Measured Accuracy: 150-T Stiffness Readings Redefine Precision Standards

Overview

Taber's V-5 Stiffness Testers have long served as an industry benchmark for material stiffness evaluation. With the introduction of the model 150-T, Taber aimed to bring consistency, accuracy, and data fidelity into alignment with 21st-century standards. In addition to incorporating a digital interface, the redesigned instrument includes a new encoder system and refined mechanical tolerances, resulting in improved precision and repeatability.

Mechanical Backlash: A Limitation in Legacy Stiffness Measurement

During validation testing, an intra-laboratory study was completed comparing results from the models 150-E and 150-T. Testing across the lower test ranges (Range 3 to 6) revealed the modernized machine consistently produced equivalent stiffness values compared to the legacy model and the results between the two systems are nearly identical. However, as the test range and calibration specimen stiffness increased, the 150-T measured slightly higher stiffness values. This difference was most noticeable in test range 9, in which the average stiffness value exceeded those from the old machine by more than 20 units.

This trend reflects the mechanical limitations of the legacy design: at higher loads and deflections, gear backlash and mechanical play in the old system led to understated stiffness measurements. The updated design eliminates these sources of error, resulting in readings that more accurately reflect the true stiffness characteristics of the tested specimens.

One of the primary limitations of the legacy machine design was the presence of mechanical backlash in the gear system used to measure the Driving Disc rotation. This backlash caused a delay or dampening in recorded displacement, especially at higher loads, resulting in under-reported stiffness values. In stiffness testing, where force is applied to a specimen and the resulting rotational displacement is used to calculate stiffness, even minor mechanical play can introduce error. While this effect was minimal at lower ranges, it became increasingly problematic as test forces grew. With the model 150-T, Taber addressed this issue by implementing new "anti-backlash" gears into our mechanical system. With the gears preloaded, the backlash in the system is minimized, reducing the rotational displacement error to near zero.

Enhanced Accuracy Through Absolute Encoder Integration

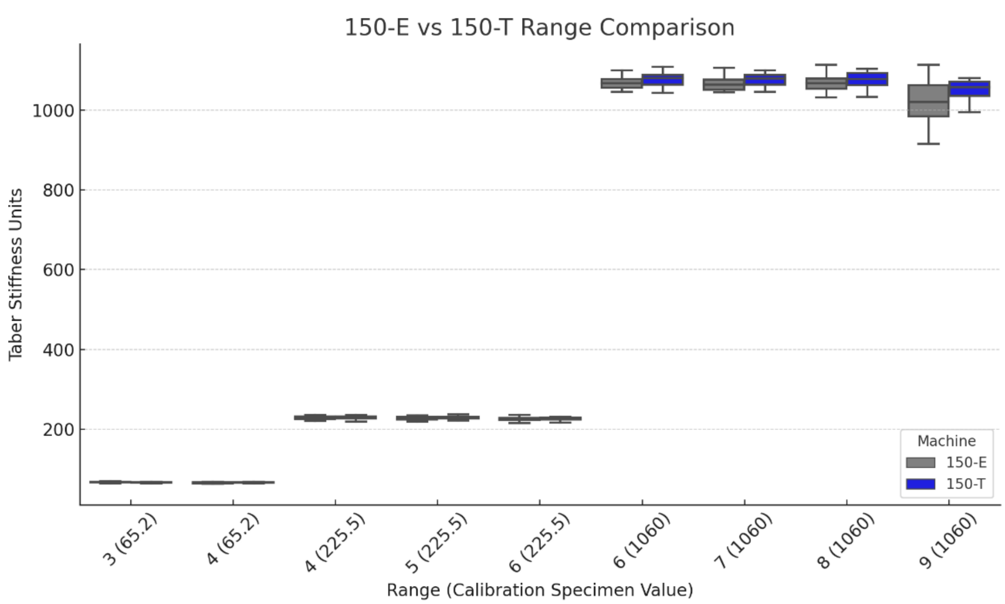
A key upgrade in the model 150-T is the addition of an absolute encoder mounted directly to the pendulum shaft. The absolute encoder provides direct, high-resolution digital feedback of displacement throughout the test unlike the older system used with the model 150-E, which relied on indirect mechanical linkages prone to backlash and drift.

