Effective Date: March, 2006

EC-1600/2000/3000 - Leveling

EC-1600/2000/3000 - Leveling

Introduction

Leveling of the machine is required to obtain the correct right angle geometry of the machine's X, Y, and Z axes, and to ensure the correct positioning of the tool changer. Incorrect level will result in out-of-round circle milling, incorrect linear interpolation, and the possibility that the tool changer may drop tools.

NOTE: Many factors can affect a machine's ability to remain level — the rigidity of the floor, the stability of the support under the floor, trains or trucks passing nearby, seismic activity, and so on. Therefore, until your experience shows how often re-leveling is required, you should check the machine's level frequently after it is installed.

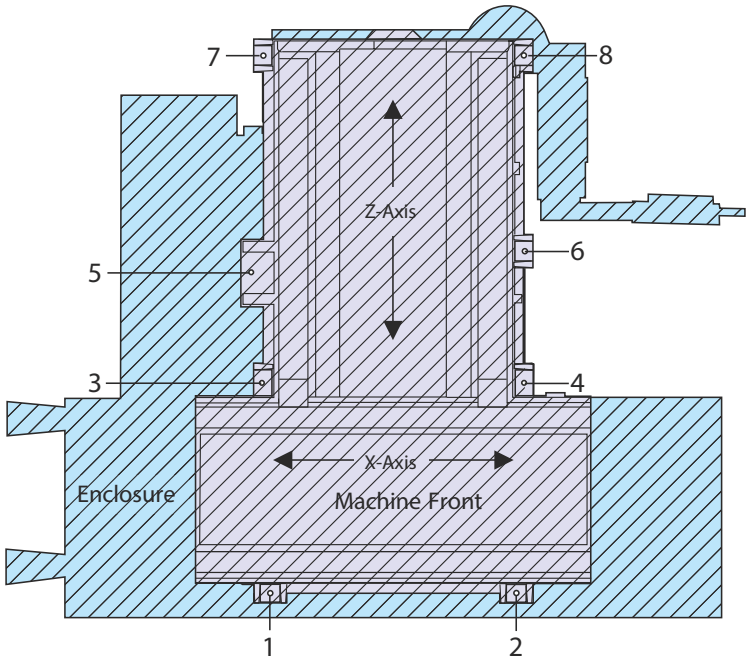
NOTE: Anchoring of the EC-1600 is highly recommended if large, heavy, or tall parts are to be machined, or if the foundation is suspect.

The leveling includes rough and fine leveling and pursuant geometry checks. The following tools are required to perform this operation:

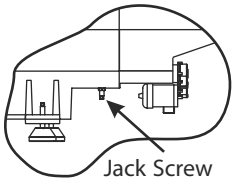
- .0005" bubble level
- 50T split tool/T-2089 for CT50, T-2088 for BT50
- 24" granite parallel
- Large magnetic indicator base
- .0005" caliper
- .0005" indicator
- 50T spindle lock tool/T-2080
- 24" granite square
- 1-2-3 blocks

The machines are leveled at the factory, using an electronic level. If not available, use a precision bubble level with each division equal to **0.0005** inch per **10** inches, or **.05** mm per meter, or **10** seconds per division. Before starting, check the accuracy of your level. Set it on the table on the X-axis and record the reading. Then turn it **180**° and the reading should be the same. If it is not, the level is out of calibration and should be adjusted before you continue.

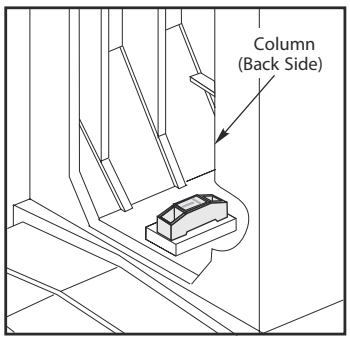
Screw all leveling screws through the base until the base is 4" above the floor (3" pad height + 1" of screw extending from bottom of base). Note that the condition of the foundation may require different heights at some leveling screws to achieve level.



