How to Use an Edge Finder on a Milling Machine: Standard Operating Procedure

This SOP explains how to use an edge finder on a milling machine to locate the edges, hole centers, and round-stock centers of a workpiece. It covers the paper and end mill method, the mechanical edge finder, and the electric edge finder. It also covers finding the center of a hole and finding the center of a round shaft. Each technique is inexpensive and suits different machining situations.



Operator holding the edge finder and demonstrating its use after finding the edge, with the workpiece clamped in the vise.

Purpose

Use this procedure to locate a reference position on a workpiece, set your work coordinates, and confirm the position accurately before machining.

Scope

This procedure applies to the following tasks on a milling machine with a workpiece held in the vise:

- Finding an edge with a paper feeler and an end mill

- Finding a side edge with an end mill
- Finding an edge with a mechanical edge finder
- Evaluating an electric edge finder
- Finding the center of a hole
- Finding the center of a small hole with a centering tool
- Finding the center of a round workpiece



Hand holding paper against the end mill and workpiece edge, showing the tactile edge finding process.

Required equipment and PPE

- Milling machine with a digital readout (DRO) or compound dials
- Milling vise to hold the workpiece
- End mill
- Ripped piece of paper about 0.003 in (3 thou) thick
- Mechanical edge finder with a 0.200 in (200 thou) diameter small end
- Electric edge finder (optional, see the evaluation section)
- Centering tool for holes of about 1/8 in diameter
- Center finder or alignment tool for the drill chuck
- Layout dye, and a scriber or file

- Safety glasses



End mill very close to the shaft, showing gentle handling of thin alignment materials.

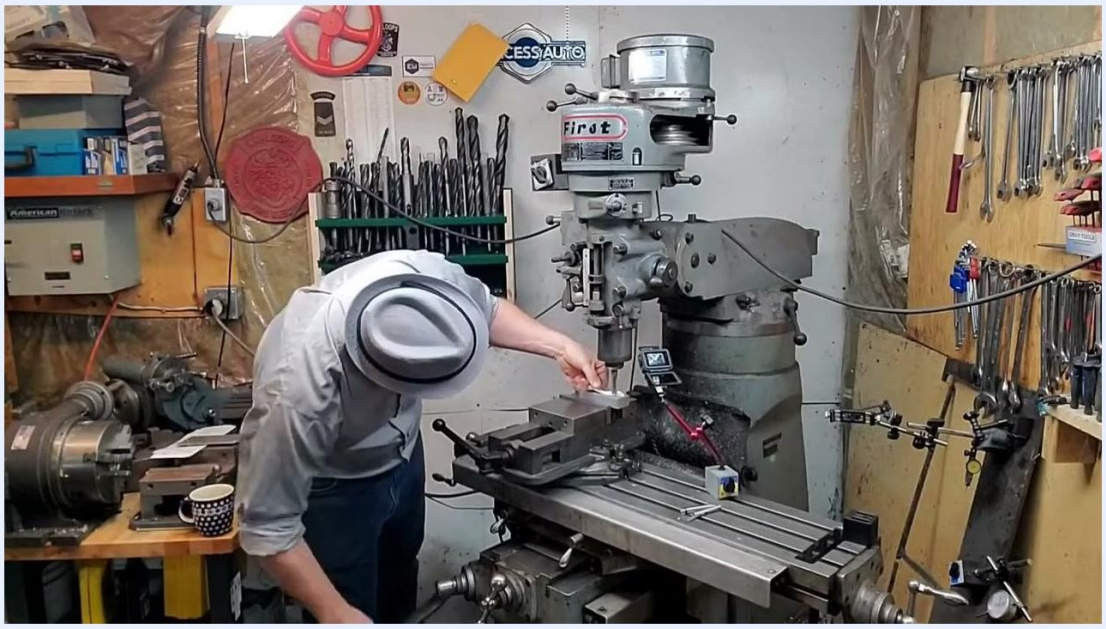
> **Safety:** Wear safety glasses at all times. When you use paper as a feeler, hold it gently so that the end mill pulls the paper out of your thumbs. Never let the end mill pull your thumbs in.

Part 1: Find an edge with the paper and end mill method

This method works best for down-feed edge finding. For finding a top surface, consider taking a light test cut and measuring the depth removed instead. Every machining situation is different, so use this method where it fits.



End mill positioned above the workpiece, ready for a down-feed edge finding operation.



Finger pointing to a small cosmetic mark left by the end mill on the workpiece after edge finding.

Step 1: Set up the paper and workpiece

Secure the workpiece in the milling vise and confirm the end mill is installed in the spindle. Hold the ripped piece of paper gently between your thumbs. Place it between the end mill and the workpiece edge.



End mill approaching the workpiece in the vise, with a piece of paper visible on the vise jaw.

Step 2: Feed the end mill toward the paper

Slowly advance the end mill toward the paper while keeping a gentle grip. The end mill must pull the paper out of your thumbs, not the other way around. As the end mill contacts the paper, friction increases until the paper is pulled away. This shows that the end mill is close to the workpiece edge.



Machinist in workshop introducing edge finding techniques, holding a piece of paper and standing next to a milling machine with various tools and equipment visible in the background.

> **Safety:** Do not hold the paper too tightly. Avoid cutting through the paper or having it pulled into the tool, because this can cause injury or misalignment.

