

CRITICAL CHECK OF THE REPEATABILITY AND BIAS OF HARDNESS TESTING MACHINES RESTRICTED BY THE HARDNESS STANDARDS

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Abstract – Since the ISO standards for four major hardness scales were revised in 2005, the indirect verification has been considered as the mainstream of the traceability chain of hardness. In the recommended procedure of ISO, the uncertainty of hardness machine should be estimated and added to the combined uncertainty of hardness measurement value. The equation to calculate this uncertainty component was introduced according to the rectangular distribution of bias of hardness machines.

However, if the error propagation is investigated in detail, the uncertainty of hardness machines should be obtained by considering the probability distributions of the uniformity of hardness reference block, the repeatability and the bias of hardness machine. In addition, the distribution of verification results should be calculated after some hardness machines are screened out by the maximum permissible values requested in ISO.

In this paper, the probability distribution of the hardness machines, which passed in the indirect verification, are obtained by means of the Monte Carlo method. Since a calibration value of hardness is obtained only by measuring a specimen, it is not possible to separate the uncertainties of hardness machine and hardness block. Then the result of indirect verification is affected by the uniformity of reference block. The relation between the distribution of passed hardness machines and the uniformity of reference blocks is presented for several hardness scales. In addition, the guideline to estimate the uncertainty of the measured hardness values can be verified by means of the Monte Carlo method.

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