Interpreting Common Verification Problems

Author: Wesley Womack, PE, PhD

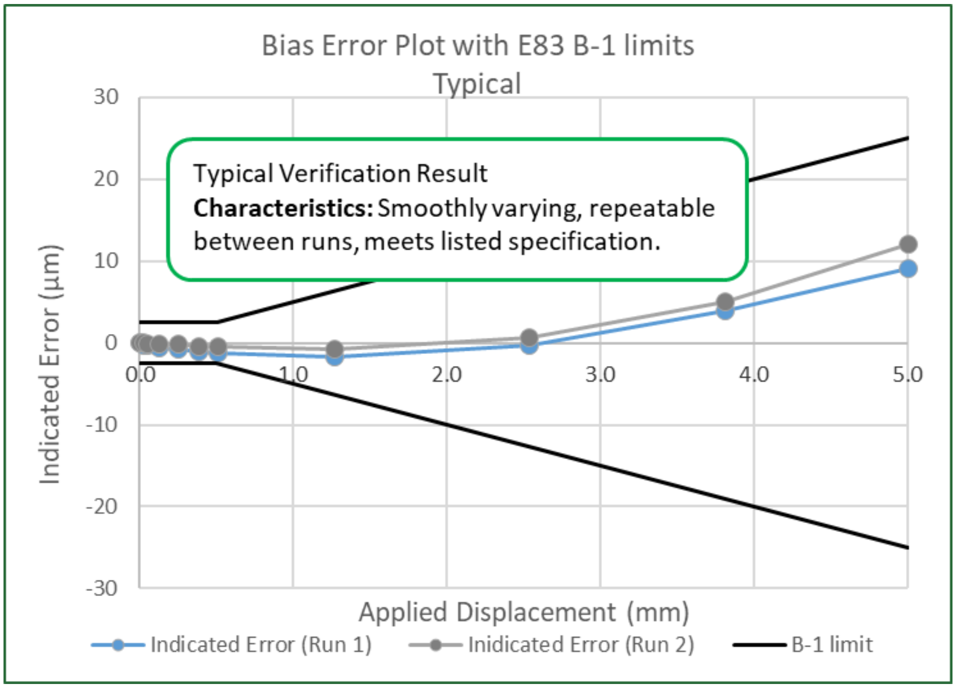
Pro Tip - Assess your verification graphically.

A visual assessment of an extensometer verification result can often reveal much more than a raw verification table on a service provider's test certificate. Some common problems which might be indicated by visual assessment are shown on the following pages. A typical application sample has been plotted against ASTM E83 class B-1 limits, although other limits may apply in other applications.

A graphical *Epsilon Verification Template* is available >here on our website<.

Raw Verification Table (Example)				
Applied Displacement (mm)	Indicated Displacement (mm)	Absolute Error (µm)	Relative Error (%)	Class
0.0000	0.0000	0.00	-	0,2
0.1000	0.0998	-0.20	-0.20%	0,2
0.2000	0.2001	0.10	0.05%	0,2
0.3000	0.3011	1.10	0.37%	0,5
...	...	...	...	...
10.0000	10.0140	14.00	0.14%	0,5

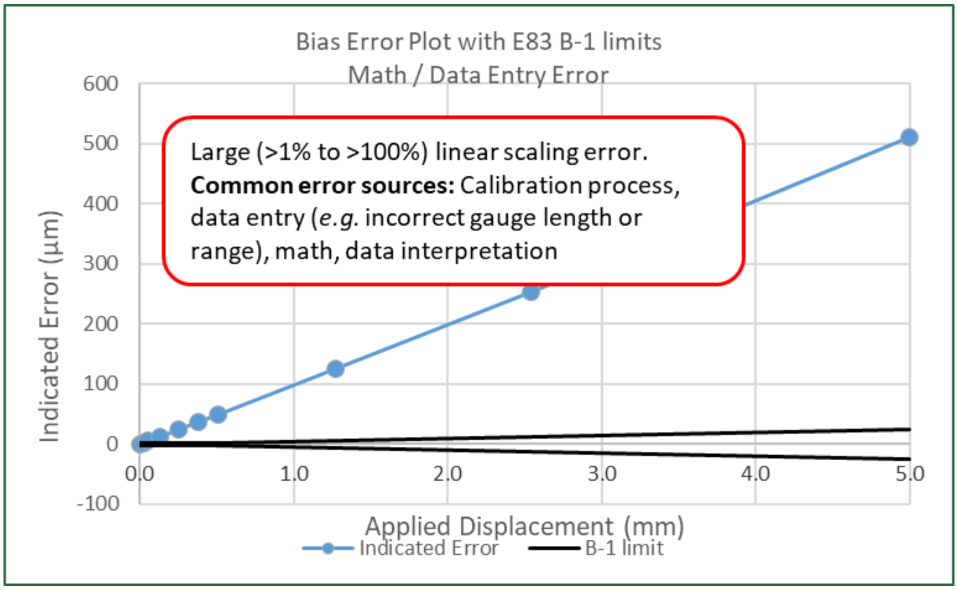
A typical verification result is characterized by smoothly varying results, repeatable between runs, meeting all listed specifications for the device:



