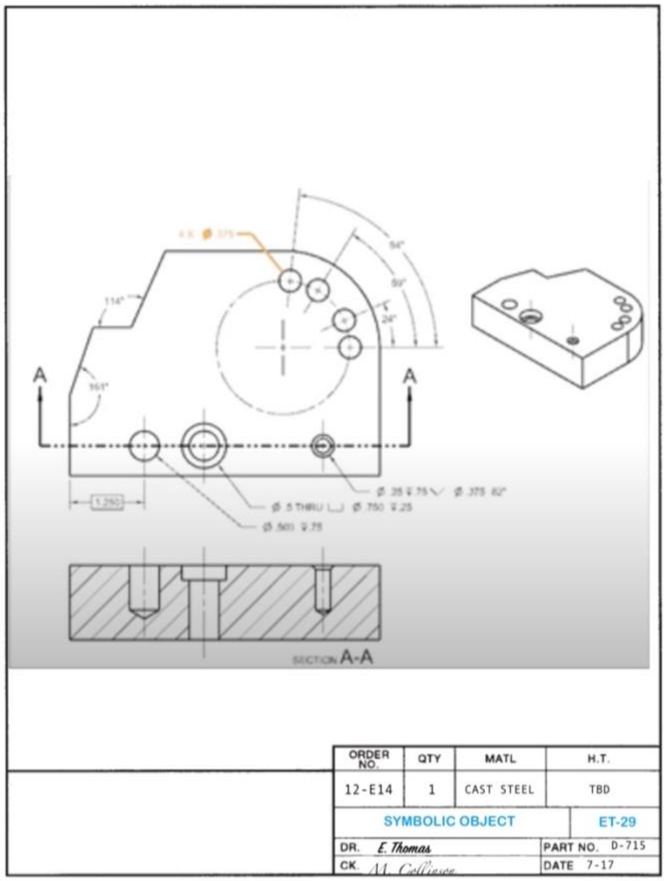
Welcome to the workroom! We will continue our exploration of reading technical drawings and dive deeper into common markings that specify a design. We will explore common symbols, how these symbols are used in annotations and identifying types of screws called out within a technical drawing. Let's get started!

#1 Symbols Intro

1. Let's take a look at a technical drawing and decode some of the markings.

Trainee prompt: *Touch the rolled up blueprint so you can see the drawing.*

[blueprint unfurls, flat onto desk][drawing appears after it unfurls]



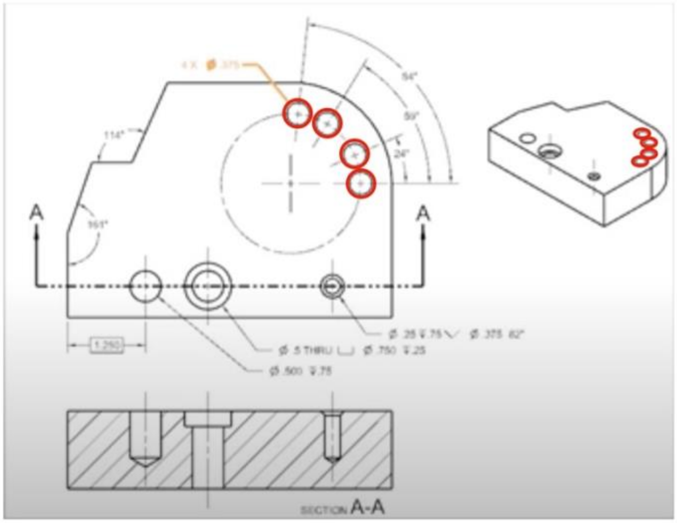
As you can see there are some symbols and lines that may look familiar, like extension lines, center lines, and leader lines . In this drawing, and a few others, let's work through some new symbols that further communicate design details.

1.1 Angular Dimensions

2. Take a moment to scan the drawing and look at some of the frequently used shapes in the drawing. As you can see, there are several holes in this object, each with a center mark.

[highlight all seven holes]

Trainee prompt: *Touch the four holes that are marked with angles.*



[trainee touches four holes marked with angles]

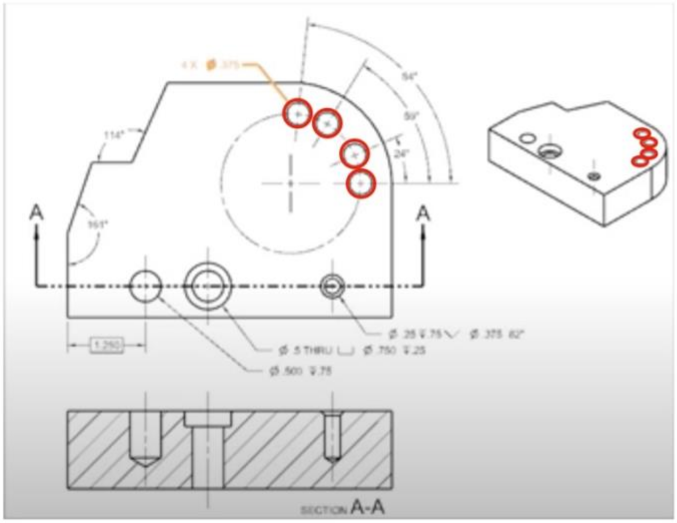
[large 2D box floats above the drawing with question text plus VO:
What method is used to dimension these four holes?
[Choices on buttons:
Coordinate Method
Angular Method]

[if trainee selects Angular] That's right!
[if trainee selects Coordinate] That's not quite right!

Here we see the angular method used to dimensions the degree of the angle itself and one distance along the angle. If the coordinate method was used it would only show two locations distances along the angle.