1. Disconnect rear Z axis cover from column to allow access to the Z axis linear guides. Stone the two column blocking bosses behind the column and place a 1-2-3 block on each. Place a bubble level on the blocks and level the base, checking off of both Z axis linear guides with the level parallel to Z axis.
2. Place the level on the center of the table, parallel to the Z-axis, and note the position of the bubble.
3. Jog the table to the left, until the level is above screw 1, and note the position of the bubble.
4. Jog the table to the right, until the level is above screw 2, and note the position of the bubble.
5. Adjust for roll, by using screws 1 and 3 or screws 2 and 4 until the position of the bubble remains constant over the full range of travel.
6. On newer EC-1600/2000 machines, X-axis pitch can be removed by adjusting the jacking screws under the base (one on each side - see illustration). Readjustment may be needed after heavy loads are placed on the table. For the EC-3000, use the outrigger screws for pitch adjustment by turning the screws for each outrigger by equal amounts in the same direction so as not to affect roll.

   Note: This adjustment is critical to the proper function of the machine. Pitch and roll must be completely eliminated.
7. Jog the table to the center of travel.
8. Place 1-2-3 blocks (gauge blocks) on the platter or table, for machines without the A-axis platter, (ensuring both surfaces are clean); one at the rear of the platter or inside of the table, and one at the front of the platter, or outside edge of the table.
9. Attach a .0005" indicator to the spindle head and zero out on the block at the rear.
10. Jog the Z-axis to the front of the platter, or outside edge of the table, and indicate the 1-2-3 block at that position.
11. Raise or lower screws 1 and 2 equally, and repeat, until readings between blocks without rotating the A-axis platter are within .0001".
12. Remove roll from the Z-axis. Place a level on a 6" square of granite, or suitable block, inside the rear of the column, with the level parallel to the X-axis. Shim the level as necessary. The level does not need to be centered, just within a readable range.
13. Jog the column to the maximum (Z-negative) position and note the position of the bubble, then jog the column to the maximum (Z-positive) position and note the position of the bubble. Adjust screws 7 and 8 by equal mounts in opposite directions, to eliminate roll without affecting the results of Steps 6 through 10.
14. **Re-verify steps 2 through 11.** It is absolutely critical that these steps are correct before proceeding.
15. Adjust until readings at each end of the travel are within .0001".
16. Remove the level and the block from the back of the column.
17. Repeat Steps 6 through 10 to verify the Z-axis geometry in relation to the platter or table. Keep in mind that when repeating these steps, that Z-axis roll has already been removed, so leveling screws 7 and 8 must be adjusted up or down equally; that is, both up or both down in equal amounts.

18. Remove pitch from the Z-axis. With a level placed parallel to the Z-axis (inside the column), jog the column to the maximum (Z-negative) position and note the position of the bubble, then jog the column to the maximum (Z-positive) position and note the position of the bubble.
19. If necessary, adjust leveling screws 5, 6, 7 and 8 to correct for Z-axis pitch.

20. With Z-axis pitch established, repeat all steps to verify X-axis roll (and pitch, if the machine has the means for such an adjustment), Z-axis pitch and roll, and the indication in the Z-axis across the platter of table. If all are correct, move on to A-axis rotation, geometry, and TC alignment verification. If not correct, repeat the necessary steps to correct the error.
21. If the machine is to be anchored, perfect level must first be achieved. After the anchors are locked in, and 80 ft/lbs of torque applied, Step 20 must be repeated.
22. When leveling is complete, reinstall Z-axis waycovers and seal with black RTV.

NOTE: Once these steps are verified to be correct, with the axes at the center of travel and the bubble level at the center of the table checking in the X and Z plane, it is possible that the machine table surface may not be perfectly perpendicular to earth gravity. This is acceptable, as long as the machine is square and its geometry is correct.

NOTE: If the Z-axis pitch cannot be adjusted to an acceptable tolerance that allows for correct geometry; it will be necessary to determine the cause for error in the Z-axis flatness, and to take the necessary steps to correct the problem. Normally this is due to a bow in the casting between the front and the rear of the Z-axis portion of the base casting, and adjusting leveling screws 5 and 6 will correct this. If the pitch cannot be adjusted into tolerance with leveling screws 5 and 6, it may be that an upward bow is present. If so, it may be necessary to anchor the machine to bring the flatness into specification. If you believe this condition exists, please contact Haas factory service.