Calibration / Scaling Errors

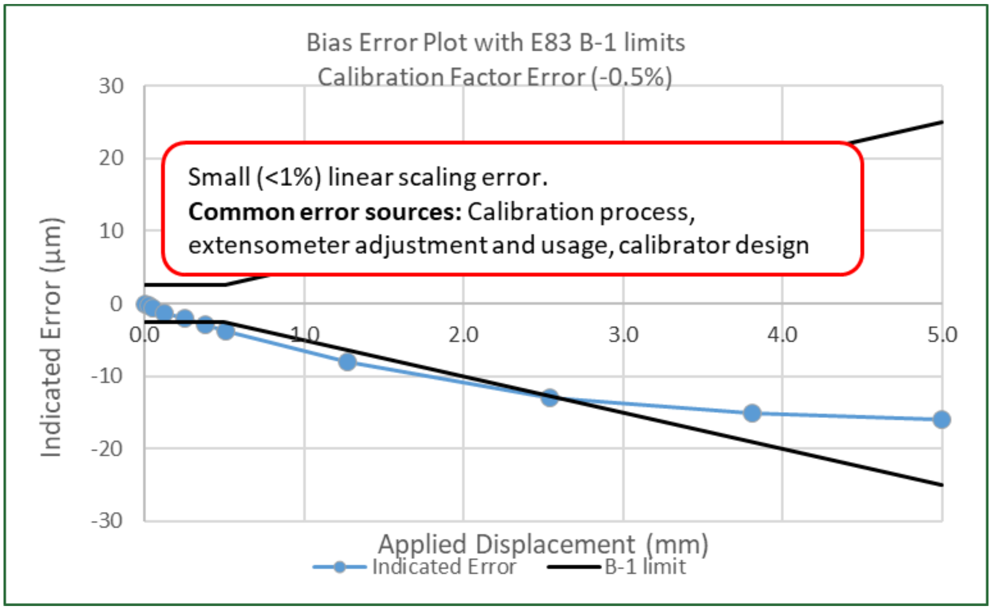
Large (>1%) linear scaling errors typically result from errors in the calibration process due to math, data entry, and/or data interpretation. Common causes include using the incorrect gauge length, range, or units.

Resolution: Check data entry and math. Repeat calibration.



Small, repeatable, linear scaling errors (<1%) resulting in an upward or downward bias (*e.g.* calibration scaling error of -0.5% shown below) *always* indicate a discrepancy between the calibration and verification.

