ASME B5.64-2022

Methods for the Performance Evaluation of Single-Axis Linear Positioning Systems

AN AMERICAN NATIONAL STANDARD

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FOREWORD

Linear positioning systems are used in wide-ranging manufacturing applications from machine tools to high-precision applications such as semiconductors and photovoltaics. Many new high-precision single-axis linear positioning systems are emerging with exceptionally long ranges of motion and positioning resolutions as low as several nanometers. The ability to meet high-precision manufacturing tolerances requires accurate knowledge of the positioning performance of these systems, yet a dedicated standard for evaluating the performance of single-axis linear positioning systems did not exist. In contrast, performance standards have been used for decades to measure the performance of single-axis linear positioning systems within machine tools. However, use of these standards to measure high-precision systems with off-the-shelf instrumentation and test methods can be difficult because the performance of the high-precision class of positioning systems can approach the measurement uncertainty. Due to increasing demands on performance and new applications, many manufacturers and users have developed their own methods for characterizing these systems, but performance specifications based on these different methods and terminology has led to certain customer confusion. Hence, a new standard was needed with specific measurement methods for single-axis linear positioning systems.

Toward this end, this Standard was created by members from industry, academia, and government in coordination with the B5 Standards Committee of The American Society of Mechanical Engineers (ASME) to provide methods for the performance evaluation of single-axis linear positioning systems. The intended use of the tests described in this Standard are acceptance testing of new or reconditioned systems and verification of the performance of systems already in operation.

ASME B5.64-2022 was approved by the American National Standards Institute on December 5, 2022.

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Section 1
Scope

1-1 SCOPE

(a) This Standard establishes a methodology for specifying and testing the performance of single-axis linear positioning systems. It covers linear positioning systems with travels ranging from micrometers to meters.

(b) This Standard describes equivalent test methods and instrumentation described in existing machine tool standards (ASME B5.54, ASME B5.57, and ISO 230 series) and additional methods and instrumentation used for the characterization of positioning systems having a relatively high positioning performance when compared to standard machine tool performance.

(c) This Standard seeks to highlight the importance of understanding measurement uncertainty and the test uncertainty ratio (TUR) by providing methods for estimating the test uncertainty and the uncertainty of positioning performance results.

(d) In addition to clarifying the positioning performance evaluation, this Standard facilitates performance comparisons between systems by unifying terminology and the treatments of environmental effects and measurement uncertainty.

(e) This Standard provides a series of tests that should be used to perform acceptance testing of new and reconditioned positioning systems and could be used to verify the continued capability of systems, already in operation, through periodic testing. The set of acceptance tests and the specification limits for system conformance shall be the subject of contractual agreement between the user and the manufacturer/supplier.