A-axis Rotation Verification

These steps measure the parallelism of the A-axis (axis of rotation) to the Y-axis, and the platter face runout. The EC-1600 geometric inspection report (GIR) is placed in the back of the operator's manual when the machine is shipped from the factory. Refer to this document for A-axis and column square verification.

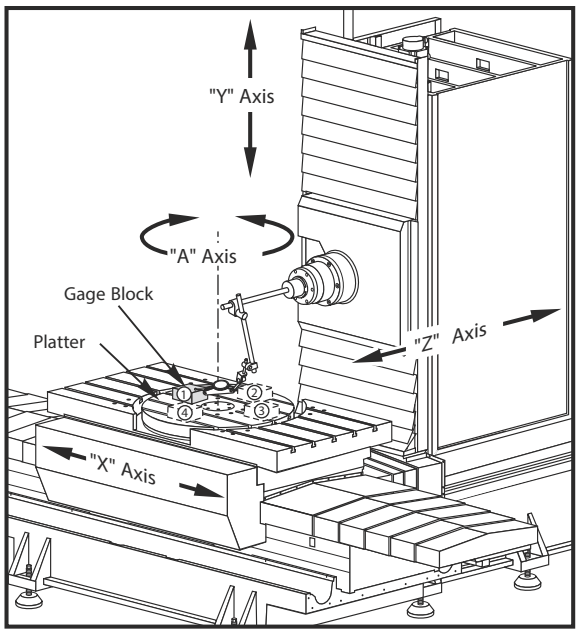
1. To check the axis of rotation, check a single point at four positons, 90° apart on a 1-2-3 block, as shown in the illustration. Rotate the platter 90° CW, then **jog the X and Z axes** to the indicating point. Check the block in the same spot, record the reading, and repeat the procedure every 90°.

   If the A-axis is an indexing axis, (not a full 4th rotary axis) remove the 1-2-3 block while indexing between readings to provide clearance for platter pop-up.

   NOTE: The readings are not to exceed 0.0005".

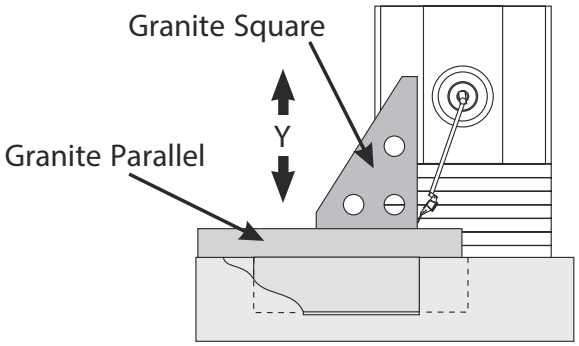
2. To check the platter face runout, check four points, 90° apart, by indicating the runout at the 0° position (as shown in the previous illustration). To do this, jog the axis to locate the indicator at the 0° position and zero out the indicator. Leave the indicator in this position for all four readings. **Rotate the platter** at 90° increments and record the readings.

   NOTE: The readings are not to exceed 0.002".

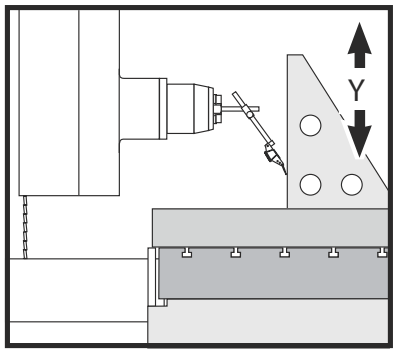


Geometry Verification

These steps measure the squareness of the Y-axis to the X-axis, and the squareness of the Y-axis to the Z-axis.



Y-axis Tilt Relative to X-axis



Y-axis Tilt Relative to Z-axis

1. Set up the granite parallel and square, as shown in the above illustration, to check Y-axis tilt relative to the X-axis. Position the square so that its edge overhangs the parallel enough to take an indicator reading on the underside of the square (parallel to the X-axis). Before taking this reading, adjust the square by indicating across its vertical edge to ensure that it is parallel with the Z-axis (obtain a zero reading). Now indicate the underside of the square to verify a zero reading. If the reading is not zero, check that all surfaces are clean.