1.2 Holes

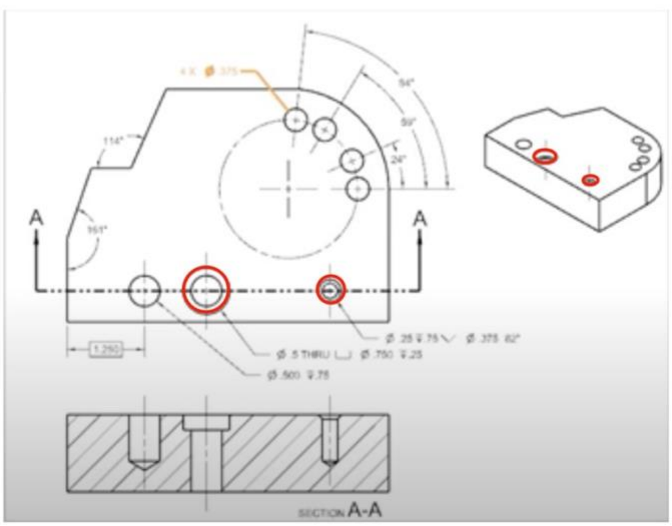
In technical drawings there are two types of holes: simple holes and compound holes. Previously, you saw simple holes like this one.
[highlight the five simple holes in the pictorial view and drawing]



Trainee Prompt: *Touch the other four simple holes.*

[trainee touches the other four simple holes]

These types of holes depict a drilled hole that do not go all the way through the object. The second type of hole is called a compound hole.

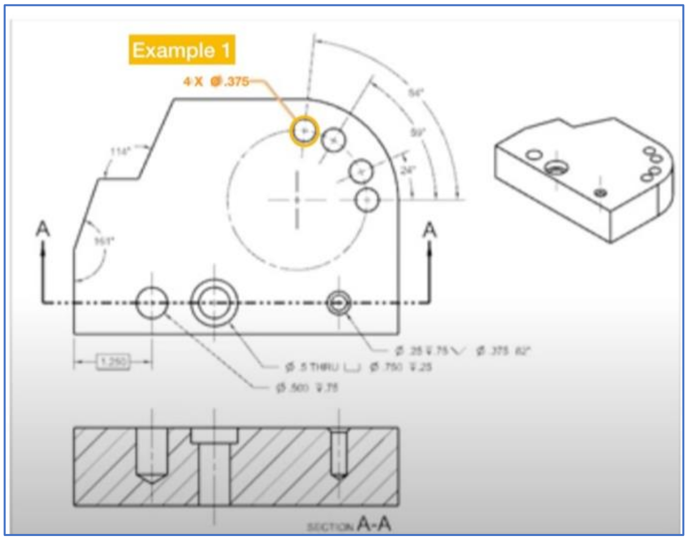


[highlight two compound holes]

These are identified by two concentric circles and indicate inside the hole is a deeper hole. In your everyday life you have seen this, like a [INSERT REAL LIFE EXAMPLE HERE—like a well or pipe or golf ball hole].

1.3 Times & Diameter

3. In the top right of the object, a leader line that points to one of the holes has an annotation to the left of it.



[highlight annotation 4 x Ø .375][other annotations and leader lines disappear on drawing]
Trainee prompt: *Next to the highlighted annotation is a leader line. Touch the hole that connects to the leader line.*

You should recognize a symbol in the annotation.
[highlight Ø in annotation]

large 2D box floats above the drawing with question text plus VO:
What does Ø mean?

[Choices on buttons:

- Depth
- Diameter
- Radius
- Symetrical]

[if trainee selects Depth] That's right!
[if trainee selects another response other than Depth] That's not quite right!

This is the diameter symbol. It always accompanies a circle, in the case of this drawing it's a hole. But what about the other numbers and symbols before the diameter?

[highlight 4X on annotation]
At the beginning of the annotation we see "4 X".
[highlight four circles on drawing and on pictorial view]
The number four is describing the four holes. The letter "X" means *times* or *by*. So, putting it all together this means four holes by diameter .375 inches.

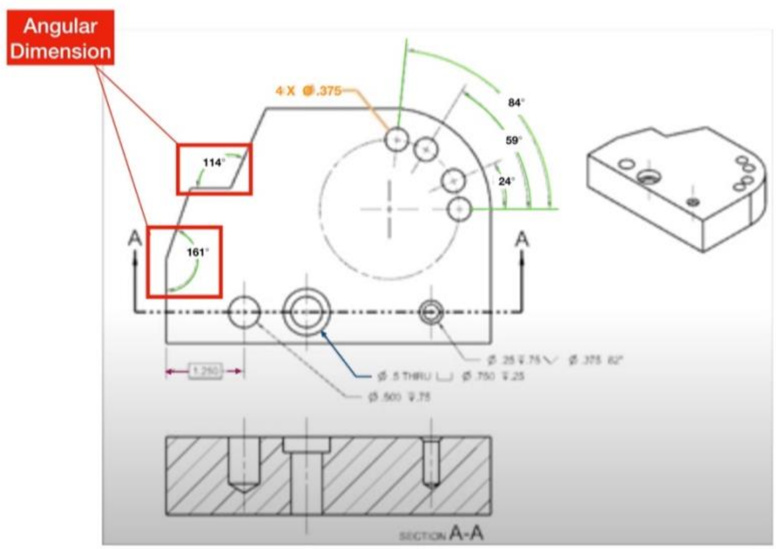
We can see there are some angular dimensions marked by the holes, encompassed by extension lines.

[highlight 24°, 59°, and 84° (near four holes) and 114° and 161°].

Trainee Action: Touch the other two angles labeled on the left side of the drawing.

[trainee touches 114° and 161°]

Nice!



Trainee Action: Touch the angle that is not correctly dimensioned.

[trainee touches 161°] That's right!

[trainee touches 114°] That's not quite right!

The 161° should *not* be labeled on the object itself. As we know, it's poor practice to place dimensions on the part. To correct this, extended the vertical object line with a vertical extension line. Then define the edge of the angled surface using an acute angle.

