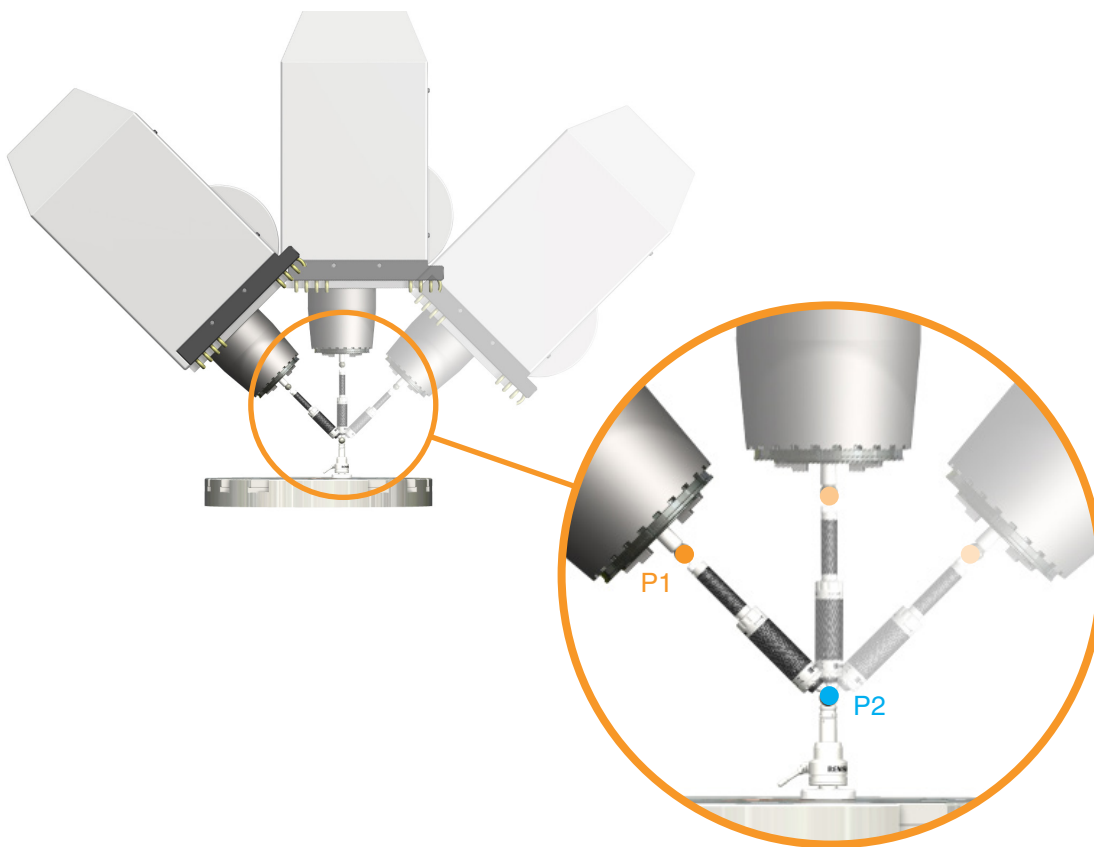


Defining the tool length

Introduction

When contouring, a machine tool is trying to keep the separation of two points constant during multi-axes movements. The tool length tells the machine controller the location of one of these points (**P1**) and the G54 position defines the other (**P2**). A ballbar is able to measure contouring performance by measuring any deviation in the two points' separation whilst carrying out tool paths.



Whilst a ballbar is measuring the deviation, it is measuring the change in length between the centres of its two balls. Therefore when taking a tool length measurement for contouring, the critical tool length is to the centre of the ballbar ball, not the tip.

Having the correct tool length is critical in allowing the tool centre point function to contour accurately. Failure to measure tool length correctly will result in the offset between the centre pivot and toolcup increasing or decreasing and the QC20-W being dropped.

Tool length can be measured manually or by using a tool setter. The processes are as follows:

Taking a measurement manually:

(more information on each step is provided in the following section)

- Step 1 – Reference machine and set work offset in Z (optional);
- Step 2 – Measure setup 1, using a calibrated length bar;
- Step 3 – Measure setup 2, using the toolcup;
- Step 4 – Calculate tool length;
- Step 5 – Enter the tool length into the machine controller.

