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Excellence in Everything We Do

Essential Skills and Apprenticeship

Using Essential Skills: On the Job with a Machinist

Are you starting an apprenticeship in machining or are you thinking about a career in this trade? Pursuing a career as a machinist requires strong essential skills such as reading, document use, numeracy and critical thinking.

Use this booklet to:

- learn how machinists use essential skills;
- follow the daily routine of a machinist; and
- find out how your essential skills compare to those of a journeyperson in machining.

How machinists use essential skills

Machinists use essential skills to perform a variety of job-related tasks, for example:

- **document use** to read work orders, drawings and specifications;
- **numeracy** to calculate precise dimensions and tolerances, or to measure and lay out work pieces; and
- **critical thinking** to visualize the products they make through drawings and their own sketches to be able to anticipate design issues.

Machinist

Essential Skills

Reading
Document Use
Numeracy
Writing
Oral Communication
Working with Others
Thinking
Computer Use
Continuous Learning

Machinists set up and operate a variety of machining tools to cut or grind metal and similar materials into parts or products with precise dimensions. Machinists are employed by companies that manufacture machinery, equipment, motor vehicles, automotive parts, aircraft and other metal products; they are also employed by machine shops.

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Canada

A day in the life of a machinist: Andrew's story

Reading a work order

Andrew is a machinist in the aerospace industry. He is a specialist in jigs and fixtures, which are devices used to hold down work pieces and guide cutting tools to produce accurate duplicate parts. The shop Andrew works for specializes in making parts used in airplanes. When he arrives for his shift, he picks up a work order to modify 1000 brackets so they can be used to attach airplane doors *(document use)*. The work order shows that these brackets are missing four holes; all new brackets on order will already have the holes. These brackets are made for a standard door hinge that is used for several different types of airplanes.

Work order

Note: `0` *refers to number zero*
Ø holes refers to diameter of hole

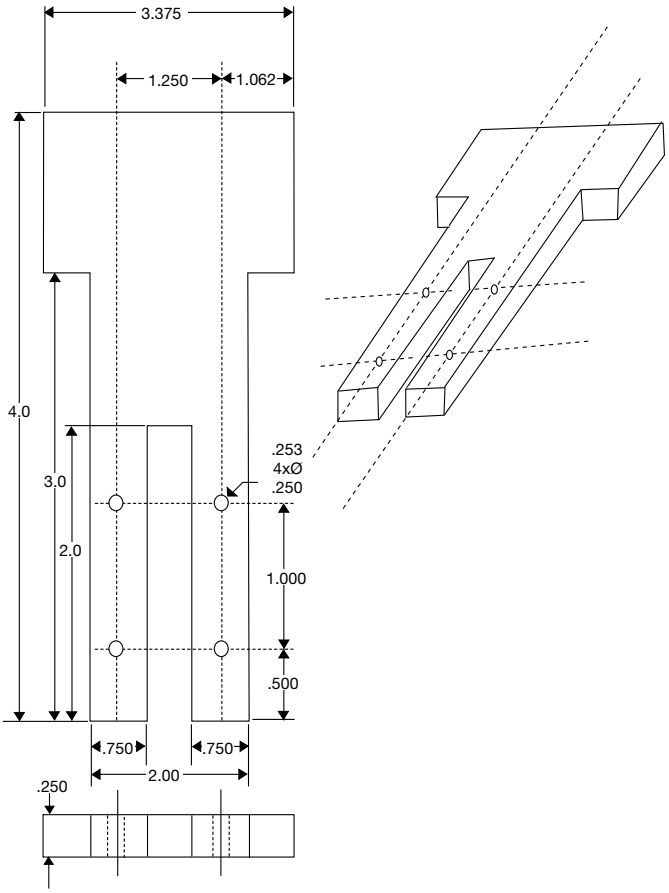
```
Manufacture drill jig to add 4-250 Ø holes to
bracket. Next batch of brackets on order will already
have 4-250 Ø holes included.
Receive brackets from stores
Receive hardware from stores
```

Meeting with the supervisor

Before Andrew gets started, he discusses the drawing and specifications with his supervisor *(document use, oral communication)*. They discuss making a basic drill jig that can be used by a production worker to add the four holes missing in the brackets. Andrew must pay attention to the finish and tolerances of the working area of the drill jig only. The supervisor tells Andrew to add a bevel, or slanting edge and to think about how he will mount the jig. Andrew must consider how to make the jig safe to use and how to prevent the brackets from being inserted the wrong way *(thinking skills – problem solving)*.

