How to use a surface plate to inspect a machined swivel plate for parallelism and flatness

This procedure shows you how to use a surface plate to inspect a recently machined swivel plate. You use a granite surface plate, an inspection holder, and a dial indicator to check how parallel the machined surfaces are and how flat the part is.



Machined part and dial indicator on granite surface plate, operator’s hands resting on table, drawers and open door in background

Purpose

This procedure gives you a repeatable method to check how parallel the second machined side of a swivel plate is to the first. It also shows how to check the part's flatness with a dial indicator, and how to interpret the readings you record.

Scope

This procedure applies to inspecting the swivel plate for the Fireball Tools hardtail vise.

- The plate was machined on both sides. The first side was faced and bored in an American Pacemaker lathe.
- The plate was then flipped, and the back side was machined on a fixture.
- The goal is to check whether the second machined side is parallel and true to the first side.
- The surface being inspected is the one where the main vise body bolts down and which allows the plate to swivel.

Required equipment

- Granite surface plate
- Starrett No. 675 Inspection Holder
- Starrett No. 25-131 Dial Indicator, with 0.0005" graduations and a 0.125" total range
- The machined swivel plate to inspect
- A means of wiping the granite surface plate clean



A granite surface plate with a machined metal swivel plate, a dial indicator mounted on an inspection stand, and overlaid text: "Measuring for Parallelism Using a Granite Surface Plate"

Part 1: Check parallelism

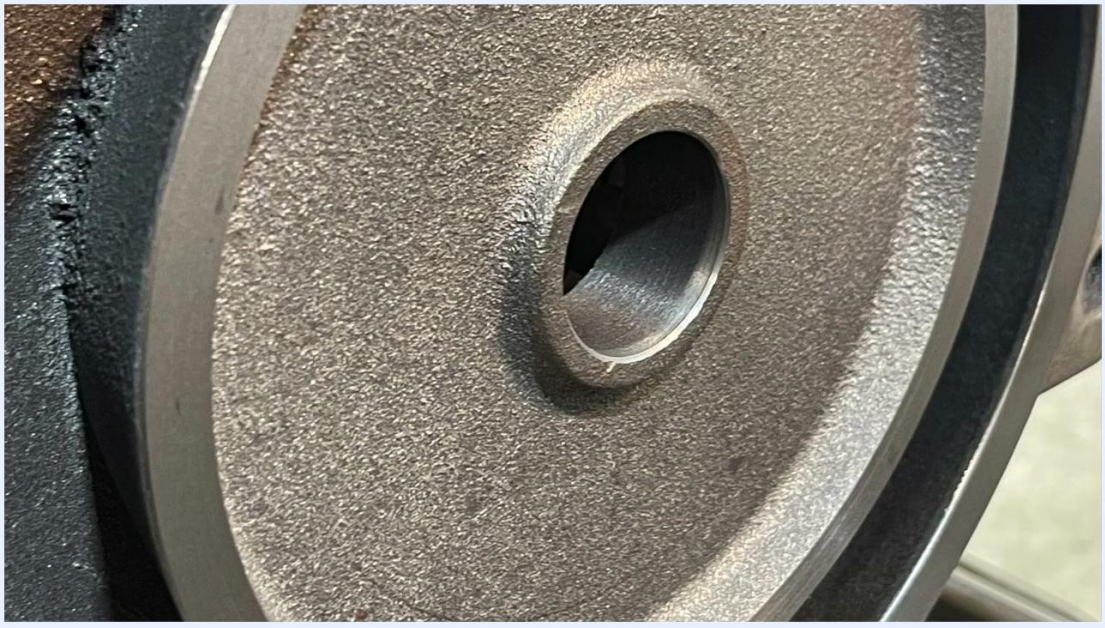
Step 1: Prepare the work area and equipment

1. Clean the granite surface plate thoroughly. Debris and dust affect measurement accuracy.
2. Gather the Starrett No. 675 Inspection Holder and the Starrett No. 25-131 Dial Indicator.

Note: Keep the granite plate clean throughout the process.

Step 2: Inspect and handle the swivel plate

1. Carefully lift the swivel plate and look at the surface you will inspect.
2. Identify the surface where the main vise body bolts down and which lets the plate swivel.
3. Make sure the machined face is clean and free of debris.