Taking a measurement using a tool setter:

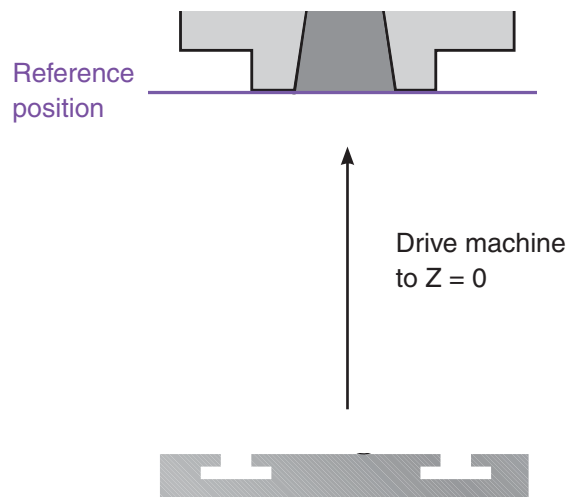
- Step 1 – Measure the tool length with a setting ball in the toolcup (with the setting ball handle directed away from the tool setter);
- Step 2 – Manually remove 6.35mm (setting ball radius) from the measurement.



Manual measurement

Step 1 – Reference machine and set work offset in Z (optional)

1. Drive the machine until it is at the reference position (Z furthest away from the machine bed).
2. Select the work offset page in the machine. Set the Z axis offset (this will ensure that all machine readings are the same and avoid mistakes).

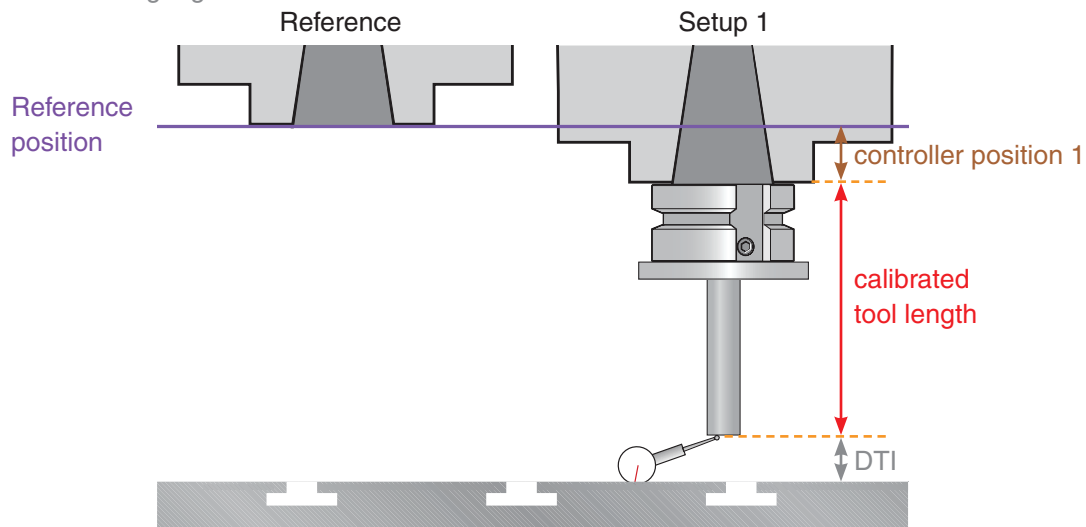


Step 2 – Measure setup 1, using a calibrated length bar

1. Insert the calibrated length bar into the machine and call it into the spindle.
2. Place the DTI gauge onto the machine bed.
3. Drive the tool down until the known length tool is just touching the DTI gauge.
4. Take note of the new position on the machine control (**controller position 1**), the **calibrated tool length**, and the position of the DTI gauge.

Equipment required:

- Calibrated length bar
 - DTI gauge (or slip gauge*)
- *a slip gauge requires the tool to touch the bed. This should only be used by an expert user.