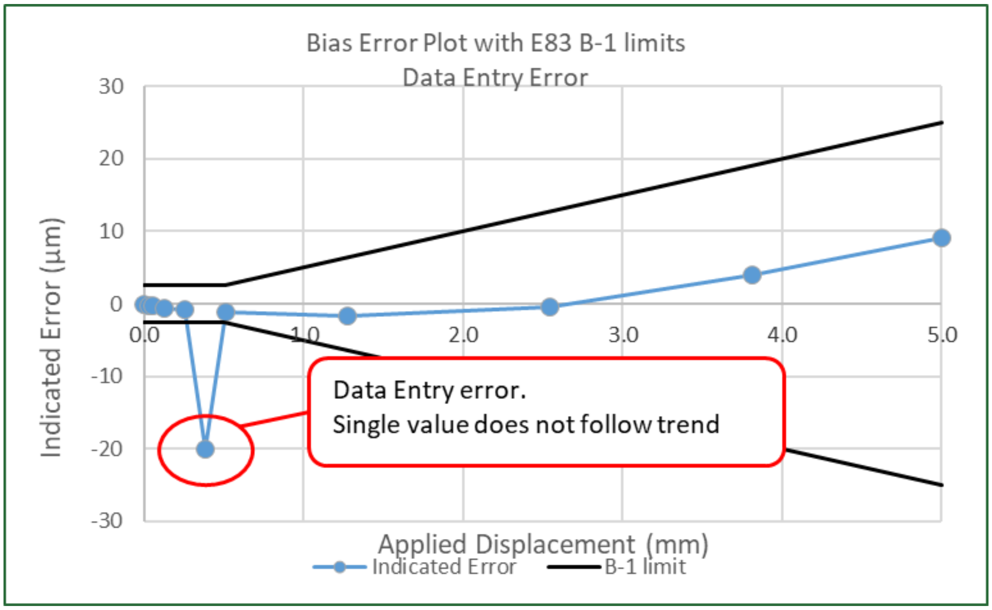
Resolution: Follow best practices for calibration and verification for your device (see extensometer user manual); use Epsilon's recommended calibrator and adapters. Repeat calibration and verification. Check Epsilon Shunted value.   See also *Optimizing for the Application* (page 7).



Data Entry Errors

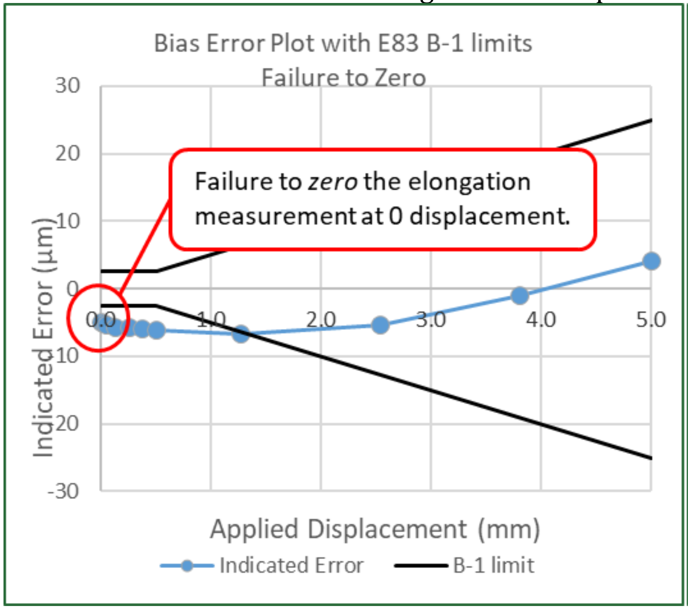
A single value which does not follow the general trend may appear as a “spike” on the error plot. This is most often caused by errors in manual data entry, such as transposed digits, rounding, and other typos.

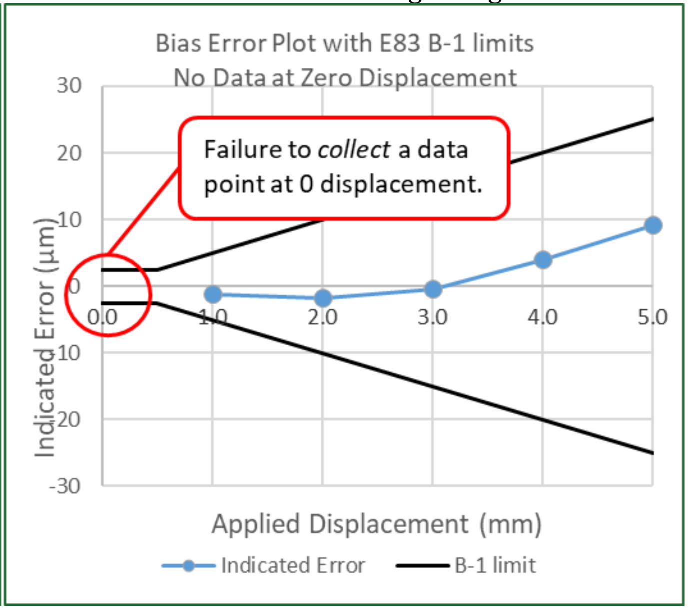
Resolution: Repeat verification.



