Concentricity and Coaxiality Dimension Calculations

Concentricity and coaxiality dimensions often generate questions from users, because these dimensions sometimes produce large values. You should understand how they work inside PC-DMIS so that you know where these large values come from.

To calculate concentricity, the dimension takes the centroid of the circle or cylinder and finds its perpendicular distance to the datum's vector. Because the direction of the vector is extremely important in this calculation, reversing the features—as seen in the second example—can have a drastic effect on the calculations.

Example 1 – Cylinder 2 to Cylinder 1

In this concentricity example, the datum vector is the axis of Cylinder 1 (shown as CYL1) is:

```
1,0,0
```

The centroid XZY location of Cylinder 2 (shown as CYL2) is:

```
9.5142, 0.0000, 0.0360
```

The calculated distance from CYL2's centroid to the datum's vector is:

```
0.0360
```

The calculated measured value is:

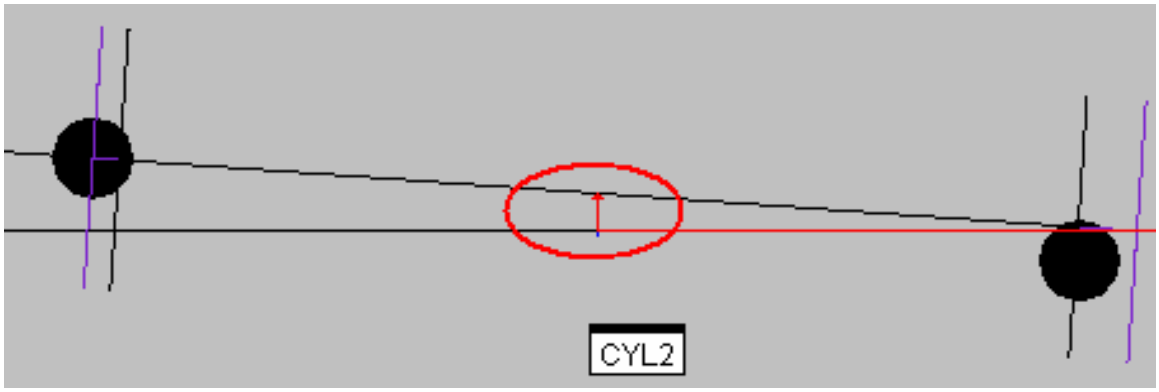
```
2 * 0.0360 = 0.0720
```

In this sample dimension, this measured value of 0.0720 is reported (except for some round off error):

```
DIM CONCEN8=CONCENTRICITY FROM CYLINDER CYL2 TO CYLINDER CYL1  UNITS=IN ,$
GRAPH=OFF  TEXT=ON  MULT=1.00  OUTPUT=BOTH
AX   NOMINAL     +TOL       -TOL       MEAS        DEV      OUTTOL
M      0.0000     0.0100     0.0000     0.0719     0.0719     0.0619 -------->
```

Side View Showing a Graphical Analysis of the Concentricity from CYL2 to CYL1

In the Graphical Analysis display for this example, the **Arrow Multiplier** value is set to 1.0. This shows a small, red, deviation arrow listed in the Graphics Display window for the CYL2 feature, indicating the distance from the CYL1 vector to the CYL2 centroid:



Enlarged Side View of Just CYL2 Showing the Deviation Arrow

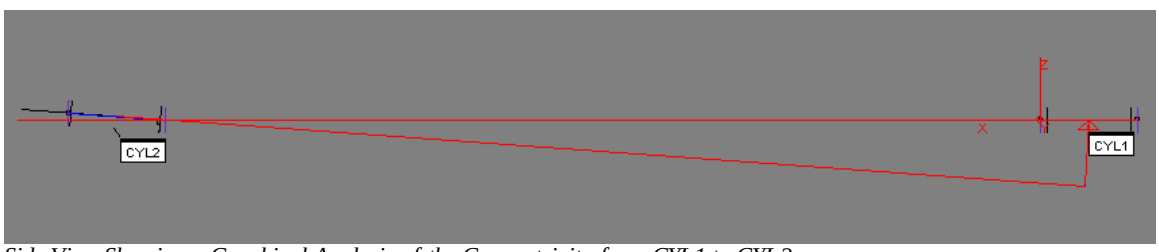
Example 2 – Cylinder 1 to Cylinder 2

When the dimension uses the same features, but in reversed order, the deviation in the datum's angle has a larger effect, especially if the two features are far apart.

```
DIM CONCEN9=CONCENTRICITY FROM CYLINDER CYL1 TO CYLINDER CYL2  UNITS=IN ,$
GRAPH=ON  TEXT=ON  MULT=1.00  OUTPUT=BOTH
AX   NOMINAL     +TOL       -TOL       MEAS        DEV      OUTTOL
M      0.0000     0.0100     0.0000     1.3258     1.3258     1.3158 -------->
```

This results in a much larger deviation, even though CYL2 is only slightly rotated about 4 degrees; this makes many users question the measured value. However, if you turn on the Graphical Analysis for this example, you can see that the deviation is indeed much larger.

Important: Be sure that the Arrow Multiplier is set to 1.0, because then the deviation arrow will be the actual size of the deviation.



Side View Showing a Graphical Analysis of the Concentricity from CYL1 to CYL2

Simply by switching the order of the features, the deviation arrow is indeed much larger, because the datum now has the angle deviation.

Also, in this example notice that if the CYL2 is rotated about 4 degrees from its nominal, and CYL1 and CYL2 have their centroids about 9.5 from each other. This makes the deviation is equal to:

```
9.5 * tan(4 degrees) = .664
```

This results in a measured value of:

```
2 * .664 = 1.33
```