NOTE: The granite parallel may need to be shimmed to obtain a zero reading, due to table surface tolerance.

2. With the indicator positioned as shown in the illustration, slowly jog the Y-axis a minimum of 24" to check Y-axis tilt relative to the X-axis.

3. Set up the granite parallel and square, as shown in the above illustration, to check Y-axis tilt relative to the Z-axis. Position the square so that its edge overhangs the parallel enough to take an indicator reading on the underside of the square (parallel to the Z-axis). Before taking this reading, adjust the square by indicating across its vertical edge to ensure that it is parallel with the X-axis (obtain a zero reading). Now indicate the underside of the square to verify a zero reading. If the reading is not zero, check that all surfaces are clean.

NOTE: The granite parallel may need to be shimmed to obtain a zero reading, due to table surface tolerance.

4. With the indicator positioned as shown in the illustration, slowly jog the Y-axis a minimum of 24" to check Y-axis tilt relative to the Z-axis.

NOTE: The readings in steps 2 and 4 are not to exceed 0.0005" for 24" of travel.

NOTE: If the X-axis roll, Z-axis pitch and roll, and the indication in the Z-axis across the platter or table are correct, the column square should also be within specification, or very close to it. Small adjustments to the leveling can be made without compromising the overall accuracy of the machine. If excessive adjustment is necessary to bring the column square into tolerance, or if you have any questions, please contact the Haas factory service department for technical support.

Tool Changer (TC) Alignment Verification

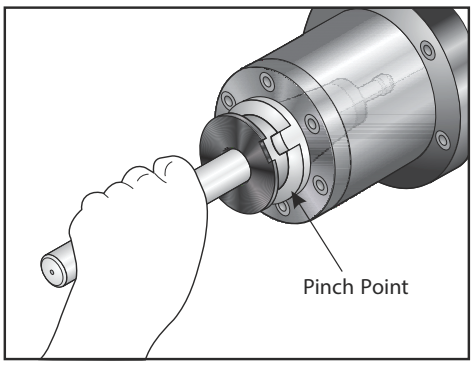
TC alignment must be verified before loading any tools. Any adjustment or change to the machine level will affect TC alignment. Incorrect TC alignment can result in dropped tools, damaged waycovers, cambox damage, excessive wear, and damage to the TC double-arm.

Warning

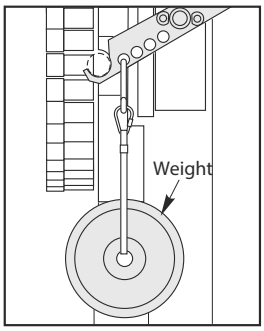
Verify tool changer alignment before operating the mill.

As a safety precaution the Service technician must ensure that the tool changer is aligned properly to the spindle. The installation and leveling of a new machine will affect the tool changer alignment. Use the following instructions to verify alignment. Do not load any tools into the tool changer or spindle until alignment is complete.

Tool Required: Split Tool P/N T-2088 for 50 taper, BT tooling
T-2089 for 50 taper, CT tooling



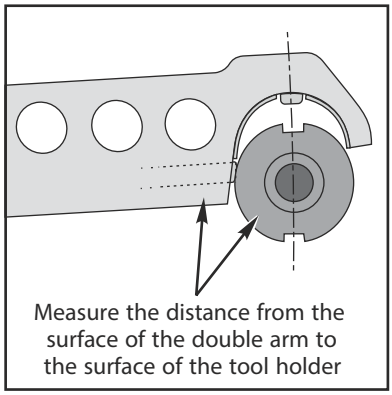
Split Tool

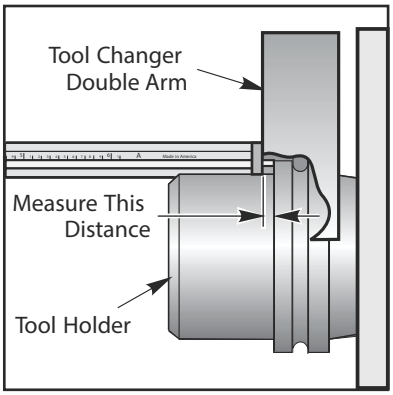


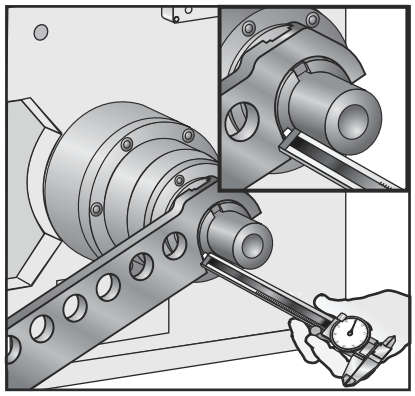
Weight hung from the tool changer double-arm