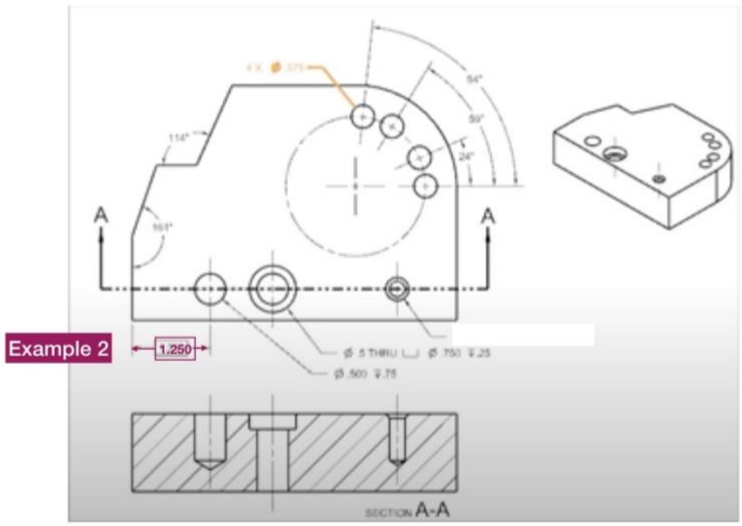
[161° dimension on object fades and corrections are made]

1.4 Dimension Measurement Unit

Let's move to the bottom half of the drawing. In the bottom left corner, is a dimension value of 1.250.

[other annotations and leader lines disappear on drawing]

Trainee Action: Touch the dimension value.



[trainee touches 1.250]

In a previous lesson, we discussed the unit of measure is implied by notation on the drawing's title block.

[large 2D box floats above the drawing with question text plus VO:

Based on the title block, what is the unit of measurement in this drawing?

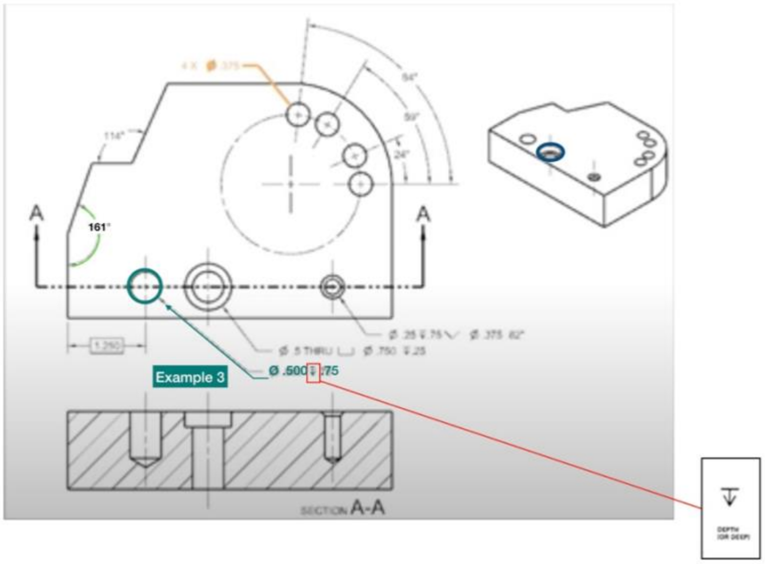
[Choices on buttons:

Millimeters
Inches
Centimeters
Meters]

[if trainee selects inches] That's right!
[if trainee selects another response other than inches] That's not quite right!

Since SI or Metric is not notated on the drawing, we can infer that the drawing is not dimensioned in millimeters, but in decimal-inch. This confirms the use of American measurements. So, this portion of the object is a basic dimension of 1.250 inches.

1.5 Depth



Next to the basic dimension, is a simple hole.

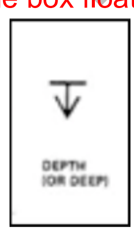
[large 2D box floats above the drawing with question text plus VO:
What is the diameter of the hole?

[Choices on buttons:
5 inches
½ inch
¾ inches]

[if trainee selects ½ inch] That's right!
[if trainee selects another response other than ½ inches] That's not quite right!

The use of the diameter is symbol is followed by a value. In this case the hole is ½ inch in diameter.

[highlight depth symbol in annotation]
The symbol following the diameter value looks like an arrow pointing down. Let's magnify this symbol so you can see it better.
[large box floats above the drawing with depth symbol]



This is called the depth symbol. It's commonly identified by two features: the downward arrow and the line above the arrow.

[highlight straight line in symbol]
This small *straight* line is depicting the surface. Since the arrow is pointing down, *below* the surface, we know that it's indicating depth, or how deep a the hole is.
[symbol disappers]
[annotation continues to highlight on technical drawing]
Let's look back at the annotation.

[large 2D box floats above the drawing with question text plus VO:
What is the annotation saying as a whole?

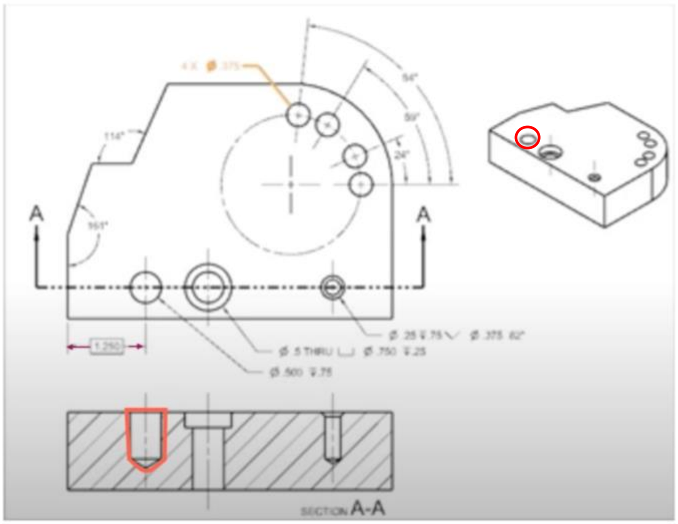
[Choices on buttons:

The hole is 1/2 millimeter in diameter drilled to a depth of 75 meters
The hole is 5 feet in diameter drilled to a depth of 3/4 centimeters
The hole is a 1/2 inch in diameter drilled to a depth of 3/4 inches]

[if trainee selects the hole is 1/2 inch in diameter drilled to a depth of 3/4 inches] That's right!
[if trainee selects another response other than the hole is a 1/2 inch in diameter drilled to a depth of 3/4 inches] That's not quite right!

Additional detail about this hole is illustrated in the cross section below the object. Take a look at the cross section of the holes.

Trainee Action: Touch the hole in the cross section that corresponds to the hole in the object.

