Axial-Torsional Extensometer Conventions

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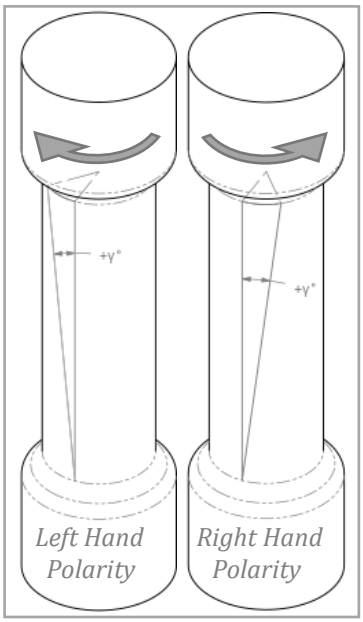
Shear Strain Polarity

The polarity for positive output of shear strain for axial-torsional extensometers varies with the application and must be specified.



Left Hand Polarity - Positive extensometer output with upper grip rotating CW or lower grip rotating CCW, as viewed from above.

Right Hand Polarity - Positive extensometer output with upper grip rotating CCW or lower grip rotating CW, as viewed from above.

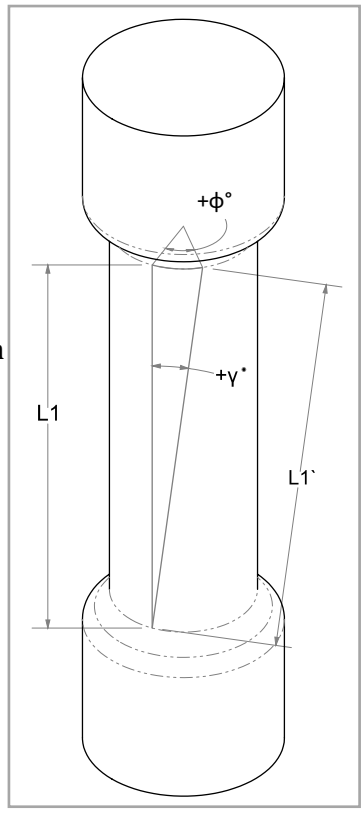
Axial Strain Orientation

Extensometer Model 3550

Under combined axial and torsional displacements, the axial channel indicates extension between the contact points along the rotated line L_1' (Engineering strain, or Green strain). *For pure twist (no change in axial length), which is simple shear on the surface, this is non-zero (positive).*

Extensometer Models 3550HT & 7650

Under combined axial and torsional displacements, the axial channel indicates extension between the contact points projected along the unrotated line L_1 (Small displacement theory). *For pure twist (simple shear), this is zero when properly aligned.*



The user should note that the distinction is equivalent to the difference between the definitions of axial strain using finite and infinitesimal strain theory, and data should be interpreted accordingly. For pure axial loading, these are equivalent. For large shear strains, the difference may be significant.

Relating Shear Strain to Angle of Twist

All of Epsilon's axial/torsional extensometers measure the shear strain *directly*, independent of the specimen diameter. Twist over the gauge length can be calculated using the diameter and length $L_1=L_0+\Delta L$ (**γ and φ in radians**):

$$\gamma = tan^{-1}\left(\frac{D\varphi}{2L_1}\right) = sin^{-1}\left(\frac{D\varphi}{2L_1'}\right) \cong \frac{D\varphi}{2L_0}$$

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