



Standard Practice for Probability of Detection Analysis for $\hat{a}$ Versus a Data¹

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1. Scope

1.1 This practice defines the procedure for performing a statistical analysis on Nondestructive Testing (NDT) $\hat{a}$ versus a data to determine the demonstrated probability of detection (POD) for a specific set of examination parameters. Topics covered include the standard $\hat{a}$ versus a regression methodology, POD curve formulation, validation techniques, and correct interpretation of results.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

E178 Practice for Dealing With Outlying Observations
E456 Terminology Relating to Quality and Statistics
E1316 Terminology for Nondestructive Examinations
E1325 Terminology Relating to Design of Experiments
E2586 Practice for Calculating and Using Basic Statistics
E2782 Guide for Measurement Systems Analysis (MSA)
E2862 Practice for Probability of Detection Analysis for Hit/Miss Data

2.2 Department of Defense Document:³

MIL-HDBK-1823A Nondestructive Evaluation System Reliability Assessment

¹ This test method is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.10 on Specialized NDT Methods.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://dodssp.daps.dla.mil>.

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *analyst, n*—the person responsible for performing a POD analysis on $\hat{a}$ versus a data resulting from a POD examination.

3.1.2 *decision threshold, $\hat{a}_{dec}$, n*—the value of $\hat{a}$ above which the signal is interpreted as a find and below which the signal is interpreted as a miss.

3.1.2.1 *Discussion*—A decision threshold is required to create a POD curve. The decision threshold is always greater than or equal to the noise threshold and is the value of $\hat{a}$ that corresponds with the flaw size that can be detected with 50% POD.

3.1.3 *demonstrated probability of detection, n*—the calculated POD value resulting from the statistical analysis of the $\hat{a}$ versus a data.

3.1.4 *false call, n*—the perceived detection of a discontinuity that is identified as a find during a POD examination when no discontinuity actually exists at the inspection site.

3.1.5 *noise, n*—signal response containing no useful target characterization information.

3.1.6 *noise threshold, $\hat{a}_{noise}$, n*—the value of $\hat{a}$ below which the signal is indistinguishable from noise.

3.1.6.1 *Discussion*—The noise threshold is always less than or equal to the decision threshold. The noise threshold is used to determine left censored data.

3.1.7 *probability of detection, n*—the fraction of nominal discontinuity sizes expected to be found given their existence.

3.1.8 *saturation threshold, $\hat{a}_{sat}$, n*—the value of $\hat{a}$ associated with the maximum output of the system or the largest value of $\hat{a}$ that the system can record.

3.1.8.1 *Discussion*—The saturation threshold is used to determine right censored data.

3.2 Symbols:

3.2.1 a —discontinuity size.

3.2.2 $\hat{a}$ —the measured signal response for a given discontinuity size, a .

3.2.2.1 *Discussion*—The measured signal response is assumed to be continuous in nature. Units depend on the NDT