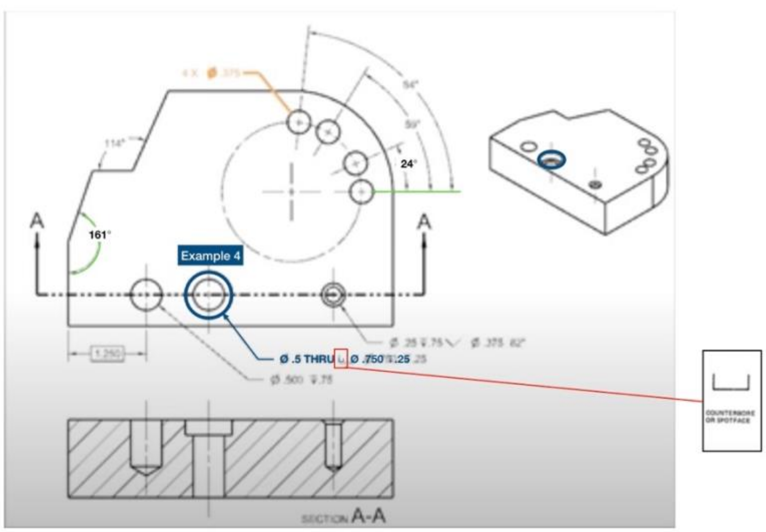


[trainee touches far left hole in cross section][sfx confirmation]
[highlight far left hole on cross section and pictoral view on right]

The cross section show that this is considered a “blind hole”. In other words, the hole doesn’t go all the way through the part.

1.6 THRU and Counterbore

[highlight middle hole on the bottom of drawing]



Trainee Action: Touch the hole in the middle.
[trainee touches middle hole]
Based on the annotation next to this hole, it has a few more features than the last hole we talked about. This hole is called a compound hole. We mentioned earlier that a compound hole is identified by two concentric circles and indicate the hole has a deeper hole inside of it.

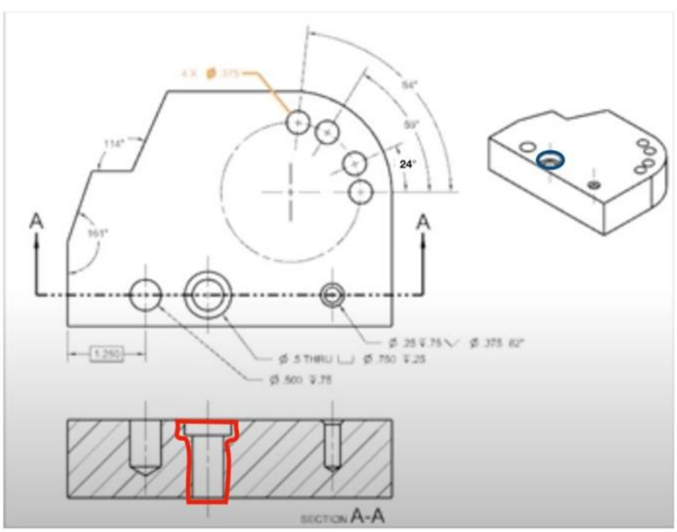
Let’s focus on the first half of the annotation.

[large 2D box floats above the drawing with question text plus VO:
What is the diameter of this compound hole?

[Choices on buttons:
- ½ inch
- ½ millimeter
- ½ meter]

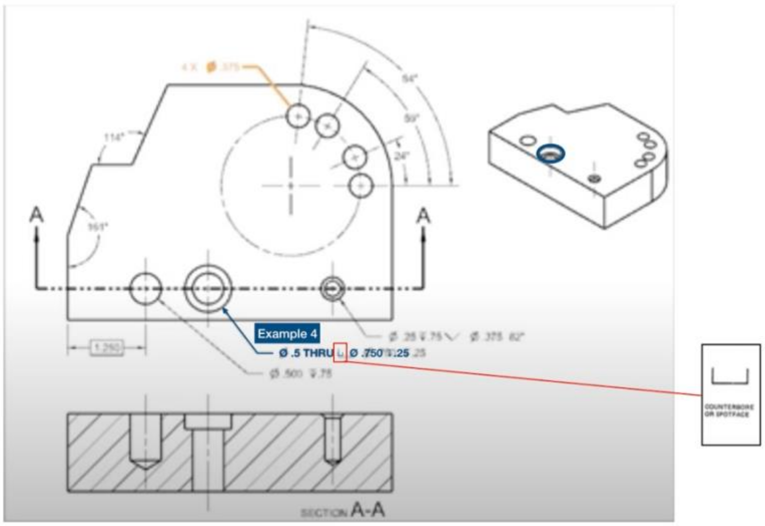
[if trainee selects ½ inch] That’s right! The diameter is a half inch.
[if trainee selects another response other than ½ inch] That’s not quite right! The diameter is a half inch.

This first half of the annotation is external part of the hole, while the second half, the larger dimension, is about the inner hole.
[large box floats above the drawing with THRU]
Next to the diameter symbol is the work “thru”. This notation means the inner hole has a diameter of a half inch and it goes thru the part. [highlight hole in cross section]



This is further confirmed by the cross section shown below the drawing.
[large box floats above the drawing with THRU disappears]
[large box floats above the drawing with depth symbol]]

Next to the “thru” notation, is a symbol that looks like the top of a letter “H”. This is called the **counterbore** symbol.



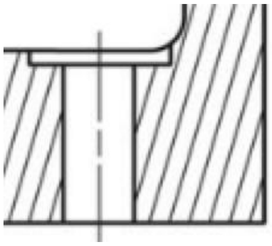
[⌴ (counterbore symbol) magnifies]

This symbol indicates a hole meant for a certain type of screw. If you look closely in the cross section, the shape of the hole resembles the head of a flat head screw. That's because it is meant for a flat head screw. We will talk another symbol and types of screws later.

[*Ø .5 THRU ⌴ Ø .750 ↧.25* annotation highlights]
[highlight 0.5]
So this annotation is describing two holes. The smaller dimension is the hole.
[highlight 0.75]
The larger dimension is the counterbore hole.

