Designation: E837 – 20

Standard Test Method for Determining Residual Stresses by the Hole-Drilling Strain-Gage Method[1]

This standard is issued under the fixed designation E837; 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.

INTRODUCTION

The hole-drilling strain-gage method determines residual stresses near the surface of an isotropic linear-elastic material. It involves attaching a strain rosette to the surface, drilling a hole at the geometric center of the rosette, and measuring the resulting relieved strains. The residual stresses within the removed material are then determined from the measured strains using a series of equations.

1. Scope

1.1 *Residual Stress Determination:*

1.1.1 This test method specifies a hole-drilling procedure for determining in-plane residual stresses near the surface of an isotropic linearly elastic material. It is applicable to residual stress determinations where the stresses do not vary significantly across the diameter of the drilled hole. The measured stresses are the in-plane residual stresses that exist within the depth of the drilled hole. Stress sensitivity rapidly decreases with depth from the measured surface and deep interior stresses cannot be evaluated. The measured residual stresses are described as "uniform" if they remain approximately constant within the hole depth, "non-unifom" if they vary significantly.

1.1.2 In general, "blind" holes are used, where the depth of the drilled hole and therefore the depth of the residual stress evaluation is less than the workpiece thickness. However, for a thin workpiece, it is also possible to do through-thickness measurements of uniform (membrane) stresses using a through-hole.

1.2 *Stress Measurement Range:*

1.2.1 This test method applies in cases where material behavior is linear-elastic. When near-yeild residual stresses are present, it is possible for local yielding to occur due to the stress concentration around the drilled hole. Satisfactory measurement results can be achieved providing the residual stresses do not exceed about 80 % of the material yield stress for blind-hole drilling and about 50 % of the material yield stress for through-hole drilling.

1.3 *Workpiece Damage:*

1.3.1 The hole-drilling method is often described as "semi-destructive" because the damage that it causes is localized and often does not significantly affect the usefulness of the workpiece. In contrast, most other mechanical methods for measuring residual stresses substantially destroy the workpiece. Since hole drilling does cause some damage, this test method should be applied only in those cases either where the workpiece is expendable, or where the introduction of a small shallow hole will not significantly affect the usefulness of the workpiece.

1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E6 Terminology Relating to Methods of Mechanical Testing

E251 Test Methods for Performance Characteristics of Metallic Bonded Resistance Strain Gages

3. Terminology

3.1 *Definitions of terms common to mechanical testing:*

[1] This test method is under the jurisdiction of ASTM Committee E28 on Mechanical Testing and is the direct responsibility of Subcommittee E28.13 on Residual Stress Measurement.

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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.