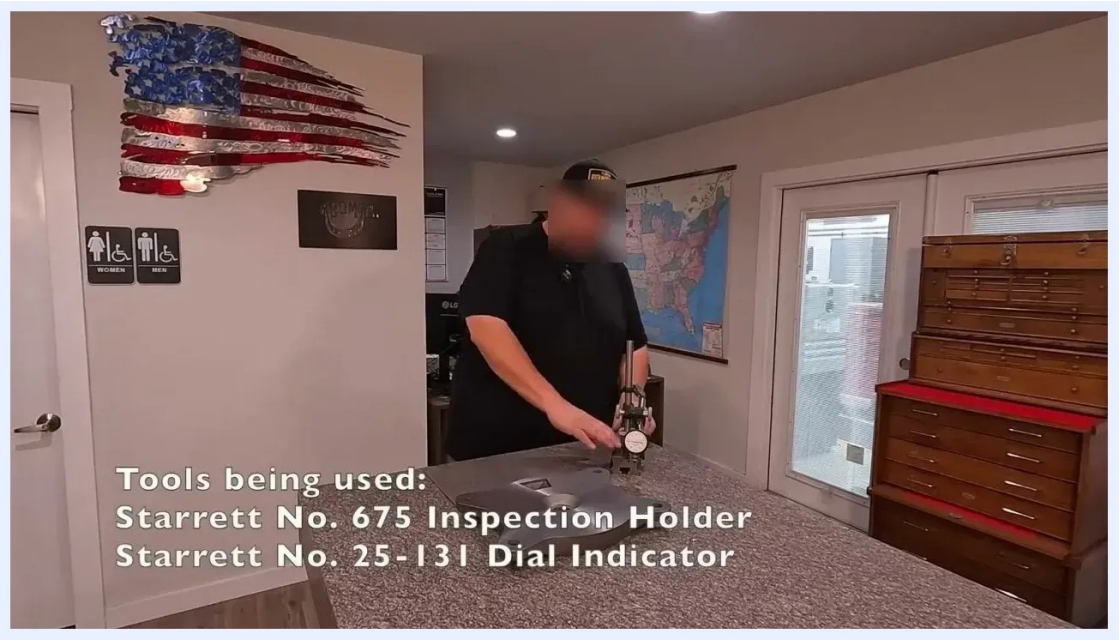


Lifting the machined swivel plate to inspect its face above the granite surface plate, with the dial indicator setup visible nearby

Step 3: Set up the inspection tools

1. Place the Starrett No. 675 Inspection Holder, with the Starrett No. 25-131 Dial Indicator mounted, on the granite surface plate next to the swivel plate.

2. Confirm that the dial indicator is securely mounted and that you can move it to different points on the plate.



Inspection setup showing the Starrett No. 675 Inspection Holder and the Starrett No. 25-131 Dial Indicator on the granite surface plate

Step 4: Position the indicator on the surface plate

Plan to check all four corners of the swivel plate. With the swivel plate on the granite surface plate, move the dial indicator to the first corner.



Operator explaining the value of measurement techniques and tools, standing beside granite surface plate and dial indicator setup in a well-equipped workshop

Step 5: Zero the indicator at the first corner

1. Set the dial indicator to zero at the first corner.
2. Watch the needle. It may move slightly because machining tool marks create small highs and lows on the surface.

3. Average out the needle movement to find a stable zero point.



Dial indicator set to zero at the first corner of the machined swivel plate

This zeroed position is the reference for all subsequent measurements.

Step 6: Move to the next corner and wipe the plate

1. Carefully move the dial indicator toward the second corner of the plate.

2. Wipe the granite surface plate as you move the indicator so dust does not interfere with the measurement.



Operator looking down at the granite surface plate and dial indicator, reflecting on the instructional process and key takeaways

Step 7: Record the second corner

1. Bring the dial indicator into contact with the second corner.
2. Make sure the dial face is visible and note the reading.
3. Record the value. In this example, the second corner reads approximately 0.001" lower than the reference corner.

Step 8: Measure the third corner

1. Rotate or slide the dial indicator and its stand to the third corner.
2. Make sure the indicator tip is properly seated on the machined surface.
3. Read the dial. In this example, the needle sits at zero with only minor fluctuations of a few tenths of a thousandth, likely from surface finish irregularities.

4. Record this corner as zero.



Dial indicator at the third corner with the needle at or near zero

Step 9: Move to the fourth corner

1. Gently move the dial indicator to the fourth and final corner.
2. Wipe the granite surface plate before you take the measurement.

3. Position the indicator tip securely on the surface.



Dial indicator remaining at the fourth corner to confirm the reading before comparing all four corners

Step 10: Record the fourth corner

Read the dial at the fourth corner. In this example, the needle shows a high spot of approximately +0.001" above zero. Note this value for comparison.

