Mitigating Axial Extensometer Slippage

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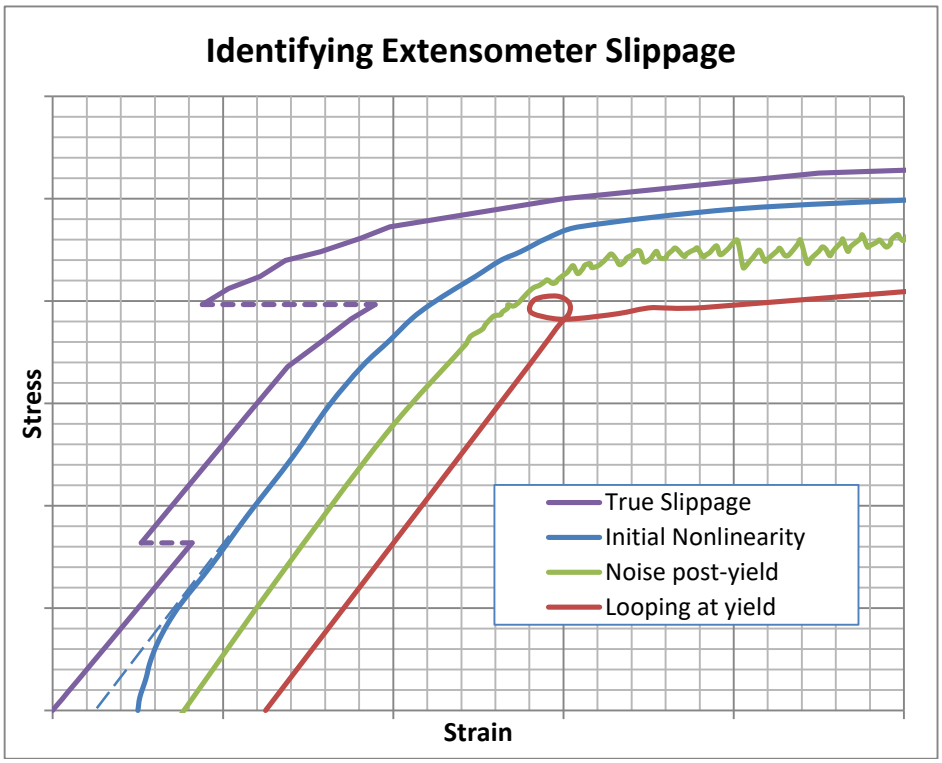
Differential Diagnosis - Identifying Slippage in your test data

Contact point slippage of axial extensometers is a common difficulty having various root causes. However, "slippage" is also among the most often misdiagnosed strain measurement problems in tensile testing – it is important first to distinguish a few other problems which are often misidentified as indicative of slippage.

Nonlinearity in the initial portion of a stress-strain curve has many causes, mostly related to testing practices and misalignments. This is usually not indicative of slippage, although alignment problems can cause contact creep. See Epsilon TechNote – Test Curve Nonlinearity

Looping / reversing at the yield point and post-yield looping / steps / noise are common phenomena common in many materials due to non-uniform yielding. See *Epsilon TechNote – Nonuniform-Yielding*. Examples of these phenomena are shown below. Curves are offset for clarity.

True slippage of an extensometer is usually characterized by one or more *sudden* drops in strain.



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Causes of Slippage and their solutions

Dull knife edges will increase the susceptibility to slippage and should be replaced as required. Insufficient knife edge contact force is another source of slippage, as well as misaligned/misadjusted wire forms. Be sure to use the recommended wire forms / attachment system and knife edge type for your specimen geometry (round or flat). See your extensometer user manual for recommendations and details on usage and adjustment.

Poor alignment of the extensometer onto the specimen will increase the tendency to slip, as the extensometer will tend to self-align as the test progresses. *If the specimen is round,* for some extensometer models such as Epsilon 3542 series, it may be helpful to "settle" the extensometer with a slight side-to-side motion after mounting but before removing the zero pin. This can help correct poor alignment during installation of the extensometer before the test begins, reducing the tendency to slip. The use of vee knife edges *or* wire forms may be recommended as well. See your extensometer user manual for details if applicable.

If the specimen is flat, misalignment of the specimen or extensometer to the test axis, twist in the specimen, knife edge misalignment and specimen flashing can all contribute to extensometer rotation and/or slipping. The use of 3-point knife edges can make your 3442 or 3542 series extensometer much less sensitive to these testing variables (Epsilon P/N 354299). Additionally, misaligned or off-center placement of a flat specimen in the grips will cause in-plane shear loads which will degrade the test results and may even cause slipping. The use of specimen alignment references in the grips is *highly recommended*.

When gauge lengths are small (<25mm/1.0" for 3542 or <6mm/0.25" for 3442), extensometer alignment and adjustment are more critical. If consistent extensometer alignment is difficult to achieve, it may be helpful to increase the specimen gauge length.

In strain-controlled tests, uncontrolled oscillation can cause an extensometer to slip – a stable, well-tuned control loop is critical.

Finally, applications with hard, polished specimens which are prone to slippage can often benefit from increased surface roughness underneath the contact area; steel wool or very fine-grained sandpaper might be used. Alternatively, the surface may be made slightly tacky in the contact region; a drop of quick-drying nail polish, superglue etc. may be used. Usually, however, specimen surface preparation is not necessary and slipping problems can be addressed with the methods described above. *Do not* glue the extensometer to the specimen. It is not recommended to use thick tape on the specimen to prevent slippage – while this may *hide* the symptoms of poor extensometer usage, strain transfer (from the specimen surface to the extensometer) may suffer.

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