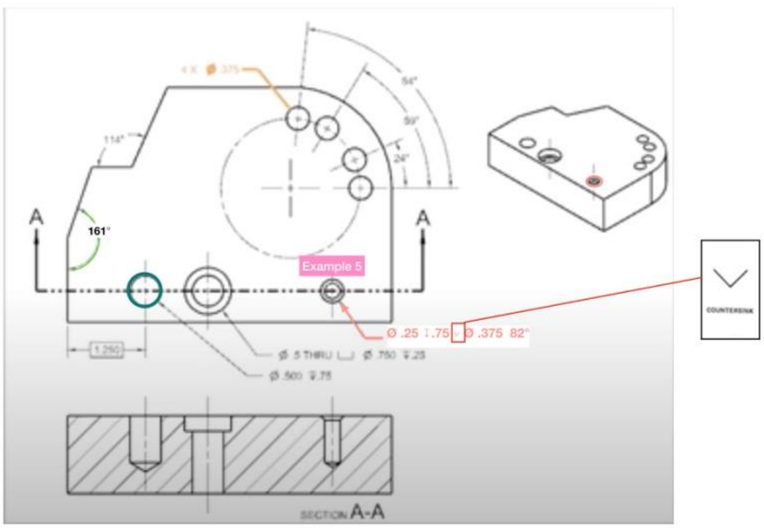
Now we can read the whole the annotation. It says "the inside hole has a diameter of a half inch and it goes thru the part; counterbore hole has a diameter of ¾ inches is cut to a depth of 0.25 inches".

A quick note about the counterbore symbol. Notice that in this annotation that after the counterbore symbol is details about depth. If depth was not provided, this counterbore symbol would be called "spotface". The shape of the symbol doesn't change but the hole would look different becase it lacks depth. It would look like this.



[spotface hole disappears]

1.7 Countersink



Ok, now let's look at the last hole. You should be able to read the first two symbols in this annotation.

[large 2D box floats above the drawing with question text plus VO:
What does Ø .25 ↧.75 mean?

[Choices on buttons:

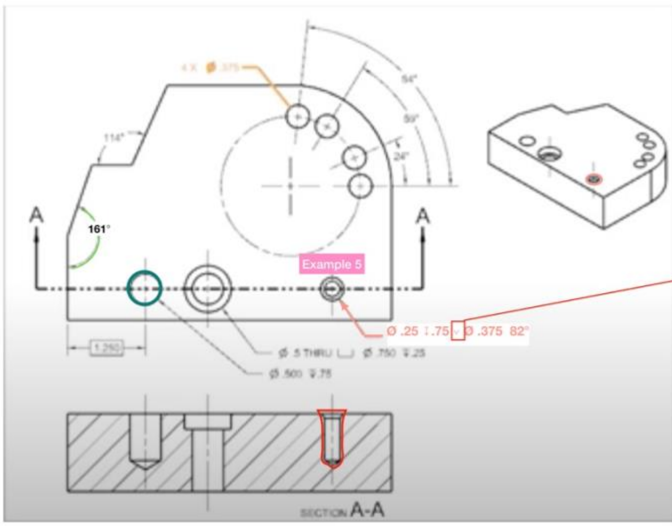
- Depth of three quarter inches with diameter of a quarter of an inch
- diameter of quarter of an inch that is drilled to a depth of three-quarter inches
- couterbore of one inch drilled to a depth of three quarter inch]

[if trainee selects diameter of quarter of an inch that is drilled to a depth of three-quarter inches]
That's right!
[if trainee selects another response other than diameter of quarter of an inch that is drilled to a depth of three-quarter inches] That's not quite right!

It reads “diameter of quarter of an inch that is drilled to a depth of three-quarter inches”. Then there is a symbol in the annotation that looks like a small “v”.

[large 2D box floats above the drawing with ∨ symbol]

This is the countersink symbol. It relates to a type of screw that has a “v” shape at the tip.



The corresponding cross section confirms that this is a hole meant for a screw shaped with a pointed tip.

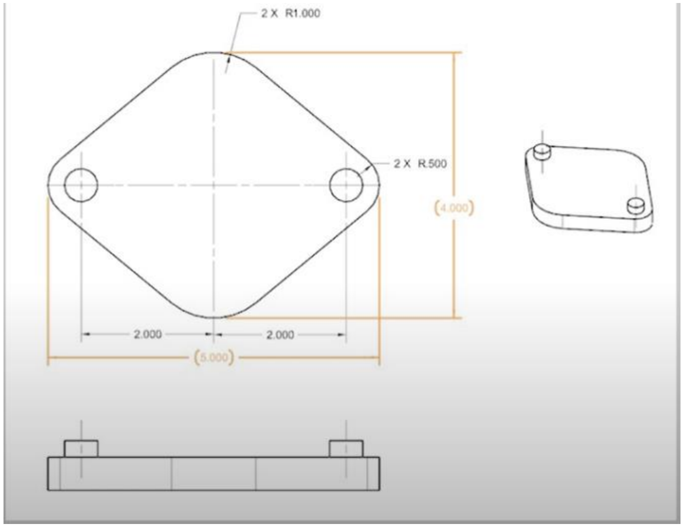
The last part lists 82 degrees. This degree measurement is referring to the countersink angle. of 82 degrees.

As a whole the annotation reads “Internal feature is a hole of diameter .25 inches that is drilled to a depth of .75 inches, countersink is cut to a diameter of .375 inches with a countersink angle of 82 degrees”.

Let’s roll up this technical drawing and check out some more symbols on another one.

Trainee Action: *Touch the edge of the drawing to roll it up.*

1.8 Radius and Reference Dimension [slide 5]



Trainee Action*: Touch drawing to unroll it.*

Pictured here is a rounded shape. You should recognize some of the lines types here as well as the letter in the annotation.

[large 2D box floats above the drawing with question text plus VO:
What does the letter R mean in the annotation?

[Choices on buttons:
- Rombus
- Rounded
- Radius]

[if trainee selects Radius] That's right!
[if trainee selects another response Radius] That's not quite right!

The letter R stands for radius.