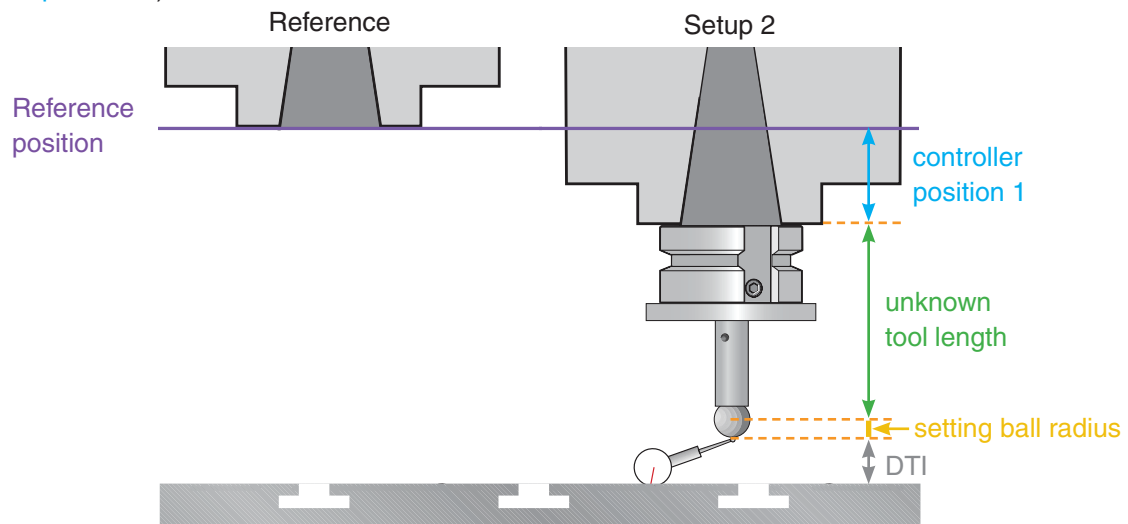


Step 3 – Measure setup 2, using the toolcup

1. Insert the **centring tool / QC20-W toolcup combination** into the machine and call it into the spindle.
2. Insert the **setting ball** into the toolcup.
3. Drive the tool down until the tool is touching the DTI gauge, and the DTI is in the same position as in step 2.
4. Take note of the new position on the machine control (**controller position 2**).

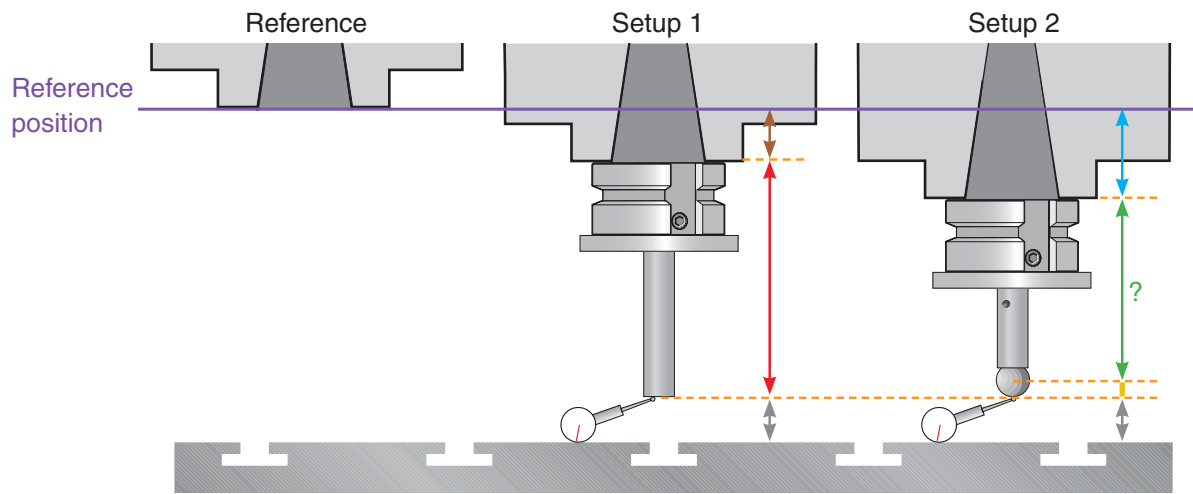
Equipment required:

- Calibrated length bar
 - DTI gauge (or slip gauge*)
- *a slip gauge requires the tool to touch the bed. This should only be used by an expert user.



Step 4 – Calculate tool length

This diagram shows the two setups that have just been completed:



The following formula stands for the two setups (using absolute values):

$$\text{Controller position 1} + \text{Calibrated tool length} + \text{DTI} = \text{Controller position 2} + \text{Tool length} + \text{setting ball radius} + \text{DTI}$$

To calculate the tool length, the formula can be reduced and rearranged to give:

$$\text{Tool length} = \text{Controller position 1} + \text{Calibrated tool length} - \text{Controller position 2} - 6.35\text{mm}$$

This formula can now be used to calculate tool length.

Step 5 – Enter the tool length into the tool offset page in the machine

1. Navigate to the tool length page on the machine controller.
2. Navigate to the tool being used for testing.
3. Enter the new tool length value.

Note: It is important to ensure that the part programs call this tool.

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