Introduction
3 parallel & tangential folded leaf springs are often used as a z, Rx, Ry fixation. Each leaf spring contributes to the total stiffness of the setup. This sheet describes the stiffness and stroke of the individual and the combination of 3 parallel & tangential folded leaf springs @ 120°.

Individual stiffness
The stiffness varies with the angle θ. If the leaf spring is combined with others the following holds.

Angle dependent linear stiffness:
\[ C_{t1}(\theta) = C \left( 1 + \frac{3}{5} \sin(2\theta) \right) \]
With: \( C = \frac{15E}{2L^3} \)
Linear stiffness perpendicular to drawing:
\[ C_{z1} = \frac{Eb^3}{(2L)^3 + 2b^2(2L)(1 + \nu)} \]
* If a folded leaf spring is used individually, the stiffness varies according to some boundary conditions, see other Precision Point sheet.

Individual stroke
Stiff direction:
\[ \delta_{\text{stiff}} = \frac{2}{3\sqrt{3}} d \approx 0.47d \]
Compliant direction:
\[ \delta_{\text{compl}} = \frac{4}{3\sqrt{3}} d \approx 0.94d \]
Unidirectional:
\[ \delta_{\text{uni}} \leq 0.42d \]
With \( d = \frac{\sigma L^2}{Et} \)

Combined leaf springs @ 120°

Combined Stiffness
Angle dependent stiffness of the folded leaf springs:
\[ C_{t1}(\theta) = C \left( 1 + \frac{3}{5} \sin(2\theta) \right) \]
\[ C_{t2}(\theta) = C \left( 1 + \frac{3}{5} \sin \left( 2\theta + \frac{2\pi}{3} \right) \right) \]
\[ C_{t3}(\theta) = C \left( 1 + \frac{3}{5} \sin \left( 2\theta - \frac{2\pi}{3} \right) \right) \]

Combined radial stiffness:
\[ C_{\text{radial}} = C_{t1}(\theta) + C_{t2}(\theta) + C_{t3}(\theta) = 3 \cdot C = \frac{45E}{2L^3} \]

Combined linear z-stiffness:
\[ C_{\text{axial}} = 3C_{z1} = \frac{3Eb^3}{L^3} \]

Combined rotational stiffness:
\[ K_x = K_y = C_{\text{axial}} \cdot r^2 = \frac{3Eb^3r^2}{L^3} \]
\[ K_z = \left( C_{t1}(\theta) + C_{t2}(\theta + 120^\circ) + C_{t3}(\theta - 120^\circ) \right) \cdot r^2 = \frac{45E}{2L^3} \]

Combined stroke
\[ \delta_{\text{uni}} \leq 0.42 \cdot d = 0.42 \cdot \frac{\sigma L^2}{Et} \]
Note that in the stiff direction of 1 folded leaf spring, the other is not stiff, so only the unidirectional stroke can be used.