This advancement ensures that every increment of movement is captured accurately and in real-time, eliminating the mechanical variability that previously affected the precision of stiffness calculations. By removing dependency on mechanical gearing for position tracking, the encoder allows the system to maintain consistent measurement accuracy across all ranges and specimen types.

As a result, the new machine exhibits greater repeatability and lower variability in stiffness readings. Testing across all test range and calibration specimen configurations showed an average reduction in standard deviation of 3.17 units, underscoring the improved consistency and reliability of the upgraded system.

Quantified Improvements Across High Ranges

To better illustrate the improvements introduced with the model 150-T, a comparative analysis was performed to evaluate the percentage increase in measured stiffness values between the legacy 150-E and the new 150-T. The results—shown in the figure below—reveal a clear trend: as the test range increases, so does the measured stiffness improvement.



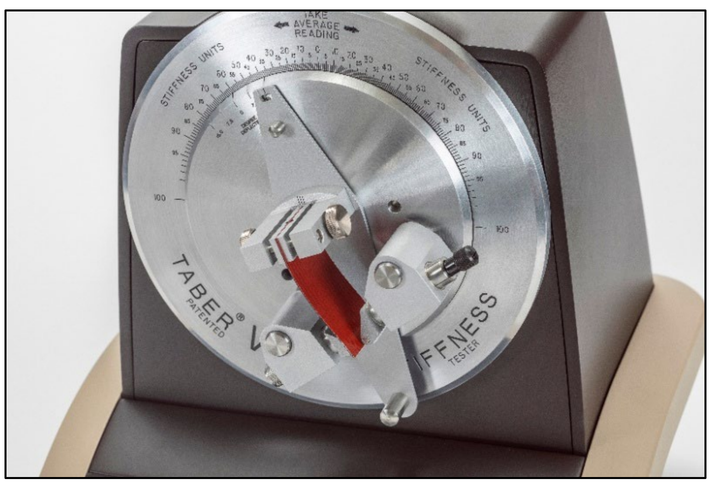
At Range 7 and Range 8, the increase in measured values remains modest (under 1%), highlighting near-equivalent performance between the two machines in lower-to-mid ranges. However, in Range 9, the new instrument reports values approximately 2.3% higher on average. This upward trend confirms the increasing influence of mechanical backlash in the older system at higher load levels, where stiffness readings were historically underreported.

While the results from Ranges 3 through 6 showed negligible percent change between the 150-E and 150-T, customers may observe noticeable differences when testing with higher-range calibration specimens. Since both instruments are calibrated at Range 3, continuity is preserved in the lower ranges. However, in Ranges 7 through 9—particularly when using -4 or -5 calibration specimens—the improved accuracy of the 150-T may yield higher readings compared to the legacy system. In such cases, applying a correction factor may be necessary to confirm that the customer's machine is still operating within expected tolerances, especially when using new calibration specimens on older machines, or vice versa.

By minimizing mechanical play and employing direct digital measurement, the model 150-T provides more accurate results—especially important when testing stiffer materials or using higher calibration ranges.

Conclusion

The enhancements made to Taber's model 150-T V-5 Stiffness Tester represents a significant improvement in measurement accuracy, consistency, and reliability. Although the new instrument may report slightly higher stiffness values in the higher test ranges, it is important to note the outcome is not a discrepancy but rather a correction of the understated results previously caused by mechanical backlash and indirect measurement systems.



The new model 150-T meets the requirements of the testing standards that reference Taber's V-5 Stiffness Tester. Compared to the model 150-E, it delivers more accurate representation of material behavior, especially in applications where accuracy and repeatability are critical.