Trainee Action: Touch the hole on the right side with an annotation next to it.
[highlight circle with annotation 2x R.500]

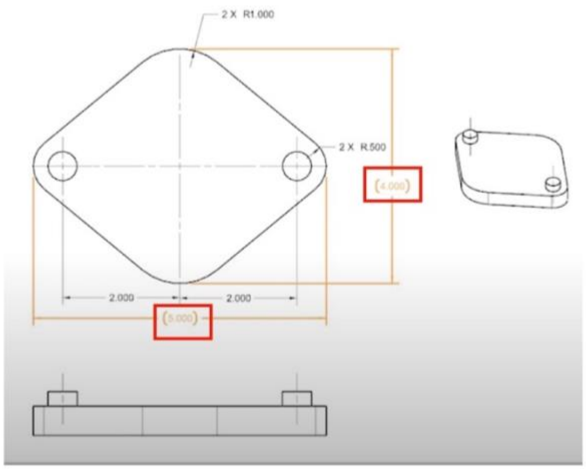
At the beginning of the annotation is a two "X". The number two tells us there are two identical shapes, in this case, two bosses—the parts that extend out of the shape.
[highlight bosses on all three images]
Remember, radius can be used on all shapes, EXCEPT for objects with circular features. in the previous object we saw circles use the diameter symbol.

The radius here is has a dimension value of .500 of an inch, in other words, a half an inch. We can tell this drawing is in American measurements because of the use of decimal-inch.

As a whole, the annotation reads “two bosses with a radius of a half inch.”

Notice the two extension lines on the right side and the bottom of the image.

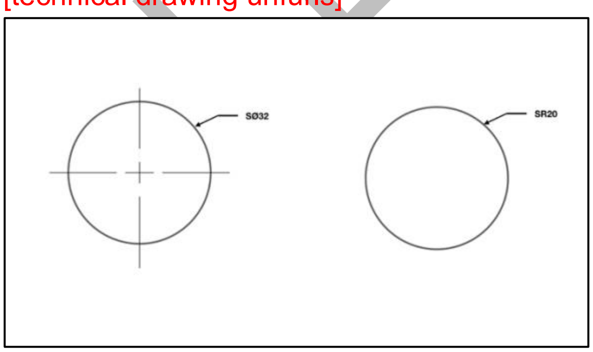
Trainee Action: Touch the two dimension values in parenthesis between the extension lines.



This is called a reference dimension. Using reference dimensions indicate the approximate size of an object. If these dimension values were not in parenthesis this object would be over dimensioning

Trainee Action: *Touch the edge of the drawing to roll it up.*

Spherical Diameter & Spherical Radius
I’m going to place a new drawing on your desk.
[technical drawing unfurls]



Next to your desk is a globe. A globe is a sphere shape and two symbols are associated with this shape.

***Trainee Action**: Use the grip button on your controller to take the globe out and put it above your desk. I will hold it up.*
[globe hovers over desk]

You are already familiar with diameter. On a sphere diameter runs around the circumference of the sphere.
[VFX lines go around the circumference of the globe]

[highlight annotation SØ32 on technical drawing]

Take a look at the drawing.
[large 2D box floats above the drawing with SØ symbol]
The combination of the letter “S” and the diameter symbol mean spherical diameter. Here the spherical diameter is 32 inches.

Look back at the globe.
***Trainee Action**: Use your controller to divide the globe in half to create a half sphere*
[VFX lines go from center point to edge of globe]
[top half of globe disappears]

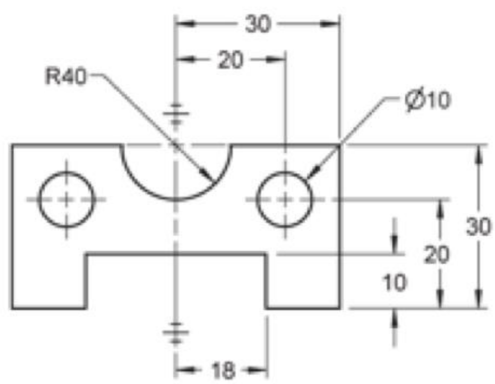
This half sphere better shows the radius. The radius runs from the center point to the edge of the object.

[highlight annotation SR30 on technical drawing]
[large 2D box floats above the drawing with SR symbol]
On any spherical object, like this globe, this is called the spherical radius.

Trainee Action*: Use the grip your controller to grab the globe and put it back on its stand.*

Ok now that the globe is back where it belongs, let's add another object on the drawing.

Trainee Action: *Tap the blank space around the object.*
[object 1 appears on drawing]

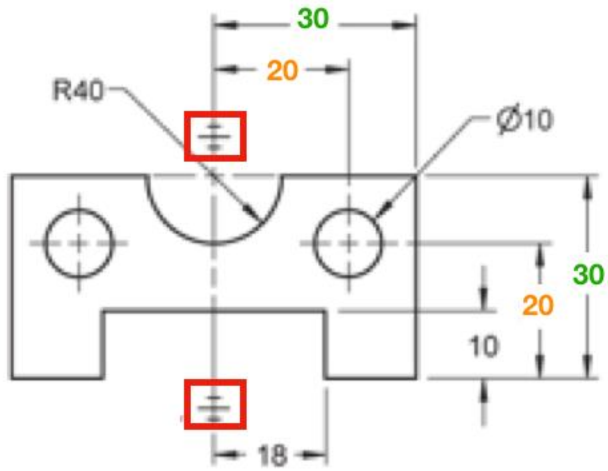


[object 1]

As you can see this object has two holes and most of the dimensioning is on the right side of the object.

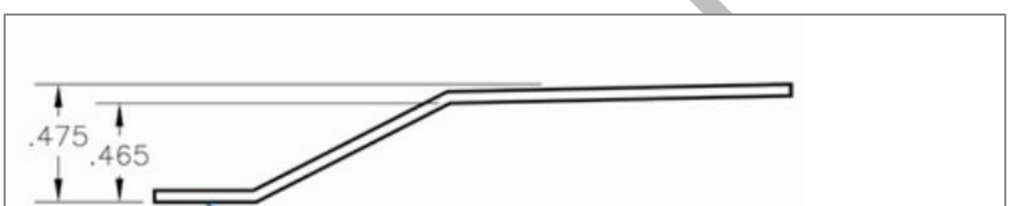
Trainee Action*: touch the dimension values that repeat.*
[trainee touches 30 and 20]
[all dimensions grey out except for 20 and 30]

Since these values are exactly the same, we know that it's symmetrical.