Step 3: Zero the compound or DRO

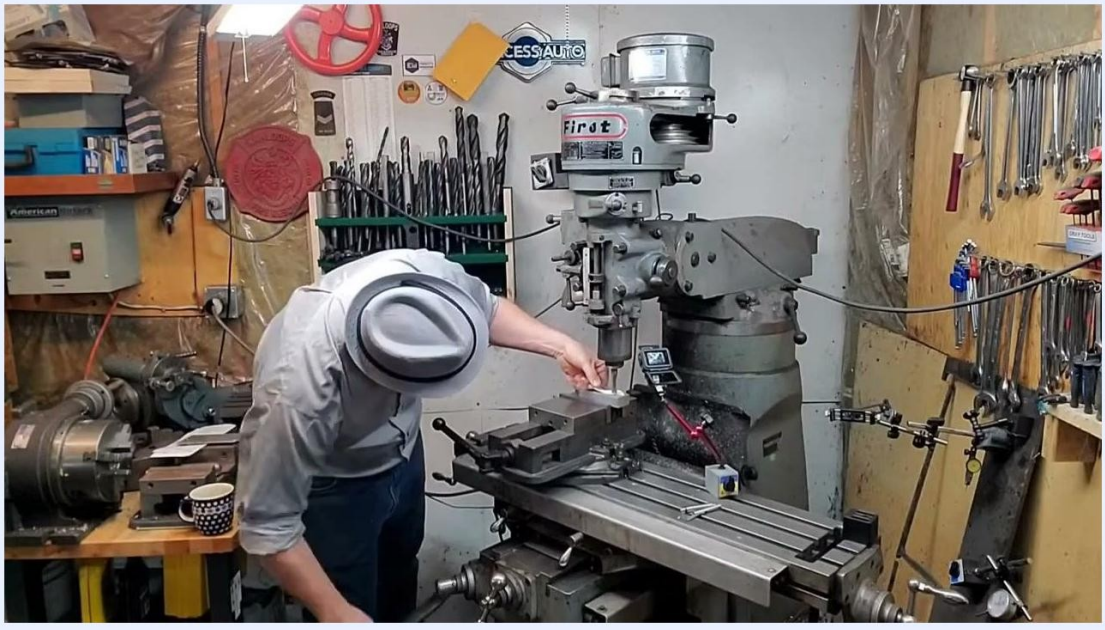
Once the end mill pulls the paper out, set the compound or digital readout to zero at this position. This method typically locates the edge to within 0.001–0.002 in.

Step 4: Check the workpiece for marks

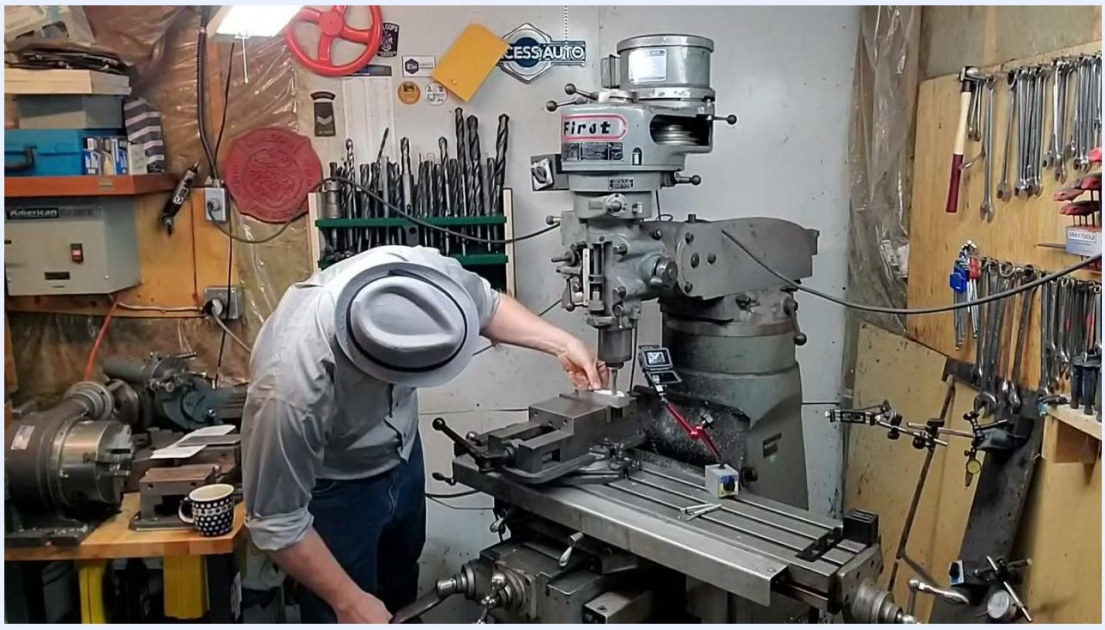
Lower the end mill and inspect the workpiece. Any mark should be minor and cosmetic only.

Step 5: Avoid the quill-down-and-spin shortcut

If you simply lower the quill and turn on the spindle, the end mill can cut 0.002–0.003 in into the workpiece. This leaves a visible peck mark or ring, which is generally undesirable. Use this shortcut only if a small mark is acceptable for your application.



Machinist leaning over the milling machine, adjusting the workpiece and preparing for measurement.



End mill positioned above the workpiece with a hand reaching toward the spindle, showing the risk of leaving a peck mark.

Step 6: Measure the material removed

After edge finding, measure the amount of material removed to verify accuracy. You do not always need the paper method. If you can take a test cut and measure the material removed, that also works.

Part 2: Find a side edge with the end mill

Step 7: Touch off the side of the workpiece

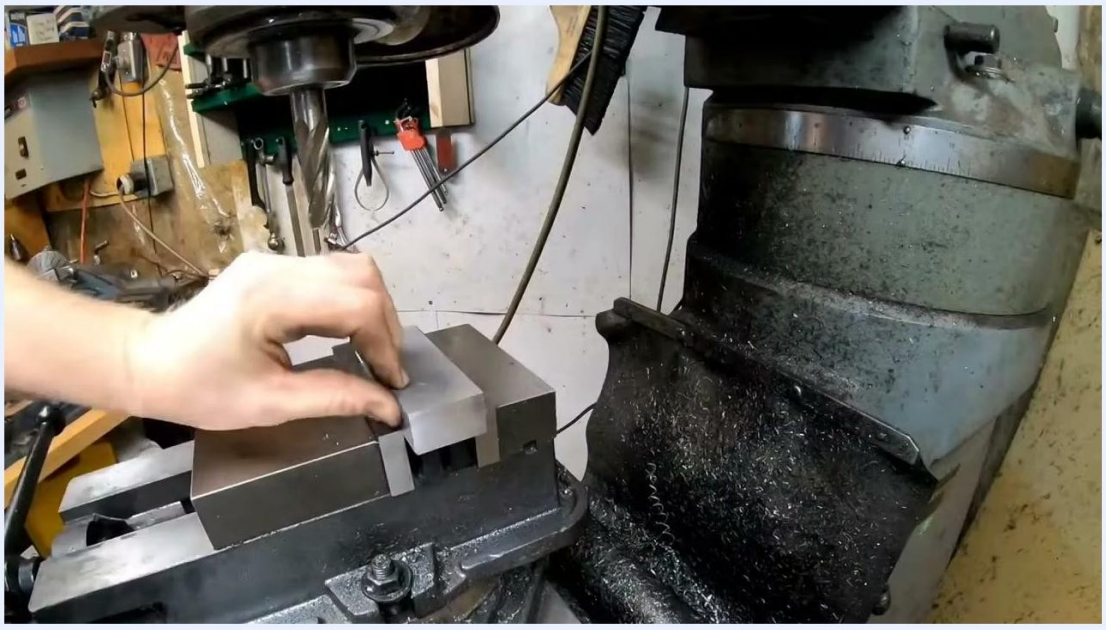
Apply the same tactile technique to the side of the workpiece. Gently feed the end mill into the side until you see it just begin to remove material. The end mill leaves a small cut on the side, which is intentional for this method. Cut only 0.002–0.003 in ("two or three thou") for minimal marking.



