

50 Pipe Blind Testing Performance

In Fall 2017, blind testing of 50 pipe joints of varying grade, vintage, and seam type was conducted to evaluate the performance of several proprietary testing methods for the nondestructive measurement of tensile strength properties. These methods included:

Frictional Sliding (MMT)

Instrumented Indentation Test (IIT)

Brinell Hardness + Metallography (BHN)

Comparing these three methods with the laboratory tensile tests on the same pipe joint, frictional sliding tests conducted with the Hardness, Strength, and Ductility (HSD) Tester by Massachusetts Materials Technologies (MMT) LLC was the most accurate, exhibited the least variability, and highest correlation. A summary of different statistical metrics applied to the 50 pipe samples is shown in the table and plot below.

Performance Metric	MMT	IIT	BHN
MAPE	7.0%	7.6%	8.4%
R ²	0.70	0.63	0.58
PE +10% To -10%	76.0%	71.4%	68.0%
PE +10% To -15%	88.0%	75.5%	76.0%
Max Percent Error	13.4%	34.6%	21.8%

Yield Strength Comparison

Formulas and Nomenclature

PE = percent error

$$PE = \frac{NDE-tensile}{tensile} (\%)$$

MAPE = mean absolute PE

$$MAPE = \frac{\sum_{i=1}^N \text{abs}(PE_i)}{N}$$
 where N is number of samples

R² = correlation coefficient

$$R^2 = 1 - \frac{\sum_{i=1}^N (x_i - f_i)^2}{\sum_{i=1}^N (x_i - \bar{x})^2}$$
 where x_i = strength measurement
 \bar{x} = mean strength measurement
 f_i = linear model prediction

Disclosure: This comparative data from blind testing organized and sponsored by PRCI is shown for information purposes using data presented at the public PRCI Research Exchange meeting in Miami, FL, on March 6th, 2018.

