



Designation: E3081 – 16

Standard Practice for Outlier Screening Using Process Compensated Resonance Testing via Swept Sine Input for Metallic and Non-Metallic Parts¹

This standard is issued under the fixed designation E3081; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice describes a general procedure for using the process compensated resonance testing (PCRT) via swept sine input method to perform outlier screening on populations of newly manufactured and in-service parts. PCRT excites the resonance frequencies of metallic and non-metallic test components using a swept sine wave input over a set frequency range. PCRT detects and analyzes component resonance frequency patterns, and uses the differences in resonance patterns between acceptable and unacceptable components to perform non-destructive testing. PCRT frequency analysis compares the resonance pattern of a component to the patterns of known acceptable and unacceptable populations of the same component, and renders a pass or fail result based on the similarity of the tested component to those populations. For non-destructive testing applications with known defects or material states of interest, or both, Practice E2534 covers the development and application of PCRT sorting modules that compare test components to known acceptable and unacceptable component populations. However, some applications do not have physical examples of components with known defects or material states. Other applications experience isolated component failures with unknown causes or causes that propagate from defects that are beyond the sensitivity of the current required inspections, or both. In these cases, PCRT is applied in an outlier screening mode that develops a sorting module using only a population of presumed acceptable production components, and then compares test components for similarity to that presumed acceptable population. The resonance differences can be used to distinguish acceptable components with normal process variation from outlier components that may have material states or defects, or both, that will cause performance deficiencies. These material states and defects include, but are not limited to, cracks, voids, porosity, shrink, inclusions, discontinuities, grain and crystalline structure

differences, density-related anomalies, heat treatment variations, material elastic property differences, residual stress, and dimensional variations. This practice is intended for use with instruments capable of exciting, measuring, recording, and analyzing multiple, whole body, mechanical vibration resonance frequencies in acoustic or ultrasonic frequency ranges, or both.

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. Some specific hazards statements are given in Section 7 on Hazards.*

2. Referenced Documents

2.1 *ASTM Standards:*²

E1316 Terminology for Nondestructive Examinations
E2001 Guide for Resonant Ultrasound Spectroscopy for Defect Detection in Both Metallic and Non-metallic Parts
E2534 Practice for Process Compensated Resonance Testing Via Swept Sine Input for Metallic and Non-Metallic Parts

3. Terminology

3.1 *Definitions:*

3.1.1 The definitions of terms relating to conventional ultrasonic examination can be found in Terminology E1316.

3.2 *Definitions:*

3.2.1 *broadband, n*—the range of frequencies, excitation parameters, and data collection parameters developed specifically for a particular part type.

3.2.2 *classification, n*—the labeling of a teaching set of parts as acceptable or unacceptable.

¹ This test method is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.06 on Ultrasonic Method.

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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.