End mill positioned at the side of the workpiece in the vise, ready for a side edge finding operation.

Part 3: How to use a mechanical edge finder on a milling machine

The small end of the mechanical edge finder is 0.200 in (200 thou) in diameter, so its radius is 0.100 in (100 thou). You need this radius to set the center of the quill.



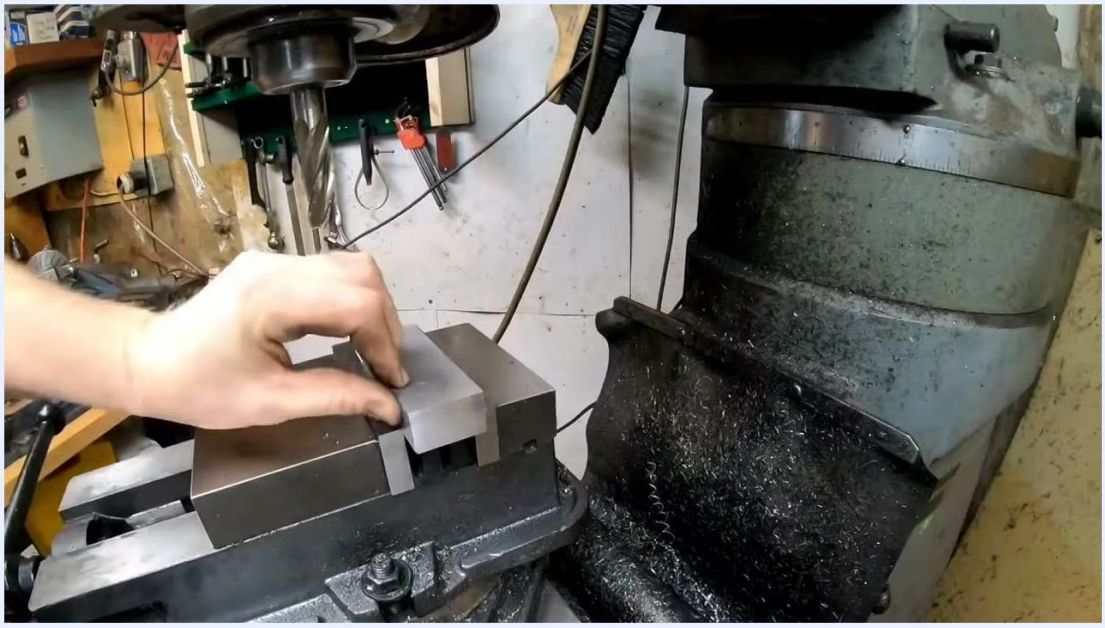
Hand installing a mechanical edge finder into the milling machine spindle above the workpiece in the vise.

Step 8: Install the mechanical edge finder

Insert the mechanical edge finder into the milling machine spindle above the workpiece in the vise.

Step 9: Spin the edge finder and approach the edge

Start the spindle. The edge finder rotates with a visible wobble at first. Slowly move it toward the workpiece edge and watch the wobble decrease as you get close. When the wobble disappears and the edge finder "climbs the wall" of the workpiece, you have found the edge.



Mechanical edge finder spinning and approaching the workpiece edge, with the operator watching for the wobble to disappear.

Step 10: Repeat, zero, and offset by the radius

Repeat the process a second time for accuracy, then zero your work coordinates at this position. Next, move the spindle over by 0.100 in (the radius of the edge finder) and zero again. This sets the center of the quill. Confirm that the edge is accurately located and the quill is centered.

Part 4: Evaluate the electric edge finder

An electric edge finder completes an electrical circuit when it touches the workpiece. It produces an audible signal ("beepity-beep").



Operator holding an electric edge finder, showing its construction.

Step 11: Review the electric edge finder

Inspect the construction of the electric edge finder before you decide to use it.

Step 12: Position it in the spindle

Position the electric edge finder in the spindle and prepare to touch it to the workpiece to complete the circuit.



Operator positioning the electric edge finder in the spindle above the workpiece.

Step 13: Check compatibility and accuracy before use

Note these limitations of the electric edge finder in this procedure:

- It has a 20 mm shaft, and it cannot be used without a compatible 20 mm collet.
- It shows some visible runout ("a bit of a spin"), which can affect accuracy.
- When it sticks out far, runout can cause an error of up to 0.010 in (10 thou).
- Twisting the tool back and forth reduces the error, but it is still typically within 0.002 in (2 thou).
- The paper method is also accurate within 0.002–0.003 in (2–3 thou).

Given the similar accuracy, the metric/imperial incompatibility, and the extra expense of the correct collet, this SOP does not use the electric edge finder for now. With the right equipment it can be very accurate and enjoyable to use. Store it away until the correct collet is available.



Presenter in a workshop, standing beside a milling machine, explaining the limitations of using a 20 mm shaft electric edge finder due to collet incompatibility. Various hand tools, drill bits, and equipment are visible on the walls and benches.

Part 5: Find the center of a hole with an edge finder

For best results, make sure the hole has no burr or chamfer.

Step 14: Align the edge finder to the hole by eye

Visually align the edge finder roughly to the center of the hole. Move the spindle so the edge finder is directly above the hole.



Edge finder in the spindle above the hole, finding the left edge to determine the center.

Step 15: Find the left edge of the hole

Use the edge finder to locate the left edge of the hole. When you find the center of a hole, you do not subtract the edge finder radius from your measurement. You are only interested in the center position.



Milling machine spindle with an edge finder positioned above a machined hole in a metal workpiece clamped in a vise.

Step 16: Move the milling head to the right side

Move the milling head to the right-hand side of the hole in the metal block.



Milling head positioned above the right side of the metal block, circular pocket visible, metal shavings present.

Step 17: Repeat the edge-finding procedure without zeroing

Repeat the edge-finding procedure on this side. Do not zero the DRO at this step. Prepare to record the measurement instead of resetting the display.



Milling head above the pocket, ready for measurement, no zeroing performed.