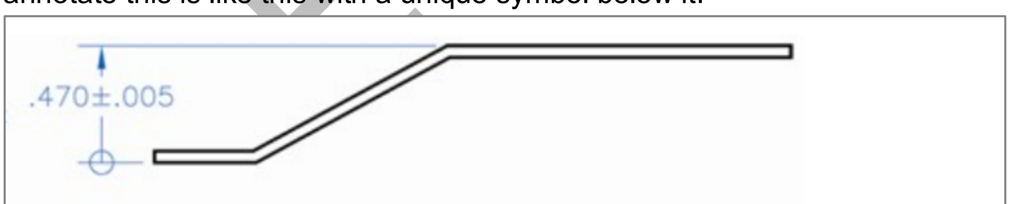
[symmetrical symbols appears (three stacked lines)]
[highlight symmetrical symbols]
This can be notated using the symmetrical symbol.

Let's a third object to this drawing.
[object # appears]



[Object #]

Notice the height of each dimension is a one one-hundrendths of apart. Another way to annotate this is like this with a unique symbol below it.

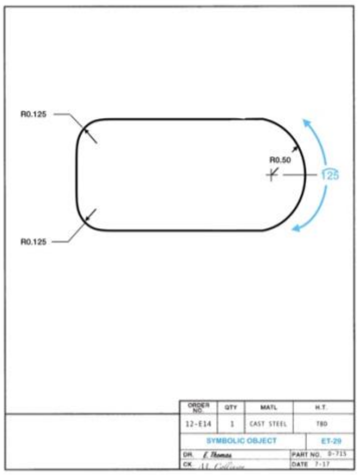


This is called the "dimension origin symbol". This is also called the DATUM. It acts an an anchor for machinist to check

Ok let's move on to the next drawing. I'll roll this one up while you get the next one.
[highlight drawing]

Trainee Action: *Use the grip on your controller to grab the rolled up drawing. I've highlighted it for you.*

1.10 Arcs—Radius and Arc Length



Trainee Action: *Tap the right side of the object to reveal the values and symbols.*
[arc length appear]
On the right side is labeled 125 with an curve above the value. This is the arc length. In this case the arc length is 125 [measurement unit].

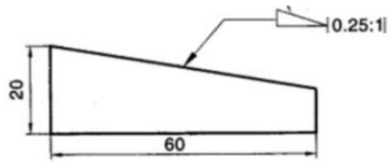
Let's check out another symbol.

Trainee Action: *Tap the blank space around the object.*
[object 1 appears on drawing]

[Object 1]

This object is a screw shaft.
[highlight taper symbol ("paper airplane symbol")]
On the top is a symbol that looks like a paper airplane with a line running through the middle. This is called the conical taper symbol.
[highlight values next to taper symbol]
The values next to the taper symbol indicates the slope of a conical shape. Here the slope is [1:50], telling us that the [meaning].

Trainee Action: *Tap the blank space around the object.*
[object 2 appears on drawing]



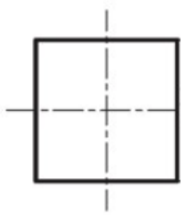
[Object 2]

Trainee Action: *Touch the highlighted symbol.*
[highlight slope symbol (triangle shape)]

This is called the flat taper symbol. It demonstrates the slope of flat tapered objects. Remember the conical taper symbol is used for cone shapes, while this flat taper symbol is used for flat objects.

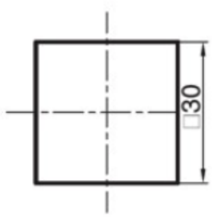
Lemme show you another symbol.

Trainee Action: *Tap the blank space around the object.*
[object 3.1 appears on drawing]

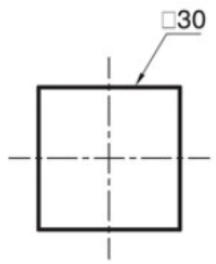


object 3.1

Trainee Action: *Touch the square.*
[□30 appears and highlights]

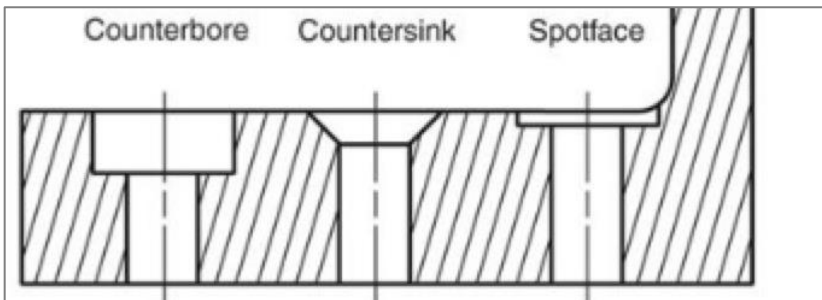


This is the squared symbol. It's used to dimension for squared features. It can also be annotated like this using a leader line and has the same meaning.
[object 3.2 appears to the right of object 3.1]



Dimension origin

#2 Thread



Earlier we covered the symbols couterbore and countersink, mentioned their relationship to two tyoes of screws. Let's dive deeper into types of screws and how to read annotations specific to this tool.

All screws are notaed in two ways: American or Metric. A screw annotation is called a "callout" and made up of a line of sumbers and symbols. At the top of your desk are two boxes of screws.

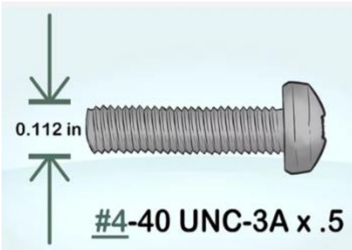
Trainee Action: Use your controller to grab the blue box and set it in front of you.

Nice! This is a box of American screws.

Trainee Action: Take one of the screws out of the box and place it on the desk.
[trainee removes one screw]

The top of the screw is called the head. [highlight screw head]
While, the body of the screw is called the shaft. [highlight screw shaft]
Along the shaft are tiny grooves called thread [highlight thread]
And at the end is the tip, which can be wither flat or pointed.

Take a look at the label on the top of the box. On the label is a call out made up of a mixture of letters and numbers. Let's breakdown what each of these means.



The number four is the thread diameter. [highlight 4] Along the shaft of the screw are tiny grooves, these grooves are what is being measured in diameter.