Designing a jig

With these extra instructions, Andrew is on his own to figure out how to accomplish his task. He thinks about the brackets and refers to the drawings that are attached to the work order. He checks the requirements for the placement of the drill holes *(document use)*. The drill holes must be precise. Tolerances are very small – there can only be a 0.003-inch difference between specifications and actual measurements – and each bracket must be drilled in exactly the same place. He designs a drill jig to keep each bracket firmly in place while it is drilled *(thinking skills – problem solving)*. The actual drilling job will be given to one of the production workers, who will put the brackets into the jig one at a time and drill the holes in the same spot for each one.



Calculating dimensions for the jig

Andrew starts by making a drawing of the jig that will guide the drill bit. He refers to the work order drawing for the measurements *(document use, numeracy)*. He has to consider who will use the jig as he designs; if a worker uses the jig incorrectly because of the design, the worker could suffer an injury or the brackets could become damaged. Andrew also has to consider how soon the brackets are needed, how long the jig needs to last and what materials to use *(thinking skills – critical thinking)*.

Making a list of materials

As he designs the jig, Andrew also starts a list of materials and supplies he will need *(writing)*. He checks the stock on hand and orders any items that are missing to avoid having to delay the job once it has started *(document use)*.

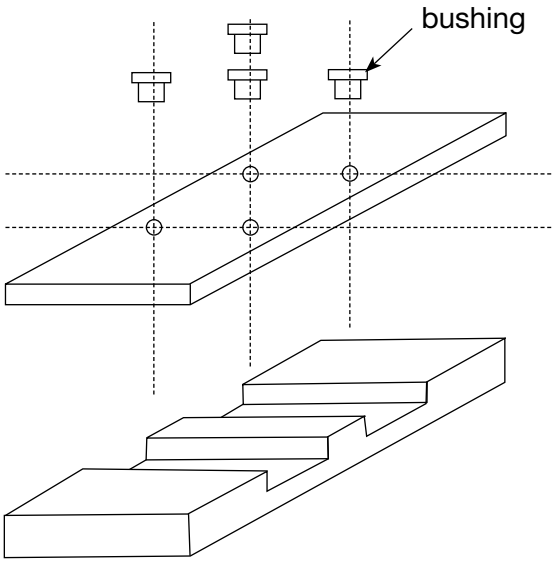
List of materials/supplies:

- 4 hardened drill bushings
- mild steel top plate
- mild steel bottom plate
- 4 socket head cap screws
- 2 dowel pins

Drawing the jig

Andrew must design, draw and make two metal parts for his jig: a base that will hold the shape of the brackets, and another part to hold the drill bushings that will guide the drill bit.

The part that will guide the drill bit needs to have four holes drilled in it. These holes then need to be reamed (shaped and finished), and bushings need to be pressed into the holes. A drilled hole could make a guide for the drill bit, but without the hardened bushings, eventually the holes would get bigger and they would not guide the drill bit accurately enough. Bushings must be made out of hardened steel that will not change even when 1000 holes are drilled *(thinking skills – problem solving, document use)*.



Making the base of the jig

Andrew makes the base of the jig out of mild steel (a common steel with a low carbon content) and machines all the outside faces. He has to ensure that the whole base block is flat and parallel; he has not machined the areas of the jig that will not be working faces (surfaces that interact with the part). He machines two locating steps carefully, paying particular attention to their surface finish, width and depth *(thinking skills – problem solving, numeracy)*.

Writing a note

Close to the end of his shift, Andrew completes the base of the jig. He also machines the top plate that will hold the drill bushings in place. The machinist on the next shift will finish where Andrew leaves off.