Step 18: Return to the center and read the DRO

Move the milling head back to the center of the pocket. Observe the DRO for the X and Y axes and note the displayed value for later reference.



Close-up of the MITUTOYO DRO with a hand pointing at the X-axis display, milling head centered over the pocket.

Step 19: Set a reference at the pocket edge

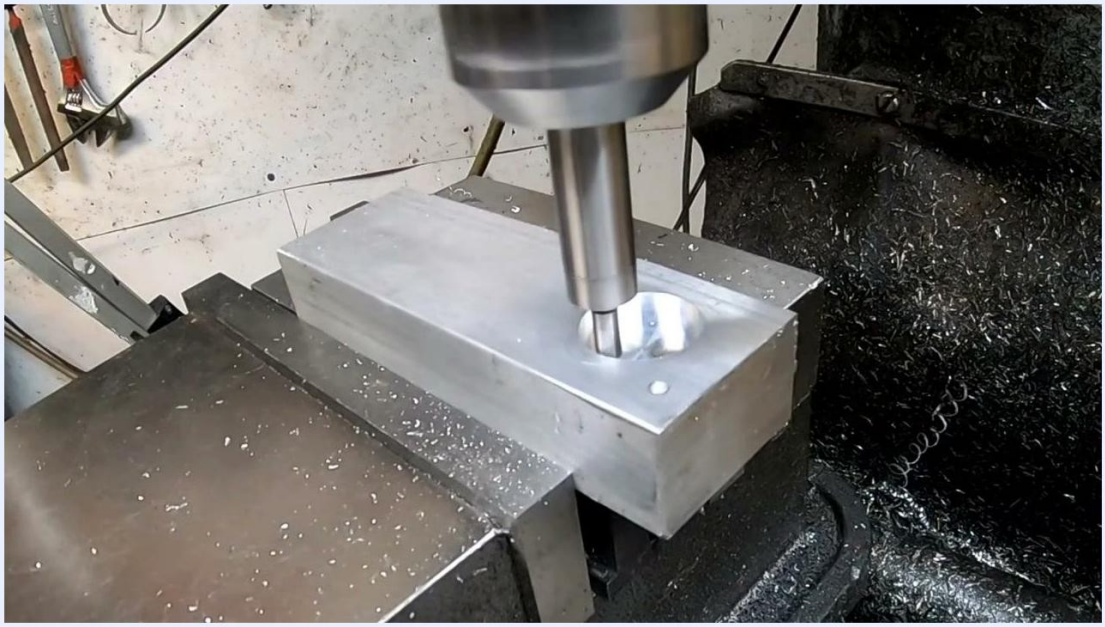
Move the milling head up against the edge of the pocket to establish a reference point. Zero the DRO at this position.



Milling head positioned at the edge of the pocket, ready to zero the DRO.

Step 20: Check the opposite edge if the pocket may be oblong

If you suspect the pocket is not perfectly round, move the milling head to the opposite edge. Repeat the edge-finding and zeroing process on that side. This confirms the true center and diameter of the pocket.



Milling head at the opposite edge of the pocket, repeating the zeroing process.

Step 21: Clean the pocket and work area

Remove all metal shavings and debris from the pocket and work surface to prepare for the next machining operation.



Milling head above a clean pocket, work area free of debris.

Step 22: Double-check the workpiece

Check that the pocket is free of chips and the surface is smooth. The milling head stays above the pocket, ready for further operations.



Milling head above the cleaned pocket, work area tidy.

Step 23: Run the machine at full speed

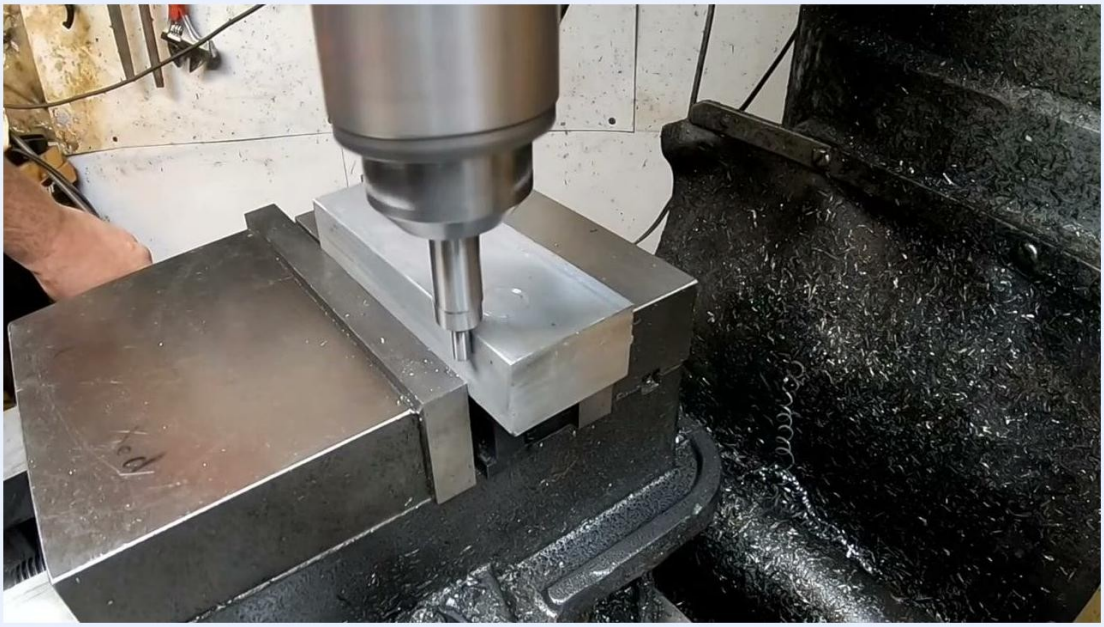
Run the milling operation at full speed to test performance. Start the machine, then monitor for smooth operation and consistent cutting.



Milling head running at full speed, operator's hand visible, machine in operation.