1. With no tool in the machine, command a tool change. Press Emergency Stop before the double arm reaches the spindle. This will cause the mill to move the Y and Z axes to the ATC position.
2. Verify the spindle is free to rotate without hitting the double arm. If necessary, use the T/C Recovery commands to move the arm further from the spindle.
3. Using T/C Recovery, orient the spindle.
4. Using T/C Recovery, rotate the double arm in the forward direction. Continue rotating the double arm until it reaches the spindle, then extends approximately 6" (152.4 mm) in front of the spindle.
5. Using the dowel pin as a handle, install the tapered half of the split tool into the spindle. Be careful to not place your hands in the pinch point between the tool and the spindle. The Tool Release button operates in a Toggle On/Off mode during Tool Recovery. Press once to activate the Tool Release; press again to clamp.
6. Remove the dowel pin, and install the second half of the split tool into the end of the double arm in front of the spindle. It will be necessary to manually press the tool lock plunger (near the center of the shaft as shown in the Service manual) to allow the spilt tool to be inserted.
7. Using T/C Recovery in the reverse direction, move the double arm back toward the spindle until the halves of the split tool are approximately 1" (25.4 mm) apart.

8. Hang a 40 lb (18.2 kg) weight from the pocket side of the arm. Hang the weight from the hole closest to the pocket. This will preload the arm.
9. Continue to move the arm toward the spindle. Watch the double arm as it approaches the spindle. The spindle dogs and the slots in the double arm should line up. This will verify Parameter 257 (Spindle Orient Offset). If the spindle and arm do not line up, reset Parameter 257 as described in the Service Manual, and continue moving closer until there is a maximum of 1/8" (3.2 mm) gap between the split tool halves, ensuring that the halves do not touch each other.
10. Check the X and Y alignment of the double arm to the spindle by inserting the alignment dowel through both halves of the split tool. The dowel should slide freely. If the pin does not slide freely, the direction of the misalignment may be determined by feeling the "step" between the split tool halves, by using a steel rule, straight edge, or similar tool.
11. If misalignment is present, read (ATC Alignment procedure Horizontal)
12. Using T/C Recovery, move the double arm in the forward direction, away from the spindle. Remove both halves of the split tool.
13. Install a tool holder into the double arm, measure the distance from the front of the double arm to the front face of the tool holder (see diagram), and record the distance.







14. Remove the tool from the double arm. Using T/C Recovery, move the arm in the reverse direction to the spindle. Continue until the arm rotates to the origin "Home" position. Once the arm is away from the spindle, insert the same tool holder used in Step 13 into the spindle.
15. Using T/C Recovery, rotate the arm in the forward direction until the arm is very close to the tool holder. The spring-loaded slide will be depressed as the arm nears the tool holder, but be sure that the arm is not touching the tool holder itself.
16. Using a caliper, measure between the same two surfaces described in Step 13. The measurement should be the same, +/-.010" (.254 mm). Be sure that you are measuring the distance between the double arm and the tool holder, not the spring-loaded slide and the tool holder. If adjustment is required, refer to "Setting Parameter 64" in the Service Manual.
17. If no changes are needed, complete Tool Change Recovery.
18. Note that the same end of the double arm must be used for the caliper measurement. The two ends may have different readings. This is normal and will not affect operation.
19. Load tools (maximum 30 lbs (13.6 kg) each) into the machine, and perform tool changes to verify proper operation. Caution: Protect the Z-axis way cover (closest to the column) in case a tool is dropped from the spindle or tool changer arm. The tool changer should be operated at 100% rapid speed, otherwise tool changer motion may jerk or be sluggish.