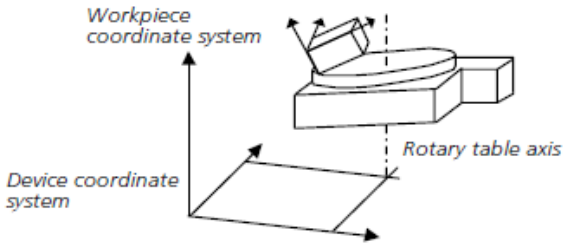
5 Definition of the RT Axis

5.1 Basic principles of rotary table operation:

The rotary axis defines the exact position of the rotary table in relation to the machine zero-point, as well as the inclination in relation to the CMM axes; in other words - the position in the machine coordinate system.



All features and coordinate systems are computationally rotated around the RT axis when the rotary table turns.

Errors in calibrating the RT axis therefore have a direct influence on the measuring accuracy.

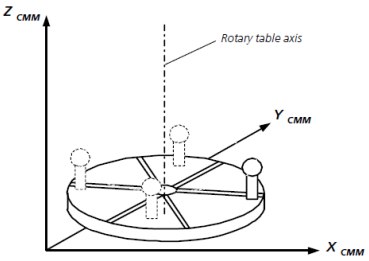
Note:

- The RT axis is stored separately for each measuring plan.
- Always measure the RT axis at the turnover point..
- Use the stiffest possible probe to define the RT axis (e.g. the reference probe).
- Ensure the highest degree of cleanliness of the probe, normal and workpiece for defining the axis.
- If the workpiece to be measured can be measured with just one probe system, also use this to define the RT axis. You will thus avoid inaccuracies due to calibration errors or probe replacement.
- The Z-value of the axis is calculated in the machine coordinates to Z=0.

5 Definition of the RT Axis

The various methods:

Single sphere method (=> Section 5.2)



- The axis is defined with a perfectly shaped sphere (e.g. a calibration sphere) in several (normally 6) rotary table positions.

Application:

- Standard method for moderate accuracy requirements.
- This method is ideal for flat workpieces with large diameters (e.g. ring gears). The greatest accuracy is achieved if the workpiece is at roughly the same height as the sphere previously used for axis determination.

Advantages:

- No additional normals are required.
- Measurement can be carried out with a reference probe.
- The measurement plan supplied can be used.

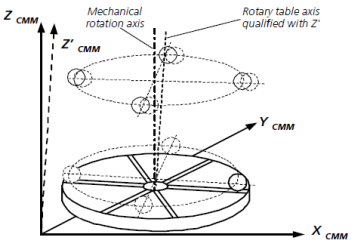
Disadvantages:

- All measurements are carried out in the same Z-height of the CMM. Rectangular residual CMM errors can lead to greater errors in other Z-levels.
- Dependent on the position of the rotary table within the measurement volume, it may be the case that the complete angular range cannot be covered.

Note:

The dual sphere method is not recommended for the O-Inspect.

Dual sphere method (=> Section 5.3)



- The axis isdefined with two perfectly shaped spheres (e.g. calibration spheres) at different heights and at several (normally 6) rotary table positions.

Application:

- For tall workpieces.

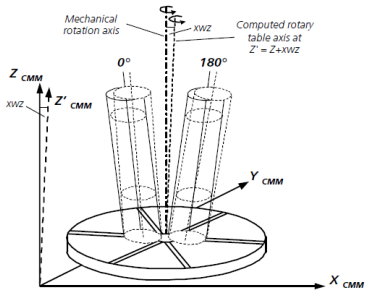
Advantages:

- The RT axis is defined over the entire height of the workpiece. Rectangular residual CMM errors are compensated and have less influence on measurement uncertainty.
- Measurement can be carried out with a reference probe.

Disadvantages:

- Relatively long calibration times.
- Either a special fixture is required on which both spheres are mounted, or complex mechanical calculation of the base alignment for each run.
- Depending on the position of the rotary table in the volume to be measured, it could be the case that it is not possible to cover the complete rotational range.

Measurement cylinder method (=> Section 5.4)



- The rotary table axis is defined by means of a perfectly formed measurement cylinder at two rotary table positions.

Application:

- For tall workpieces.
- This method can also be used for the measurement of shafts with low shape deviation. Rather than using a measurement cylinder, the rotary table axis is determined directly on the workpiece prior to each run.

Advantages:

- The RT axis is defined over the entire height of the cylinder. Rectangular residual CMM errors are compensated and have less influence on measurement uncertainty.
- Short measurement time
- Simple fixture; the cylinder may be reproducibly mounted on the rotary table at any time.

Disadvantages:

- Measurement cylinder required.
- Reference probe cannot be used.

Self-centering method (=> Section 5.5)

Using this method, the rotary table axis is defined by self-centering probing of an element (bore, cone, sphere triple,…) in several (normally 6) rotary table positions.

Note:

The self centering method is not recommended for the O-Inspect.

Application:

- In production-related use.
- The element to define the rotary table axis can be mounted directly on the workpiece pallet in this case. It is therefore possible to redefine the rotary table axis prior to each workpiece measurement without great effort

Advantages:

- Very fast method.
- Measurement can be carried out with a reference probe.

Disadvantages:

- All measurements are carried out in the same Z-height of the CMM. Rectangular residual CMM errors when measuring in other Z-heights lead to greater measurement errors.
- Depending on the position of the rotary table in the volume to be measured, it could be the case that it is not possible to cover the complete rotational range.