Step 24: Zero the DRO at the right-hand edge

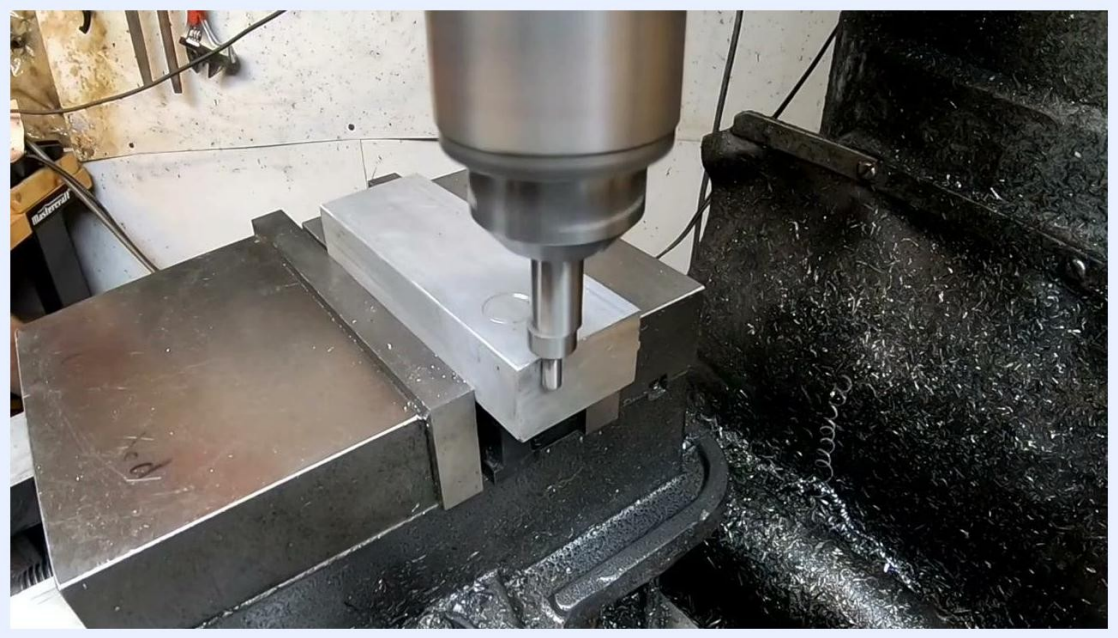
Move the milling head to the right-hand side again. Bring the tool up to the edge and zero the DRO to establish a new reference. This ensures precise alignment for later machining.



Milling head at the right edge, DRO being zeroed, ready for the next operation.

Step 25: Raise the head and move over 0.100 in

Raise the milling head and move it over by 0.100 in (100 thousandths). Lift the head vertically with the machine controls, then shift it horizontally by exactly 0.100 in.



Milling head raised above the metal block, positioned for horizontal movement, vise and work area visible.

Step 26: Zero the DRO at the new position

After moving the head over by 0.100 in, reset the DRO to zero. This establishes a new reference point for later machining.



Operator's hand near the vise, milling head above the pocket, ready to zero the DRO after moving 0.100 in.

Part 6: Find the center of a small hole with a centering tool

Step 27: Position the centering tool above the hole

Select the centering tool for the hole size (approximately 1/8 in diameter). Position it above the drilled hole in the workpiece.



Milling head with centering tool positioned above a small hole in the metal block.

Step 28: Seat the tool and lock the spindle

Lower the tool into the hole so that it sits snugly, using gentle downward pressure only. Lock the spindle to keep the tool steady in the hole.



Centering tool inserted into the small hole, spindle locked.

Step 29: Turn on the spindle

Turn on the spindle to rotate the centering tool gently. Watch the tool's movement to make sure it is centered in the hole.

> **Safety:** Avoid too much downward pressure, which can damage the tool or workpiece.



Spindle activated, centering tool rotating in the hole.

Step 30: Look for the white lip

Look for a small white lip or ring moving evenly around the tool. This indicates that the tool is centered. If the lip appears to "duck" or wobble, adjust the position until it runs true.



Close-up of the centering tool in the hole with the white lip visible, indicating centering alignment.

Step 31: Steady the tool with your fingers if necessary

If needed, gently touch the tool to reduce vibration and help it settle into the center.

> **Safety:** Use caution to avoid injury or misalignment.



Operator's hand gently steadying the centering tool in the hole.

Step 32: Review the technique

This method is a basic shop technique that gives you a practical way to find hole centers.



Centering tool in the hole, work area and vise visible, showing the basic centering technique.

Step 33: Check for inaccuracy

There are two main ways this centering process can go wrong for accuracy. One is a chamfer on the hole, which is why the hole should have no burr or chamfer.



Centering tool in the hole with the setup unchanged, ready for the accuracy discussion.

Step 34: Account for both sources of inaccuracy

Keep both sources of inaccuracy in mind. Review the setup before you accept a hole center found with this method.

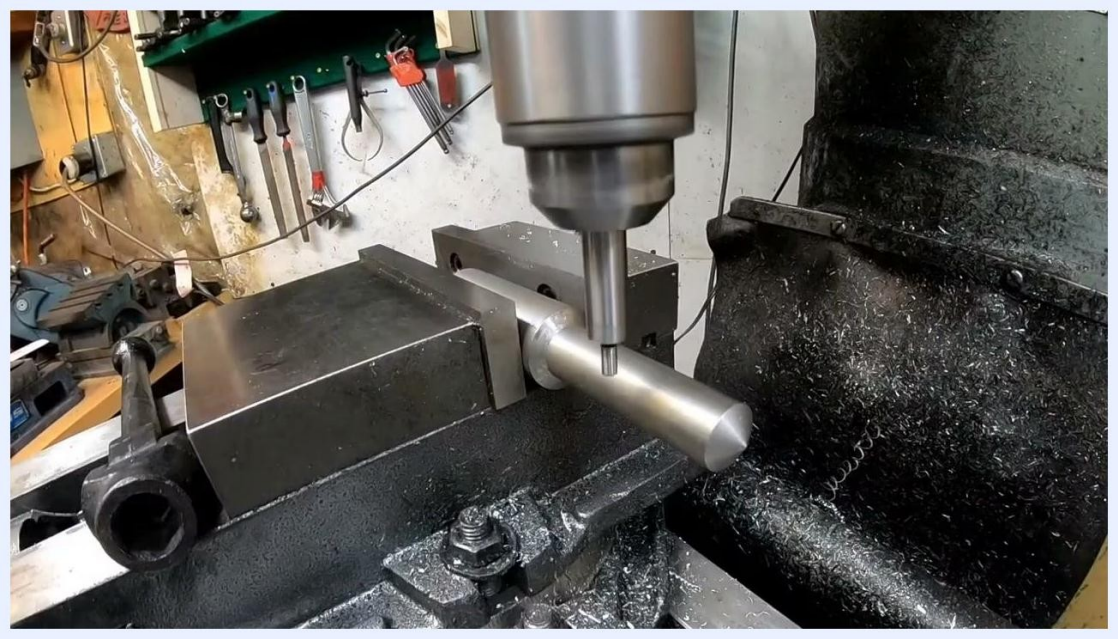


Milling machine with centering tool in a small hole of a rectangular metal block, second tool resting on the vise jaw.

