



Standard Practice for Process Compensated Resonance Testing Via Swept Sine Input for Metallic and Non-Metallic Parts¹

This standard is issued under the fixed designation E2534; 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 detect resonance pattern differences in metallic and non-metallic parts. The resonance differences can be used to distinguish acceptable parts with normal process variation from parts with material states and defects 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 This practice uses inch pound units as primary units. SI units are included in parentheses for reference only, and are mathematical conversions of the primary units.

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

[E1316 Terminology for Nondestructive Examinations](#)

[E2001 Guide for Resonant Ultrasound Spectroscopy for](#)

Defect Detection in Both Metallic and Non-metallic Parts

3. Terminology

3.1 Definitions:

The definitions of terms relating to conventional ultrasonic examination can be found in Terminology [E1316](#).

3.2 Definitions of Terms Specific to This Standard:

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

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

3.2.3 *false negative, n*—part failing the sort but deemed by other method of post-test/analysis to have acceptable or conforming specifications

3.2.4 *false positive, n*—part passing the sort but exhibiting a flaw (either inside the teaching set of flaws or possibly outside the teaching set range of flaws) or nonconforming to specification.

3.2.5 *margin part*—a single part representative of a part type that is used to determine measurement repeatability and for system verification.

3.2.6 *Process Compensated Resonant Testing (PCRT)*—a nondestructive examination method that enhances RUS with pattern recognition capability. PCRT more effectively discriminates between resonance frequency shifts due to unacceptable conditions from resonance frequency shifts due to normal, acceptable manufacturing process variations. The process employs the measurement and analysis of acoustic or ultrasound resonance frequency patterns, or both. PCRT pattern recognition tools identify the combinations of resonance patterns that most effectively differentiate acceptable and unacceptable components. Statistical scoring of the resonance frequencies is used to compare components to known acceptable and unacceptable populations, quantify process variation, and characterize component populations.

3.2.7 *resonance spectra*—the recorded collection of resonance frequency data, including frequency peak locations and the characteristics of the peaks, for a particular part.

¹ This practice is under the jurisdiction of ASTM Committee [E07](#) on Nondestructive Testing and is the direct responsibility of Subcommittee [E07.06](#) on Ultrasonic Method.

Current edition approved Dec. 1, 2015. Published December 2015. Originally approved in 2010. Last previous edition approved in 2010 as E2534-10. DOI: 10.1520/E2534-15

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.