The first data point in a verification run should always be at 0 displacement. The corresponding elongation measurement should also be 0; always null the measurement at the beginning of the run. Some performance characteristics cannot be assessed without this {0,0} value.

Resolution: Record indicated elongation at 0 displacement. Null measurement at the beginning of the run.

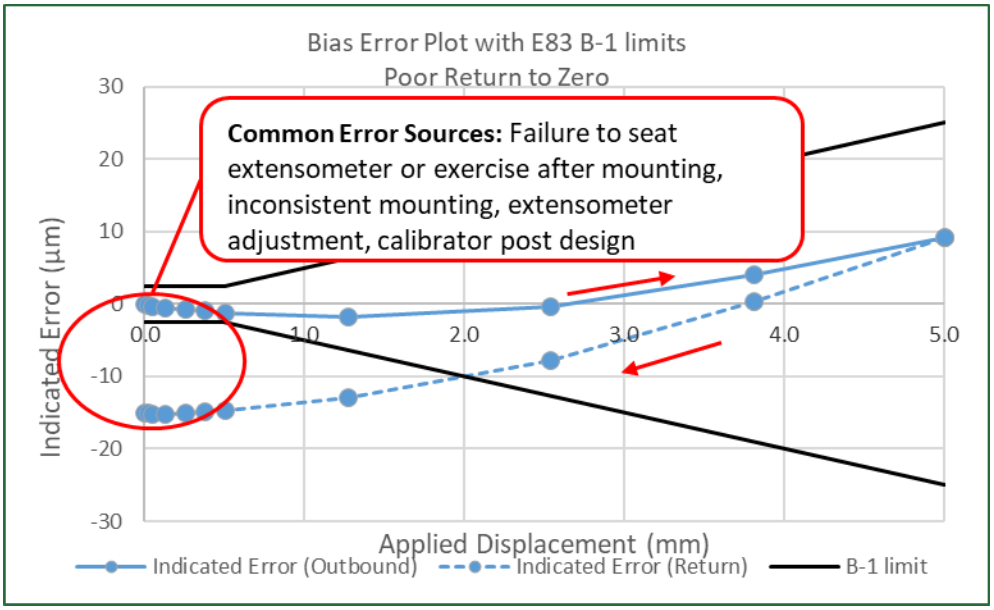


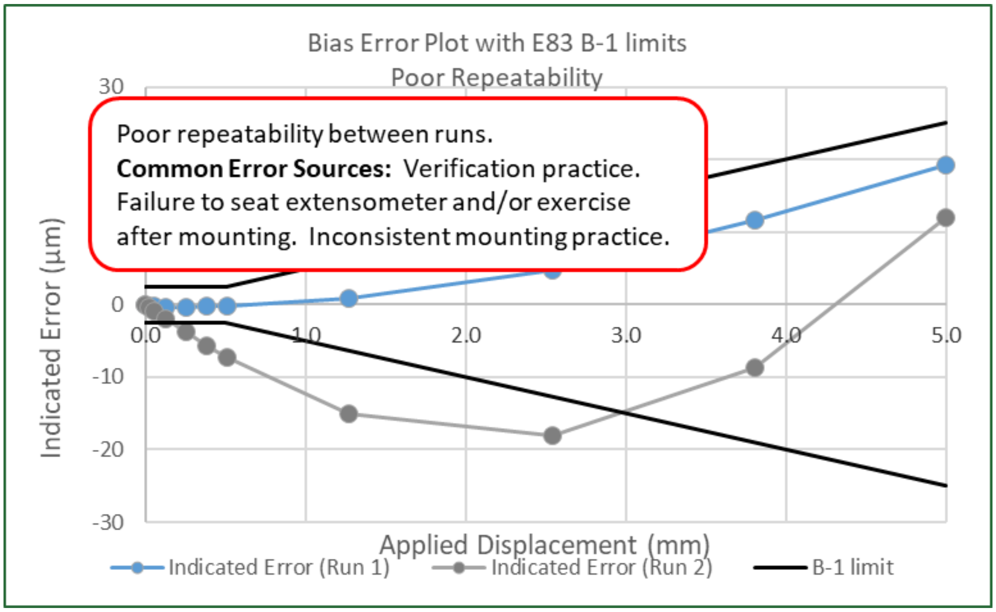


Mechanical Usage Errors

Poor return to zero, poor repeatability between runs, and slippage events are often caused by mechanical usage and adjustment errors. Common error sources include failure to seat and exercise the extensometer properly after mounting on the calibrator, inconsistent mounting practice, improper use of flat/round calibrator posts or other shapes, improper configuration of extensometer / calibrator.