Step 11: Compare the corners and calculate parallelism

1. Review the readings from all four corners:
    - First corner: zero (reference)
    - Second corner: approximately -0.001"
    - Third corner: zero, or within a few tenths
    - Fourth corner: approximately +0.001"
2. Find the difference between the highest and lowest readings. In this example it is about 0.002" to 0.0025".

3. Conclude that the plate is out of parallel by this amount across its surface.



Wiping the granite surface plate while the dial indicator and swivel plate stay in position

Small variations of around one thousandth of an inch are expected because of machining marks and minor surface irregularities.

Step 12: Confirm measurement consistency

1. Return the dial indicator to the reference corner and check that it reads close to zero again. This confirms the setup has not shifted and your measurements are reliable.
2. Check the indicator itself. It is a Starrett model with 0.0005" graduations and a 0.125" total range. The granite surface plate and the machined part must stay in place throughout.

3. Keep all tools clean and properly positioned for any follow-up measurements.



Close-up of the Starrett dial indicator on its stand, reading near zero, with the machined part partly visible beneath the tip

Step 13: Interpret the parallelism result

The plate is approximately 0.002" to 0.0025" out of parallel across opposite corners. This level of deviation is minimal and generally acceptable for many machining applications. Always compare it to your specific tolerance requirements.



Moving the dial indicator to the fourth corner of the plate

Part 2: Check flatness

Step 14: Position the part and dial indicator

1. Place the machined part flat on the granite surface plate. The part is a large metal component with a central bore and four arms.
2. Set up the Starrett 25-131 dial indicator on a stand so the indicator tip contacts the surface of the part.
3. Make sure the dial indicator is perpendicular to the surface for accurate readings.
4. Hold the indicator base steady with one hand while you adjust the position with the other.

5. Observe the dial face for initial readings.



Dial indicator positioned on the swivel plate over the granite surface plate, ready for the parallelism measurement

Step 15: Identify high spots

1. Slowly move the dial indicator across the surface of the part.
2. Watch the dial for any movement that indicates a change in height.
3. Note any high spot you find. In this example, the first high spot reads a little higher than the surrounding area.

Step 16: Check additional locations

1. Continue moving the dial indicator to different positions, especially around the central area and arms.
2. Check the other side of the part as well, so you cover multiple points systematically.

3. Note the dial reading at each location.



Dial indicator setup on the machined part with hands adjusting the indicator on the granite surface plate



Dial indicator at a new location on the part with the dial face visible

Step 17: Record and interpret readings

Observe the dial as you move it to each new position, and note the readings.

- At one location, the reading is about half a thousandth, a deviation of 0.0005".
- At another location, the reading is about zero to half a thousandth, a deviation between 0 and 0.0005".



Dial indicator reading about half a thousandth on the machined part

Continue this process for all critical points on the part.

Step 18: Sweep the indicator around the part

Move the dial indicator in a circular or sweeping motion around the part to check flatness across the entire surface. This gives you a continuous check rather than isolated points.



Wide view of the setup as the indicator begins to sweep around the machined part on the granite surface plate

Step 19: Adjust the stand and continue

1. Adjust the dial indicator stand as needed to reach all areas of the part.

2. Continue to move the indicator and record readings at each location.



Adjusting the dial indicator stand to reach another area of the machined part

Step 20: Take the remaining readings

1. At another location, read the dial. In this example, the deviation is about a thousandth, or 0.001".

2. Review all readings to assess the overall flatness of the part. In this example, the part is in pretty good shape.



Dial indicator reading about one thousandth on the machined part

Step 21: Confirm overall flatness

1. Check that all measured deviations are within the required tolerance. In this example, they fall between 0 and 0.001".

2. If they do, treat the part as flat and ready for further processing or assembly.



Dial indicator showing minimal deviation that confirms the part's flatness

Step 22: Review the final measurement

Observe the dial indicator and confirm the final reading. The part is on the granite surface plate with the indicator in contact, and this marks the end of this measurement pass. The result in this example is satisfactory.



Operator standing at granite surface plate with dial indicator and machined part, explaining measurement techniques; workshop environment with map, tool cabinets, and American flag wall art

Step 23: Quantify the highest spots

1. Move the dial indicator to the right side of the part to check for the next highest spot.

2. Read the dial. In this example, the next highest spot is about a thousandth, maybe a thousandth and a half, depending on where the tip lands on the tool marks.



Dial face showing 0.002 inch with a hand holding the stand

Step 24: Determine total out-of-parallelism

1. Continue sweeping the dial indicator across the part.
2. Position the indicator at a new location and read the dial. In this example, the dial shows approximately 0.002".

