

Causes for Variance in Radii Over Short Segments of Arcs

Example 1:

Figure 1 shows 9 points constructed at a nominal radial location of 0.981mm. The Y coordinate for points 5 and 7 were then changed by -0.0005mm to illustrate the effect that minor variances in point locations can have on calculated radii.

The following radii result:

- Radius calculated from points 2 through 10 = 0.9820 mm
- Radius calculated from points 3 through 9 = 0.9837 mm
- Radius calculated from points 4 through 8 = 0.9854 mm
- Radius calculated from points 5 through 7 = 0.9893 mm
- Radius calculated from points 6 through 7 = 0.9808 mm

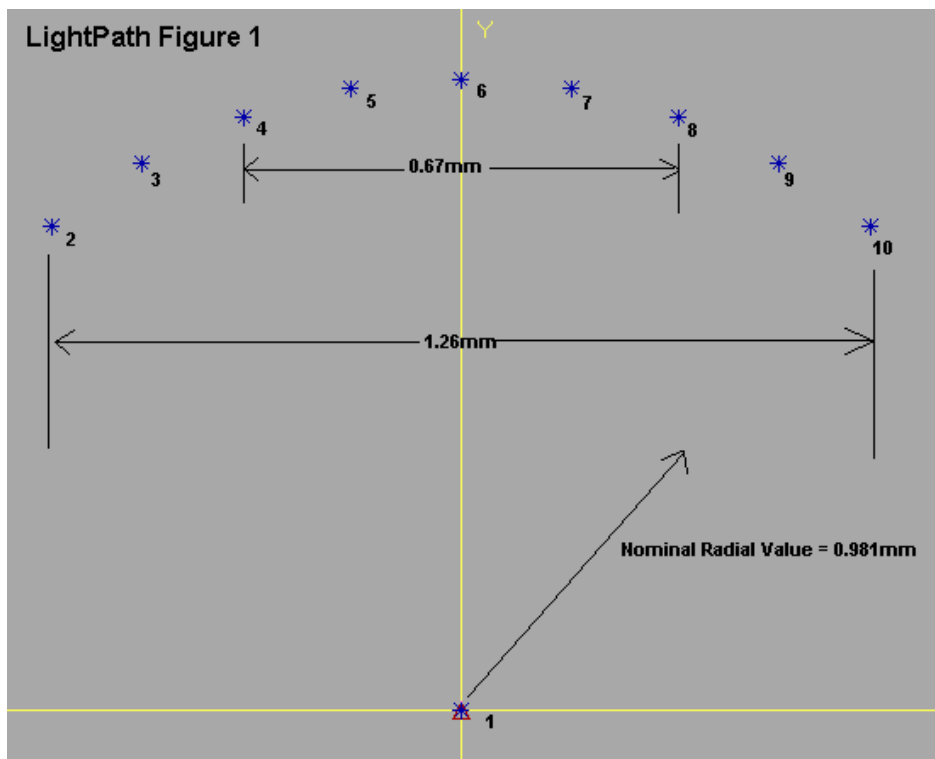


Figure 1: Constructed Radial Points

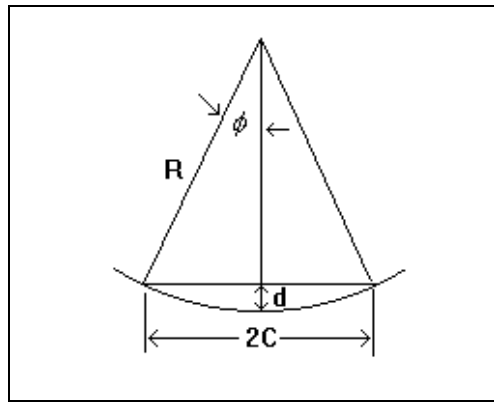


Figure 2

Where:

d = Depth of Curve $2C$ = Chord Length
 R = Radius of Curvature ϕ = Arc Segment / 2

For the above we can observe that: $d = R - \sqrt{R^2 - c^2}$

Therefore: $R = \frac{c^2 + d^2}{2d}$ where: $c = R \sin \phi$

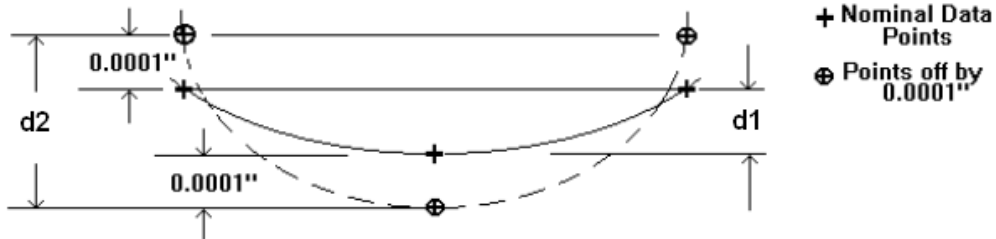


Figure 3: Nominal and Displaced Point Locations Effect on d

In Figure 3, we see that adjusting the nominal points by 0.0001" increases d by 0.0002".

Example 2:

Given $R = 6''$ and $\phi = 10$ degrees, using the given equations:

$$c = 1.04189'' \quad \text{and} \quad d_1 = 0.09116''$$

If we adjust the position of three data points on this arc by $0.0001''$ as shown in Figure 3, then:

$$d_2 = 0.09316''$$

Substituting d_2 in the equation for R yields:

$$R_2 = 5.8728''$$

For a difference of $0.1272''$ from nominal

Example 3:

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If $R = 0.05''$ and $\phi = 10$ degrees, using the above equations:

$$c = 0.0086'' \quad \text{and} \quad d = 0.00075''$$

If we have data points that are in error by $0.0001''$, then d can change by ± 0.0002 from $0.00075''$:

$$d_1 = 0.00055'' \quad \text{and} \quad d_2 = 0.00095''$$

Substituting these two " d " numbers in the equation for R yields the following:

$$R_1 = 0.06765'' \quad \text{and} \quad R_2 = 0.03975''$$

Showing that there is a $0.0279''$ range in radius values from data points that are accurate to $0.0001''$.