Part 7: Use an edge finder on round stock

Step 35: Set up the round workpiece

Replace the rectangular block with a cylindrical metal rod clamped horizontally in the vise. Position the edge finder above the rod, ready to begin.



Edge finder positioned above a cylindrical metal rod clamped in a vise, machine shop background.

Step 36: Make contact with the curved surface

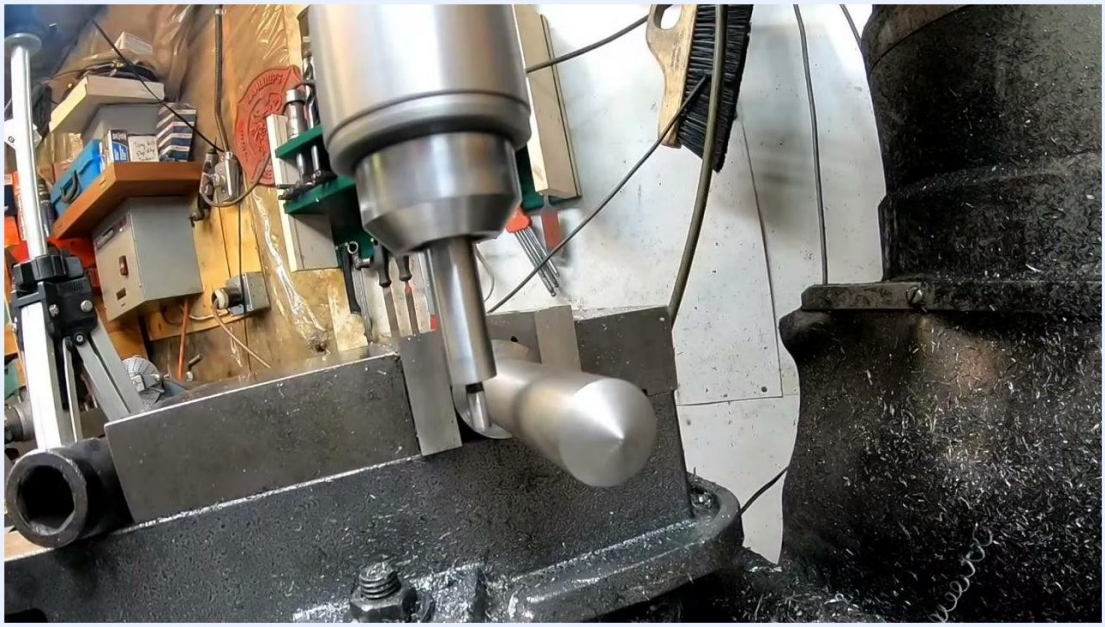
Bring the edge finder into contact with the curved surface of the rod. Make sure the edge finder touches the cylindrical surface, not the end or a chamfer.



Edge finder making contact with the cylindrical surface of the metal rod.

Step 37: Find the edge on one side

The easiest way to locate the center of a round workpiece is to find the edge on one side first. Move the edge finder to touch one side of the rod and record the position.



Edge finder in contact with one side of the cylindrical rod.

Step 38: Find the edge on the opposite side

Move the edge finder to the opposite side of the rod and find the second edge.



Edge finder in contact with the opposite side of the cylindrical rod.

Step 39: Confirm both edges

Confirm that the edge finder contacts the rod at both edges and that the setup has not changed.



Edge finder in contact with the cylindrical rod, setup unchanged.

Step 40: Calculate the center

Subtract the two edge positions to get the diameter. Then divide that number by two to find the center position.



Edge finder in position with the cylindrical rod in the vise, ready to calculate the center position.

Part 8: Center and cut a round object

Cutting a round object requires a different technique from cutting a flat one.

Step 41: Identify the workpiece and setup

Confirm that the round metal shaft is clamped securely in the vise on the milling machine table. Install the end mill (gold-colored) in the spindle above the workpiece. Keep tools such as wrenches and files on the wall within easy reach.



Round metal shaft clamped in a vise on a milling machine with an end mill positioned above it.

Step 42: Lower the end mill toward the shaft

Lower the end mill toward the shaft and align it for the intended cut. Make sure the shaft stays firmly clamped and the end mill is perpendicular to the workpiece.

Step 43: Handle thin alignment materials with care

If you use paper or a thin shim for alignment, do not hold it too tightly. Avoid cutting through it or having it pulled into the tool.



The operator stands beside the milling machine, reviewing the setup and explaining the centering results. The workspace and machine are clearly visible.

> **Safety:** A thin material pulled into the tool can cause injury or misalignment.

Step 44: Position the center finder

Place a center finder or similar alignment tool in the drill chuck above the shaft. Use your hand to guide the tool to the center of the shaft.

Step 45: Verify the alignment visually

Step back and visually confirm the alignment of the center finder with the shaft. Make sure the tool is perpendicular and centered before you continue.



Wider view of the center finder tool in the drill chuck, aligned with the shaft.

Step 46: Apply gentle pressure to the quill feed handle

Use your finger to apply gentle downward pressure on the quill feed handle. Let the center finder contact the shaft so that it finds the true center.



Hand positioning a center finder tool in the drill chuck, aligning it with the center of the round shaft.



Hand applying gentle pressure to the quill feed handle of the milling machine.

Step 47: Observe the centering

Watch as the center finder contacts the shaft and centers itself. Confirm that the tool is balanced and not deflected to one side.



Quill feed handle pointed out while the center finder contacts the shaft.

Step 48: Use the balancing ruler technique

Use the balancing ruler or "ball" technique to check visually whether the tool is level with the shaft. Adjust as needed to reach a level alignment.



Balancing ruler used to check the level alignment of the center finder with the shaft.

Step 49: Verify level alignment

Use a visual reference, such as a string or ruler, to confirm that the center finder is level with the shaft. This technique can achieve centering within about five thousandths of an inch (0.005 in).



End mill lowered closer to the round shaft, preparing for the cutting operation.



Red string or ruler used as a visual reference to check the level alignment of the center finder with the shaft.

Part 9: Create a reference flat and refine the centering

Step 50: Cut a light reference flat

Lower the end mill and make a shallow, flat cut across the top of the round shaft. Keep the cut light, just enough to create a visible flat surface. This flat is your reference for later operations.