Before he leaves the job site, Andrew writes some instructions for his co worker on how to complete the jig *(writing)*.

Hi Dennis,

I have completed the base and machined the top plate. You will need to mount the top plate to the base and make sure it is doweled so that it can be removable. You can use 1/4" cap screws and 1/4" dowels or whatever is available. I have left you the 4 drill bushings that still need to be installed and you might want to look at making sure that the jig cannot be used incorrectly by production. I was thinking that production could use a hand drill to drill the holes and they could mount the jig in a vise and hold the bracket to be drilled by hand. If you can come up with something easier it would be great, remember it needs to be quick and simple and they need this jig first thing in the morning. I have left you a few sample brackets and if you need more they are in inventory.

Have a good night.

Andrew

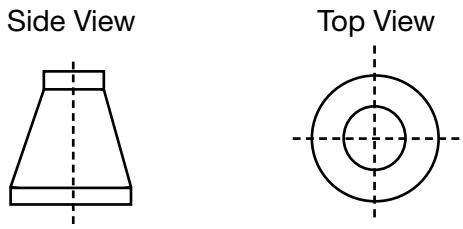
Do you have the essential skills to be a machinist?

Complete the following questions to see how your skills compare to those of a journeyperson in machining. (Answers on page 6.)

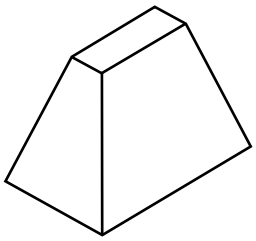
1. Making sketches

Machinists make sketches to be able to anticipate design issues or to help understand how a finished product works. They need to visualize the product from all angles.

Here is an example of two views of the same object:

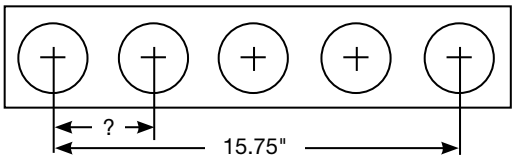


Look at the following shape. Draw a side view, an end view and a top view of the shape.

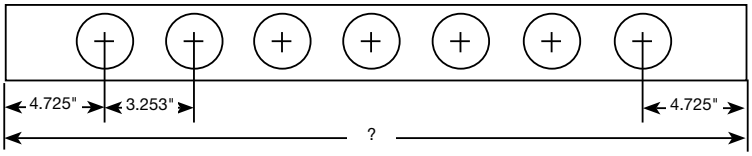


2. Measuring and calculating

a) Five holes are evenly spaced in a piece of ¾-inch steel plate. Calculate the centre-to-centre distance between holes.



b) Seven holes are evenly spaced in a piece of ½-inch steel plate. The centre-to-centre distance between two holes is 3.253 inches. The distance from one edge of the steel plate to the centre of the first hole and from the other edge to the centre of the last hole is 4.725 inches. Calculate the total length of the piece of ½-inch steel plate.

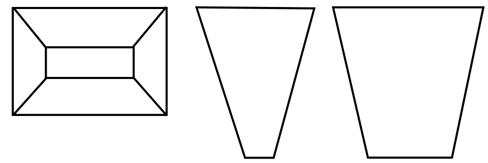


3. Problem solving

A machinist wants to create a jig that will be problem-free when it is used by a production worker. Since the bracket must be placed into the jig from the same side each time, what problem might occur for a left-handed worker? How could this problem be solved?

Answers

1. **Making sketches** *(document use)*



2. **Measuring and calculating** *(numeracy)*

a) 15.75 ÷ 4 = 3.938 inches between each hole

b) (3.253 x 6) + (4.725 x 2) = 28.968 inches

The plate is 28.968 inches long.

3. **Problem solving** *(thinking skills – problem solving)*

For left-handed workers, it may be natural to insert the bracket from the other side. If this is done, the holes will not be drilled in the right place on the brackets. To avoid this error, a metal piece could be fastened over the opening on the wrong side of the jig, so that the bracket can only be inserted from the correct side.

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