3. Record the part as two thousandths out of parallel.



Close-up of the dial indicator reading approximately 0.001 to 0.0015 inch while the stand is adjusted

Step 25: Sweep to confirm the maximum deviation

Sweep the dial indicator across the surface again to confirm the maximum deviation. The total out-of-parallel measurement in this example is again two thousandths.



Using both hands to adjust the dial indicator while sweeping the machined part on the granite surface plate

Step 26: Sweep the indicator from one side to the other

1. Place the dial indicator, as the comparative tool, on one side of the machined part.
2. Sweep it across the part's surface to compare heights and detect deviations.

3. Keep the probe in contact with the part as you move the stand.



Machined part and dial indicator on granite surface plate, operator’s hands visible, stable workshop environment



Operator standing behind granite surface plate, gesturing with hands, dial indicator and machined part in foreground, workshop background

Part 3: Interpret results and maintain the surface plate

Step 27: Understand how plate flatness affects accuracy

Every measurement in this procedure uses the granite surface plate as the master flat reference. Accurate measurements depend on the flatness of that plate.

A deviation of two thousandths of an inch is large for a granite surface plate. If the plate has a low spot, even a small deviation can significantly affect your measurement accuracy. Any unevenness or low spot in the plate can cause inaccurate readings.



Machined part on the granite surface plate with the dial indicator in position at the end of the measurement pass

Step 28: Maintain the granite plate

1. Treat the granite surface plate as essential for this kind of precision measurement.
2. Care for the plate to preserve its accuracy.
3. Use appropriate inspection tools, such as dial indicators and stands, on the plate for accurate results.
4. Keep the plate and the surrounding area clean and free of debris so measurements stay reliable.

5. Keep the inspection area organized so you are ready for further jobs.



Operator gesturing above the granite surface plate and dial indicator setup, emphasizing the importance of plate flatness; part and indicator in place

Step 29: Apply the results to the specific part

1. Remember that this part is a swivel plate for a large bench vise. Each part may have different flatness requirements.
2. Understand that not every part needs strict flatness tolerances. This swivel plate has no specified tolerance, so the application dictates what flatness is acceptable.

3. Account for assembly effects. Minor deviations of a couple thousandths of an inch are corrected when the part is bolted down during assembly.



Hands sweeping the dial indicator across the machined part on the granite surface plate



Operator standing near granite surface plate, hands visible, dial indicator and machined part in place, emphasizing plate care



Operator gesturing with both hands above granite surface plate, dial indicator and machined part in place, emphasizing use of inspection tools



Operator standing behind granite surface plate with dial indicator and machined part, wall map and tool cabinets in background, explaining part-specific requirements



Operator gesturing while explaining tolerance requirements for the part, granite surface plate and dial indicator setup visible



Touching the machined part on the granite surface plate to show how bolting down flattens small irregularities



Operator standing back from granite surface plate, organized workspace with dial indicator and machined part, clean inspection area



ABOM79 logo with micrometer graphic and "Booth Machine Shop" text over a background of colorful metal shavings, marking the end of the instructional segment

Verification and summary

Summary of the example readings

Parallelism check at four corners:

- First corner: zero (reference)
- Second corner: approximately -0.001"
- Third corner: zero, or within a few tenths
- Fourth corner: approximately +0.001"
- Total deviation: about 0.002" to 0.0025"



Dial indicator at the fourth corner with the needle at about +0.001 inch

Flatness check across the part:

- A high spot of 0.002" in the center
- One side: approximately 0.0005"
- Another side: between 0.000" and 0.0005"
- Some areas: only a few tenths of a thousandth of difference
- The last side: about 0.001" to 0.0015", depending on the tool marks

The part is in good shape, and all deviations are within a reasonable range for most applications.

Verification checklist

- The granite surface plate was clean before and during each measurement.
- The dial indicator was zeroed at the first corner, and tool mark variation was averaged out.
- You measured all four corners and recorded each reading.

- You compared the highest and lowest readings to find the total deviation.
- You measured multiple locations, including the center and all sides, for flatness.
- The indicator returned to the same reading at the reference corner.
- You compared the results to the tolerance your application requires.



Dial indicator at the second corner reading about one thousandth below zero

What's next

After you finish the inspection, use these measurement principles and techniques on your own machining and inspection tasks. Keep the surface plate clean and well maintained so your readings stay reliable. Learning how to use a surface plate this way helps you inspect jobs accurately and decide whether small deviations are acceptable for your application.