Smaller cutter positioned above the reference flat on the shaft.

Step 51: Align the cutter with the flat

Position the end mill directly above the new flat. Line up the cutter so it is centered over the flat area.

Step 52: Use the reference line for the next operation

Observe the line or flat that you just cut and use it to align the cutter for the next operation. Check visually that the cutter lines up with the reference mark.



A hand holds a file or scriber horizontally, scraping across the dyed shaft to mark or locate the center.

Step 53: Switch to a smaller cutter for more precision

If you need higher precision, replace the end mill with a smaller-diameter cutter. Position it above the reference flat for fine alignment. As the cutter diameter increases, the precision of finding the center decreases. Use the smallest practical cutter for the most accurate centering, especially on round workpieces.



Gold-colored end mill making a shallow, flat cut across the top of a round metal shaft clamped in a vise.

Step 54: Apply layout dye

Coat the shaft with layout dye so that scribed or cut lines are more visible. Let the dye dry before you mark or machine further.



Shaft coated with bright orange layout dye, with the drill chuck positioned above it.

Step 55: Mark the center with a scriber or file

Hold a scriber or file horizontally and gently scrape it across the dyed surface. This marks the center and is also useful for locating features such as cotter pin holes. Scraping horizontally helps the tool find the true center of the round shaft.



Close-up of the end mill aligned with the flat reference cut on the shaft.



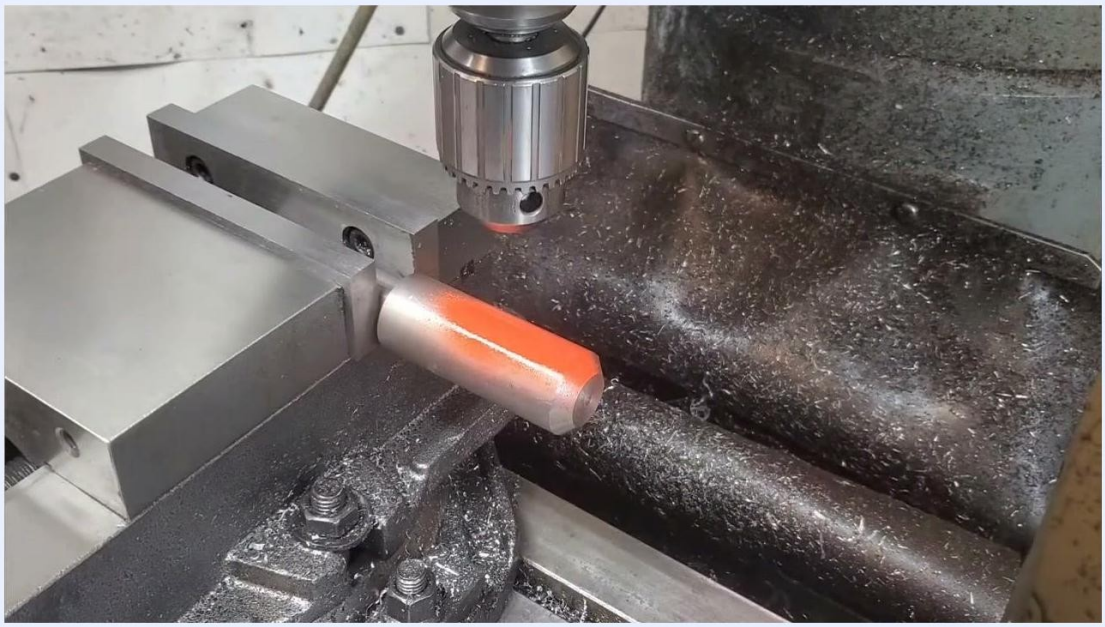
Hand holding a file or scriber horizontally, scraping across the dyed shaft to mark the center.

Step 56: Position the drill bit at the marked center

In a drill press, position the drill bit in the drill chuck directly above the marked center on the dyed shaft. Drill presses may be less accurate than milling machines, so use visual alignment and marking to improve accuracy.



End mill positioned directly above the flat cut on the shaft, ready for precise alignment.



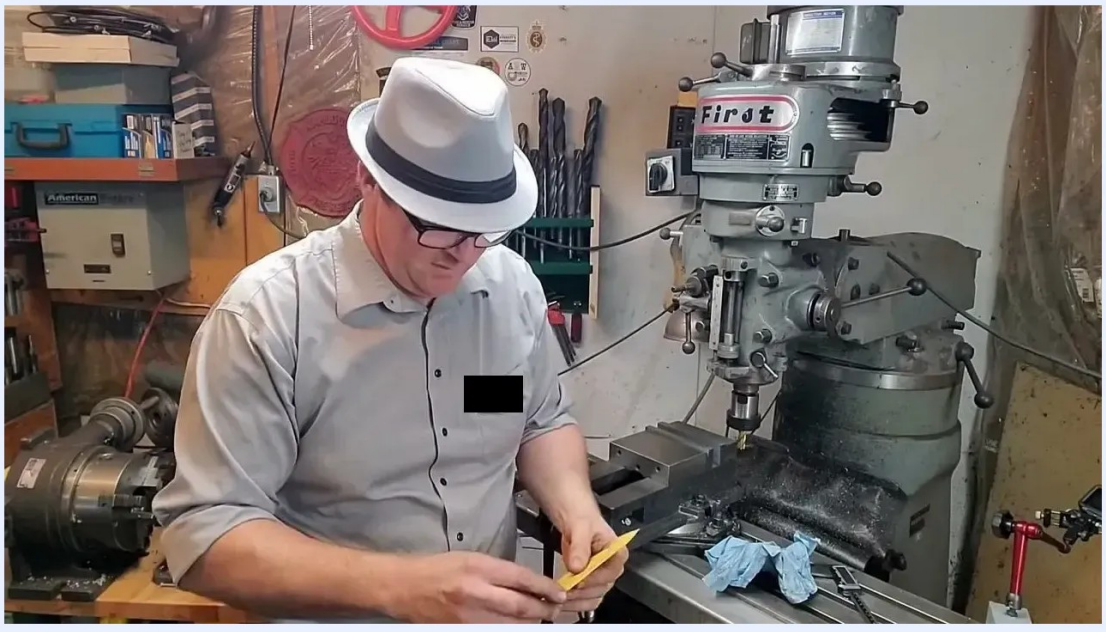
Drill bit positioned above the marked center on the dyed shaft, viewed from above.



