Designation: E 251 – 92 (Reapproved 2003)

Standard Test Methods for Performance Characteristics of Metallic Bonded Resistance Strain Gages[1]

This standard is issued under the fixed designation E 251; 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.

This standard has been approved for use by agencies of the Department of Defense.

INTRODUCTION

The Organization of International Legal Metrology is a treaty organization with approximately 75 member nations. In 1984, OIML issued International Recommendation No. 62, ′Performance Characteristics of Metallic Resistance Strain Gages.’ Test Methods E 251 has been modified and expanded to be the United States of America’s compliant test specification. Throughout this standard the terms “strain gage” and “gage” are to be understood to represent the longer, but more accurate, “metallic bonded resistance strain gages.”

1. Scope

1.1 The purpose of this standard is to provide uniform test methods for the determination of strain gage performance characteristics. Suggested testing equipment designs are included.

1.2 Test Methods E 251 describes methods and procedures for determining five strain gage parameters:

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1.3 Strain gages are very sensitive devices with essentially infinite resolution. Their response to strain, however, is low and great care must be exercised in their use. The performance characteristics identified by these test methods must be known to an acceptable accuracy to obtain meaningful results in field applications.

1.3.1 Strain gage resistance is used to balance instrumentation circuits and to provide a reference value for measurements since all data are related to a change in the gage resistance from a known reference value.

1.3.2 Gage factor is the transfer function of a strain gage. It relates resistance change in the gage and strain to which it is subjected. Accuracy of strain gage data can be no better than the precision of the gage factor.

1.3.3 Changes in gage factor as temperature varies also affect accuracy although to a much lesser degree since variations are usually small.

1.3.4 Transverse sensitivity is a measure of the strain gage’s response to strains perpendicular to its measurement axis. Although transverse sensitivity is usually much less than 10 % of the gage factor, large errors can occur if the value is not known with reasonable precision.

1.3.5 Thermal output is the response of a strain gage to temperature changes. Thermal output is an additive (not multiplicative) error. Therefore, it can often be much larger than the gage output from structural loading. To correct for these effects, thermal output must be determined from gages bonded to specimens of the same material on which the tests are to run; often to the test structure itself.

1.4 Bonded resistance strain gages differ from extensometers in that they measure average unit elongation ($\Delta L/L$) over a nominal gage length rather than total elongation between definite gage points. Practice E 83 is not applicable to these gages.

1.5 These test methods do not apply to transducers, such as load cells and extensometers, that use bonded resistance strain gages as sensing elements.

1.6 Strain gages are part of a complex system that includes structure, adhesive, gage, leadwires, instrumentation, and (often) environmental protection. As a result, many things affect the performance of strain gages, including user technique. A

[1] These test methods are under the jurisdiction of ASTM Committee E28 on Mechanical Testing and are the direct responsibility of Subcommittee E28.14 on Strain Gages.

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