Next is the number 40. [highlight 40] This is the threads per inch. So for every one inch there are forty threads.

[highlight UNC] UNC is the abbreviation for the thread standard. There are two types: UNC which stands for Unified National Coarse. If a callout has this abbreviation we know the screw is a **coarse scews**, which is the most common type because it's used for general purposes. The other type is UNF, short for Unified National Fine, which is the abbreciation for a screw that is considered a **fine screw**. These are stronger and more resistant to damage such as vibration.

In our case the callout is a UNC, telling us the shape of the thread is categorized as a coarse screw.

Next to the shape of the thread is the class of fit. [highlight 3A] The class of fit always has one number and one letter. The number can range from one to three. In our callout it's number 3. [highlight 3] This describes the kind of nuts or holes the screw is meant to fit into.

Next to the number will usually be either "A" or "B". [highlight B] In our callout, we see the letter "A". "A" represents the external threads on the screw shaft. There are three types of external threads. I've put the different types on your desk.

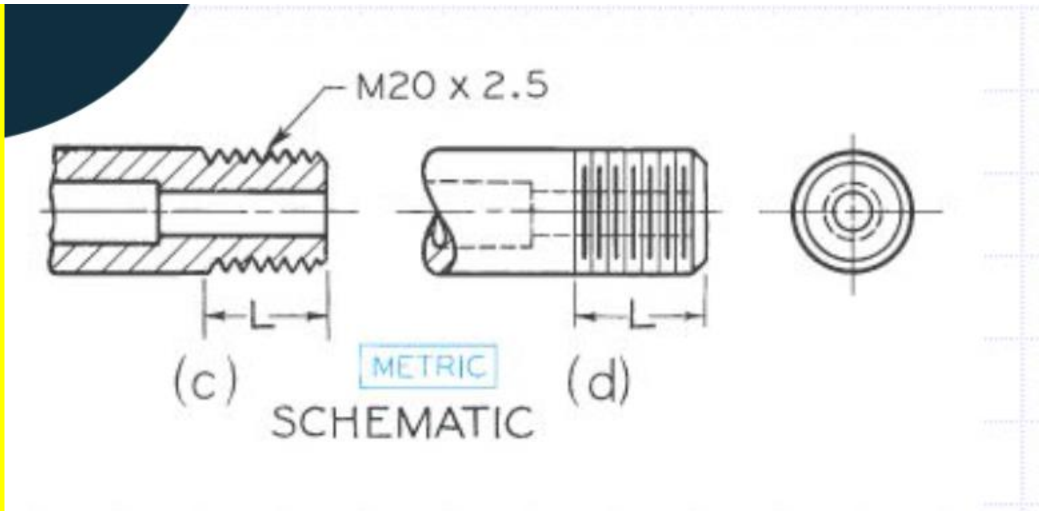
Trainee Action: Pick up one of the screw to hear about the type of external thread.

DETAILED "aka" pictorial
DESCRIPTION

SCHEMATIC

DESCRIPTION

Schematic threads in elevation are indicated by alternate long and short lines at right angles to

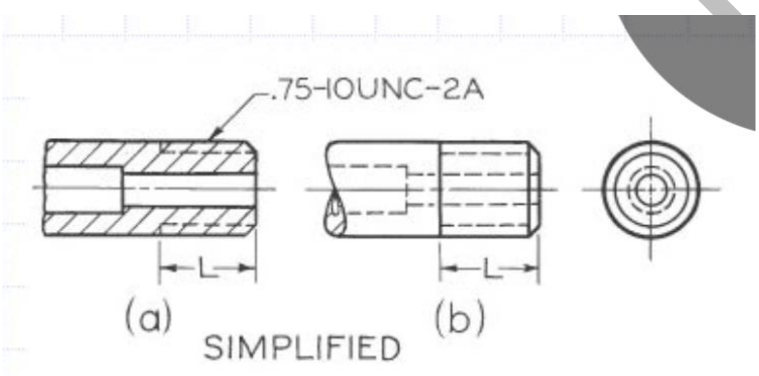


the center line.

SIMPLIFIED

DESCRIPTION

Simplified external threads are shown here. The threaded portions are indicated by hidden lines parallel to the axis at the approximate depth of the thread, whether in section or elevation.



If the letter "B" was present, this would be referencing the internal thread.

—*"B"* represents the *internal* ones

—EXAMPLE: 2A and 2B screws, which are slightly different sizes.

--types of internal thread [chart]

Left handed

I've put another callout label on the table that looks similar to the callout we just examined. After the class of fit, is the letters "LH". This stands for left handed.

Alright, we are done with the American types of screws. Let's check out the other type.

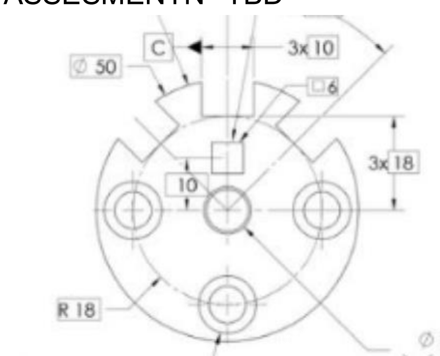
Trainee Action: Go ahead and put the blue box back on the shelf and bring down the green box.

On the label is a callout, rather than starting with a pound sign like the American callout, this one starts with an "M", for **Metric**. Next to the "M" is the number 12, this is the tread diameter in milimmeters. The X has the same meaning we are familiar with, meaning "by". Then we see 1.75 for the tread pitch. The pitch represents the distance in millimeters between the grooves on the screw's shaft. After the tread pitch is the length of the screw. Most screws are measured from the end of the shaft to the bottom of the head. In our case, the length of this screw is 85—remember this is in millimeters, since this is metric units.

Trainee Action: Touch the tread pitch number.

Specifying the **pitch** is important for distinguishing between coarse and fine screws. Coarse screws have a larger pitch than similarly-sized fine screws and are used in general applications, like [REAL LIFE EXAMPLES]. Fine Screws can be the same size as course screws AND are more resistant to damage like [REAL LIFE EXAMPLES].

ASSESMENTN--TBD



Diameter
Radius
3x10 [x]
square