Issue 33

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Tech Tip

Why Alignment is Important in Tensile Testing

Laboratories performing low-cycle fatigue tests know how important it is to have good alignment of the test specimen relative to the principle stress axis. There is an increasing awareness of the role alignment can play in the accuracy of tensile testing results. Organizations, such as NADCAP and ASTM, are addressing this in the form of laboratory accreditation and methodology for measuring alignment. For example, a NADCAP audit checklist for a composite materials testing lab will now include an alignment check of the testing instrument and refer to ASTM E1012 - Standard Practice for Verification of Test Frame and Specimen Alignment under Tensile and Compressive Axial Force Application – as the method of checking alignment. This process ensures the testing instrument is capable of performing tensile tests that produce less than 10% bending for non-brittle materials and less than 5% bending for brittle materials.

To meet the bending requirements noted above, the testing instrument must be designed and built to a high standard and the alignment of the loading frame, load cell and grips must be measured to determine the percent bending. This is typically done using an alignment specimen having a total of 12 strain gauges; four at the upper gauge length area, four in the center, and four at the lower gauge length area. The outputs of the 12 strain gauges are used to calculate concentricity error and angularity error. Our AlignPro Software is available to perform the calculations for percent bending and provide a guide to the adjustments needed to correct for bending that exceeds acceptable limits.

Tech Tip

Hardness Testing on Cylindrical Specimens

When performing hardness tests on cylindrical, convex, or concave surfaces, the operator should understand that the actual results may be inaccurate due to the curvature of the material. In most cases, these inaccurate results should be accounted and adjusted for when reporting actual material hardness. Due to the material curvature, several important factors may contribute to the invalid reading including the actual material hardness, the applied force, the size and shape of the indentation, and the diameter or radius of the test piece.

However, there are many techniques operators should consider to minimize errors.

Correction Factors

If the curved sample is used for material control purposes only, there may be sufficient information and comparative data generated that allows operators to benchmark values and processes. To make correction factors necessary, as indicated by ASTM, it is advisable to compare the hardness of the rounded material with the hardness value of a flat piece. In a convex (curvature that extends outward) or cylindrical piece, the reduction in lateral support will result in the indenter penetrating further into the material which translates to apparent lower hardness readings. In this case a correction factor must be added to the generated result. In contrast to convex surfaces, concave surfaces will provide higher material support due to the curvature towards the indenter and result in apparently harder material due to production of a shallower indent. In this case, a correction factor must be subtracted. If the diameter of the material is greater than 25 mm the surface will provide suitable surface structure for testing and corrections are not required. Lower diameter materials will need the correction factor added to the test result.

Proper Test Type

If the diameter of the material is smaller than 3.175 mm, Rockwell testing is not recommended. Instead, operators should use a Knoop or Vickers test, which can accommodate lower diameters down to thin gage wires. Most digital Rockwell testers provide the means to input the diameter of the curve. This input automatically adds or subtracts a correct factor from the test results. In manual dial gage testers, ASTM correction tables should be referenced to determine the correction factor. All corrections produce approximate results and should not be expected to meet exact specification.

Hardness Accessories

Another important factor in testing curved material is proper specimen support. The supporting anvil should be selected to match the specimen geometry and to ensure exact alignment of the indenter to the radius. It should be rigid and provide full support to prevent deformation.

ASTM E18 is a good reference for anvil selection. The anvil must position the test specimen perpendicular to the indenter. A "V" style anvil is ideal for supporting cylindrical parts. A cylindron anvil is suitable for larger diameter parts. Elongated parts that extend beyond the frame should be supported with a Vari-rest type fixture to prevent part tilt or movement. Specialized anvils can accommodate varying geometries and radiuses.

You Asked – We Answered

Q: When writing a procedure in Bluehill® Software, how do I deal with "Toe Compensation" (as described in ASTM D882) when testing the secant modulus (1%) of a thin film (1-5 mils)? Should I add a preload? And how much is appropriate?

A: In Bluehill Software, we refer to toe compensation as "slack correction" – and it can be added to a specific set of test results through the Calculations section of the Method tab. When you add this calculation the software automatically updates each tested specimen after the test is completed. You can choose from 4 different slack correction types described in detail in the help system to accommodate a wide variety of material types. These help files will assist you in determining which calculation is best for your material type. In summary, a slack correction calculation can be used to compensate for the toe after specimens are tested.

Better yet, we often recommend using a pre-load before the test starts if you know there will be some slack in your test setup or if your specimens exhibit some toe region in the data. You can set up Bluehill Software in the Control section of the Method tab to automatically apply a pre-load before data collection begins. This eliminates or minimizes the toe region and ensures that data collection on all specimens starts at the same point. The pre-load threshold value should be as small as possible to ensure valuable data isn't lost, but large enough so that the slack is removed before data collection begins. Typically, a pre-load threshold value is less than 5% of the expected break load of the specimen.

Note from the Editor

We recently re-designed our Products Section! This section incorporates a Product Showcase where you can view our latest products and most popular testing systems. Knowing that our customers search for systems or accessories in multiple ways, we included an easy-to-use product selection interface where you can find information by Product Type, Test Type, or Capacity. Lastly, we enhanced the usability of our pages by adding quick views, thumbnails, large images, videos, and animations.

I encourage you to take a few moments to check it out. We'd love to hear your feedback.

Best regards,

Denise Papa
TechNotes Editor

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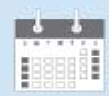

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