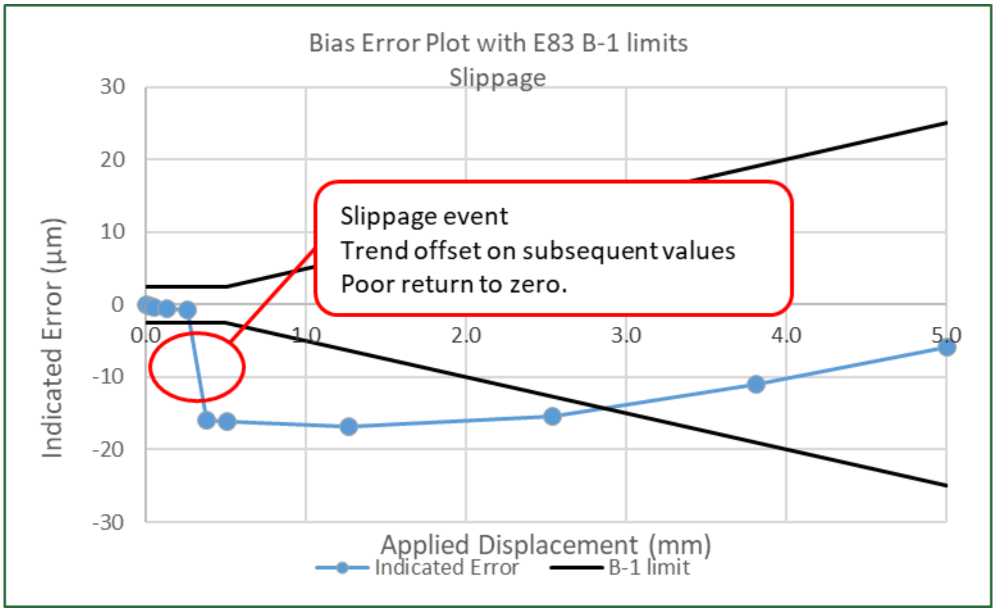
Resolution: Follow the adjustment and verification practices recommended in the user manual for your extensometer.



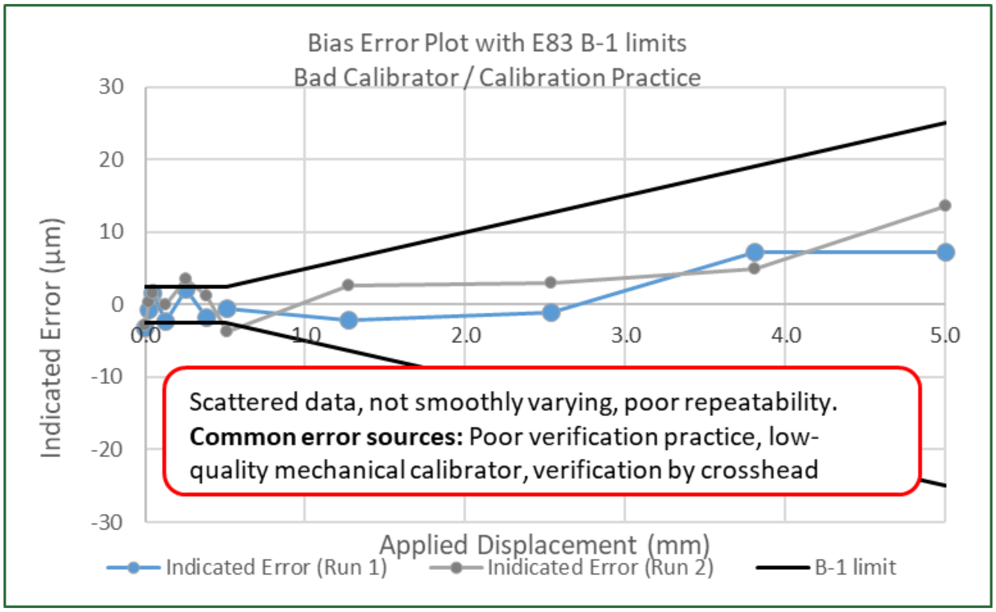


Slippage and mechanical contact events are marked by a sudden offset in the general trend of a verification. Usually the slippage event will not be consistently repeatable between runs.