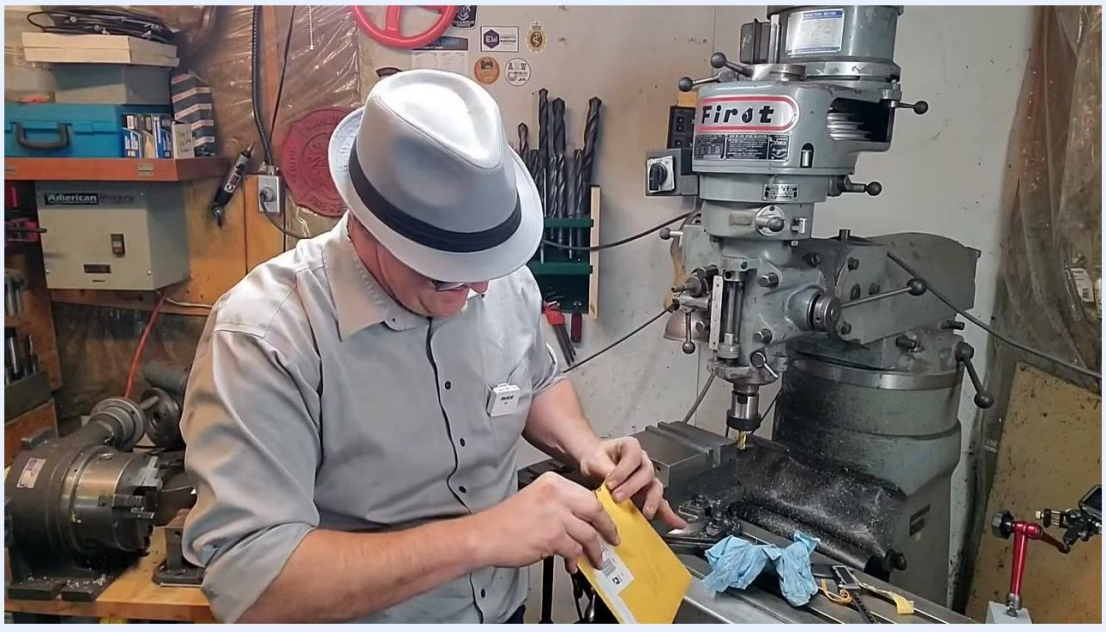
The operator stands next to the milling machine, addressing the viewer and encouraging feedback and engagement. The workspace and tools are visible in the background.



The operator gestures towards the camera, concluding the demonstration and encouraging viewer interaction.



The operator stands in a workshop beside a milling machine, holding a yellow padded envelope and preparing to open it. Drill bits, tools, and workshop equipment are visible in the background.



The operator opens the yellow padded envelope, looking inside to inspect the contents. The milling machine and organized tools are visible in the background.



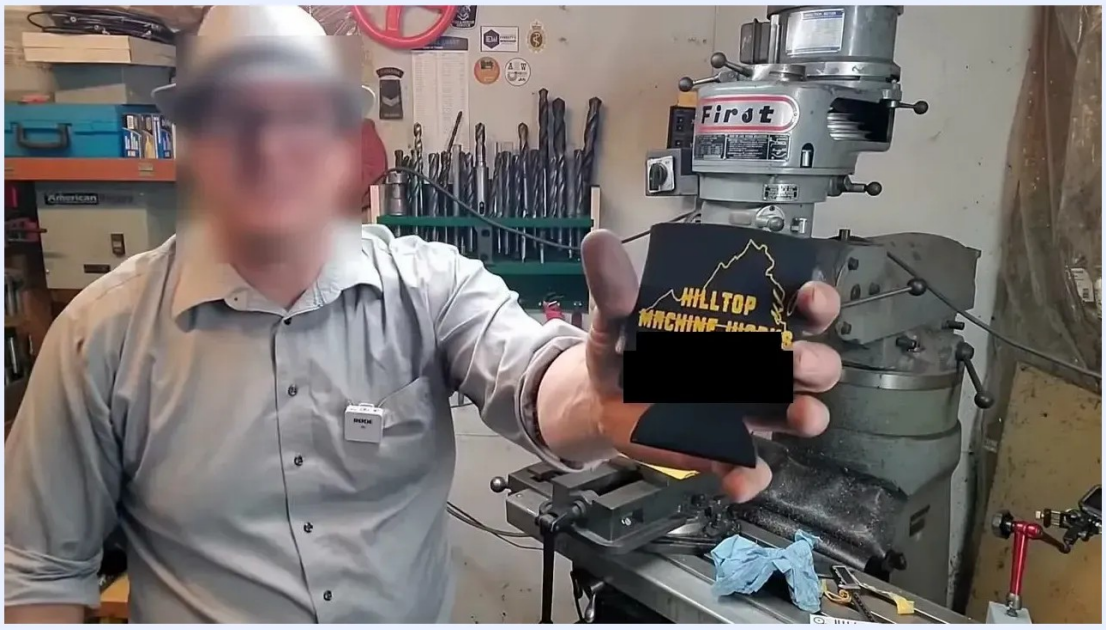
The operator holds up a rectangular item with visible text, discussing and showcasing it to the camera. The workshop setting and milling machine are clearly visible.



A close-up of a lathe setup shows a machined shaft, a large rectangular reference block with handwritten text and a sticker, a T-handle hex key, and a bolt. The lathe bed and motor are visible, emphasizing the importance of precision tools.



The operator turns away from the camera, placing the opened envelope and items on the workbench. The workspace remains organized, with tools and equipment in the background.



The operator holds a black and yellow foam can holder up to the camera, displaying the branding "HILLTOP MACHINE WORKS, Rural Retreat, VA, 276-620-1929". The operator is smiling and engaging with the audience.

Verification and summary

Before you start machining, confirm the following:

- You have checked the workpiece for marks, and any mark is minor and cosmetic.
- You have measured the material removed after edge finding.
- Your DRO or compound reference is zeroed at the correct position, with the edge finder radius (0.100 in) applied where required.
- For holes and round stock, you have the center position from both edges.
- The pocket, work surface, and vise are free of chips and debris.
- You have returned all tools to their proper places.

Using these steps, you can use an edge finder on a milling machine with the paper method, a mechanical edge finder, or a centering tool. Each method has its own limits, so choose the one that suits the workpiece.

What's next

Machine from the reference positions you set. Store the electric edge finder until you have the correct 20 mm collet.