

Technical Information

Relevance of ASTM Standards for Equotip Testing (Leeb)

Conformance of Equotip hardness testers with the various ASTM hardness testing standards are of particular concern to users e.g. with applications in the petrochemical industry who refer to API. This document will outline the current situation within standards.

ASTM A956 (Leeb)

The Equotip series of hardness testers are standardized in ASTM according to A956-06 "Standard Test Method for Leeb Hardness Testing of Steel Products". This standard was originally approved and published in 1996, and the next to last edition was published in 2002. This is the only ASTM standard that currently addresses testing with the Leeb method.

The Leeb method measures the ratio of rebound velocity to impact velocity of a defined impact body launched against a surface at a defined velocity. Therefore the Leeb method measures the loss of kinetic energy during impact, and is thus considered a dynamic technique. The accuracy of a Leeb test is dependent on proper test conditions – surface roughness, test piece thickness, and mass – which are defined in the A956 standard.

The A956 standard is not known to be specifically referenced by any current API standard. However, the Equotip conveniently converts hardness measurement values and displays the results in other hardness scales, such as Brinell, Rockwell, and Vickers. The ASTM standards governing these test methods are generally mentioned in API standards.

ASTM E140 (Hardness Conversions)

This standard covers hardness conversions for metals. The Leeb scale is not yet included in the current version of the standard. However, there has been substantial progress made by a committee task group to include conversions from the Leeb scale HLD to Rockwell HRC, Brinell HBW10/3000, and Vickers HV10 scales. There will be a formal proposal for inclusion made at the May 2010 committee meeting.

ASTM E10 (Brinell)

This standard covers the Brinell test method as used by stationary, typically bench-top machines. This standard does not apply to portable devices like the King Brinell (hydraulic force application) or comparative testers like the Telebrineller, as these devices do not conform to the force application requirements of the test method.

ASTM E18 (Rockwell)

This standard covers the Rockwell test method as used by stationary, typically bench-top machines. It does not apply to portable devices, as these devices do not conform to the force application requirements of the test method.

ASTM E110 (Portable Testers)

This standard covers portable Brinell and Rockwell testing devices. These devices typically use the same indenter (diamond cone, tungsten carbide ball) as defined in the E10 and E18 standards. However, the devices are designed for portable use and generally do not conform to E10 and E18 for the reasons stated above. E110 is currently involved in a revision ballot to modify the structure and requirements to be as similar as possible to the E10 and E18 standards.

ASTM A833 (Comparative Brinell – Telebrineller)

This standard covers the method that compares an indentation on a reference bar to the indentation on the test surface. The ratio of the indentations provides a measure of hardness. This method is generally considered to be less accurate than those of E110 and E10.

ASTM A1038 (UCI – Ultrasonic Contact Impedance)

This standard covers the method named Ultrasonic Contact Impedance (UCI), which uses a calibrated rod with a diamond indenter (typically a Vickers indenter) attached to one end. The rod is vibrated ultrasonically to a resonance frequency and pressed into the test surface with a pre-defined force (usually Vickers forces). The instrument measures the shift in harmonic frequency which varies according to the depth of penetration. This frequency shift is converted and displayed directly into a common hardness scale like Rockwell, Brinell or Vickers.

This method is strongly affected by a change in material, and therefore must be calibrated specifically to a sample of the material to be tested. It cannot use the concept of material groups like the Leeb method, as the relationship between the frequency shift and the common hardness scales is immensely material-dependent.

DIN 50156 (Leeb)

Though not an ASTM standard, the DIN 50156 standard on Leeb testing is also useful for ASTM-focused inspection conventions. This German standard is a national standard that includes traceable calibrations of test blocks and instruments to a national Leeb etalon. These calibrations are done by ISO 17025 accredited organizations in Germany whose Leeb calibration instruments are traceable to the German national laboratory (named PTB). Also UKAS calibration of Leeb reference test blocks is now available.

Conclusions

The ASTM A956 presently is the only ASTM standard that the Equotip complies with. Inspection results should ideally be stated in Leeb hardness. Traceability of calibrations to a national Leeb etalon can be granted through calibrations according to DIN 50156. If conversions to other hardness scales are used, testing on reference samples is strongly recommended to verify the accuracy of the conversion. These reference measurements can then be used to reach intercompany / interlaboratory agreement on the testing procedures and inspection records.