Resolution: Follow the alignment, adjustment and verification practices recommended in the user manual for your extensometer. Use appropriate calibrator posts. Use softer (e.g. aluminum vs steel) calibrator posts, roughen the surface, etc. *Settle and exercise the extensometer after mounting, before verifying.*



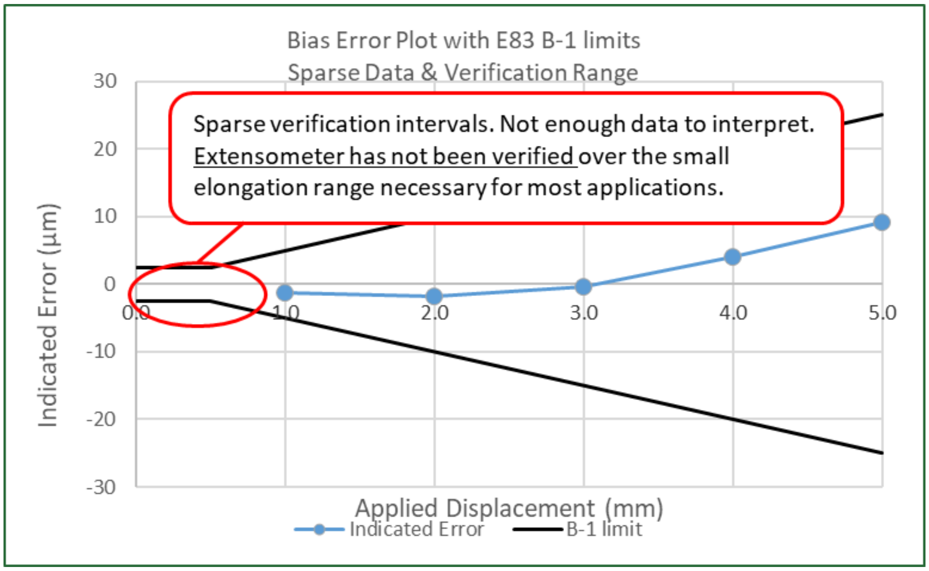
Scattered, inconsistent data as below which do not follow the typical smooth trend are often indicative of various poor calibration practices, such as attempting to verify performance using the UTM's crosshead, gage blocks, dial calipers, or low-quality aftermarket mechanical calibrators.



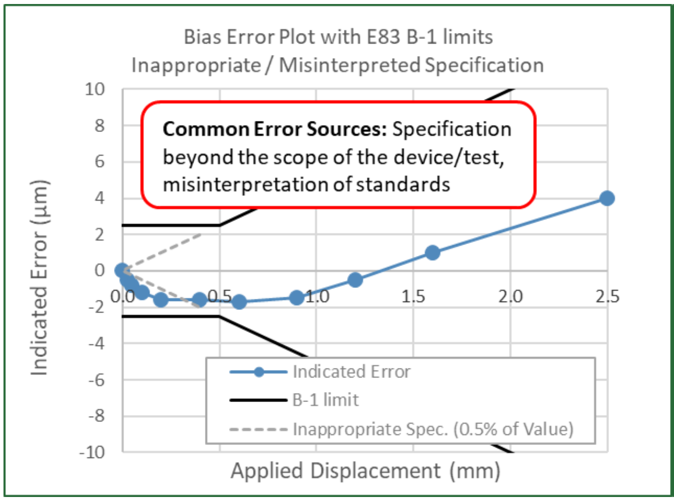
Data Interpretation Errors

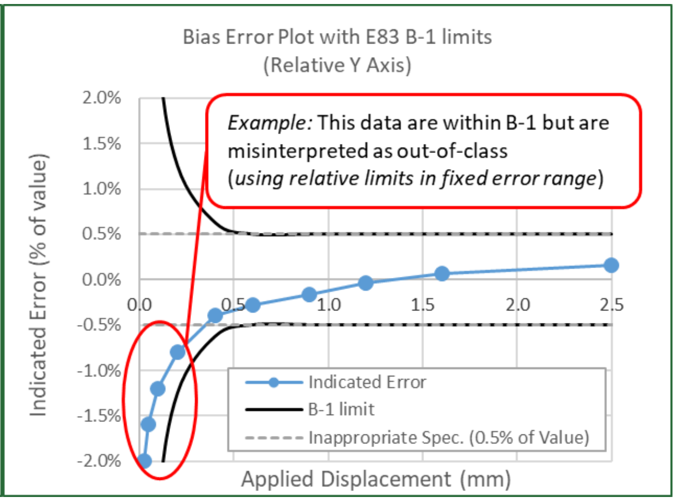
Several common verification problems are due to errors in data interpretation and standards usage. Sparse verification data (*i.e.* too few data rows) are often insufficient to interpret / diagnose performance.

> *An extensometer's verified range always begins at the first non-zero displacement. It is important to verify sufficiently over the measuring range of interest. For more detail on this important topic, see the standalone [Epsilon Tech Note – Extensometer Verification Range](#).*



Other common problems include attempting to verify an extensometer beyond its listed specification, beyond the scope required by the applicable test standard, and misinterpreting standards. One particularly common mistake is the application of *relative* error limits where *fixed* error limits are applicable. The example below meets the B-1 class but has been misinterpreted by the user as failing the 0.5% error limit. For more detail on this topic, see the standalone [*Epsilon Tech Note – Verification: Fixed and Relative Errors*](#).



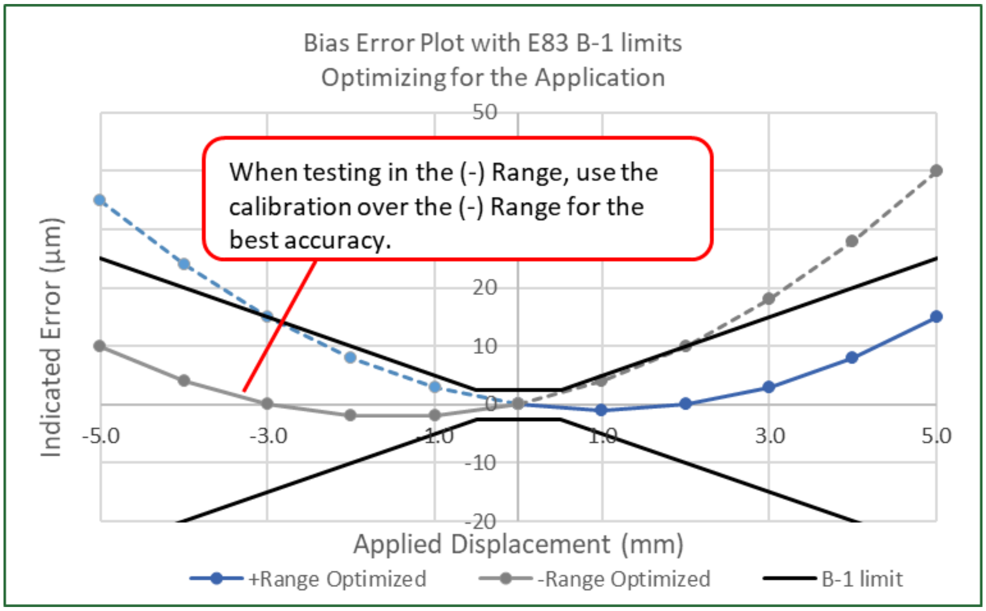


Optimizing for the Application

Extensometer output is characteristically slightly nonlinear with respect to the applied displacement. For this reason, small adjustments to the calibration coefficient (*i.e.,* gain) can be made to get the best accuracy over any specific measuring range (*e.g.,* tension vs compression). Depending on the user's software and test frame options, different methods might be employed to optimize the performance.

See *Epsilon Tech Note –Calibration Gain Optimization* for more detail on this topic.

In general, Epsilon recommends calibrating and verifying extensometers over the measuring range of interest.



Getting Help Interpreting Verification

If you need more help interpreting your verification results after plotting your results and reviewing this document, Epsilon Tech Support staff will be happy to assist. Our staff will ask you to share the verification test certificate(s) from your service provider showing the problem, typically available in PDF format. We will also ask you to provide the data formatted into our *Epsilon Verification Template* available >here< or on our website.

Epsilon Technology Corp
3975 South Highway 89 • Jackson, WY 83001 • USA
307-733-8360 • info@epsilontech.com • www.epsilontech.com