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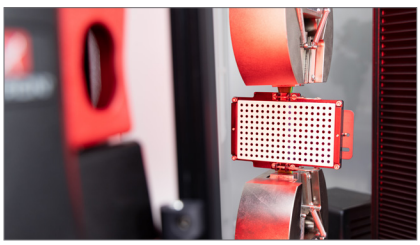
ASTM E83

Verification and Classification of AVE3

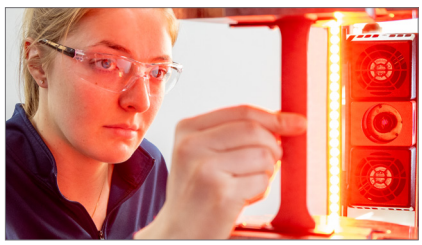
ASTM E83 is the standard practice for verification and classification of extensometers, published by ASTM International. It is widely used in materials testing to ensure that extensometers (including non-contacting types like the AVE3) meet specific performance requirements in terms of accuracy, linearity, and repeatability.

In 2023, ASTM released a new revision of E83 which included Annex A1 – specific to the verification requirements of optical extensometers. This annex advocates and emphasizes the importance of setup consistency. However, many variables impact optical device performance, and variables that are not accounted for can negatively impact test data.

THE LARGEST CONTRIBUTORS TO ERROR ARE:



DEVICE POSITION AND CONFIGURATION



LIGHTING AND ENVIRONMENTAL INCONSISTENCY

WORKING DISTANCE

This document outlines how the design of the AVE3 meets and exceeds the requirements set by ASTM E83. Once an AVE3 is installed, service engineers will perform calibrations onsite in accordance with E83 to ensure proper compliance to the working standards.

DEVICE POSITION AND CONFIGURATION

Instron engineers have implemented robust measures to ensure the AVE3's position and configuration is both highly repeatable and reproducible. The AVE3 can be mounted for use in either ambient or temperature-controlled environments, with dedicated mounting systems designed to maintain the device consistently within its specified working plane.

During configuration, both focus and aperture settings are locked to prevent unintended variation. Additionally, the AVE3 utilizes a kinematic lens mounting system, ensuring lenses are positioned identically in every test. This design maintains a fixed focal length—the distance between the image sensor and the lens—which is a critical parameter in optical systems. Focal length influences key image properties such as magnification, field of view, and depth of field. Fixing this value is considered a best practice in optical measurement, as it directly contributes to consistent and accurate strain measurements.

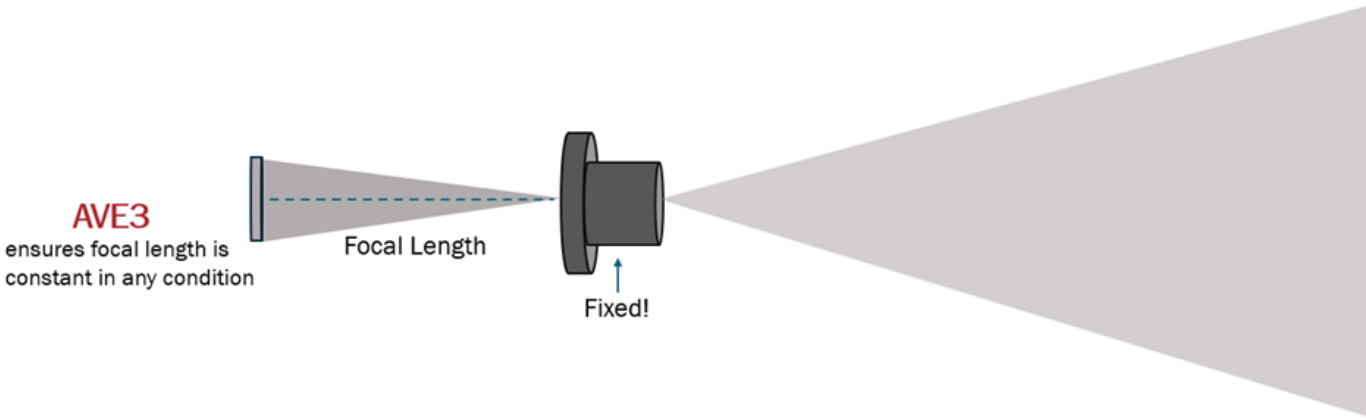


Figure 1: Focal Length Diagram

LIGHTING AND ENVIRONMENTAL CONSISTENCY

Maintaining consistent contrast of specimen markings is critical for the most reliable optical measurements. The AVE3 accommodates a wide range of specimen-and-mark color combinations, each of which can alter the apparent contrast to the camera. To address this, its integrated light bar dynamically adjusts intensity and diffusion, ensuring uniform marking contrast from calibration through test, regardless of the colors presented. Equally important is environmental stability: The AVE3's patent-pending CDAT (Constant Density Air Tunnel) technology optimizes airflow across the full field of view, eliminating the adverse effects of microthermal gradients and air-density fluctuations. By controlling both lighting and airflow conditions, the AVE3 delivers repeatable, high-precision strain data in full compliance with ASTM E83 best practices.

Figure 2: Specimen Marking Contrast Gradient

WORKING DISTANCE

Working distance (WD)—the physical distance from the front of the optical extensometer to the surface of the specimen—is a critical parameter in ensuring measurement accuracy. Even small changes in specimen geometry can affect this value; for example, if verifications were performed in the center of the load string, placing a 3 mm thick specimen (t) in front of the camera effectively shifts the working distance by 1.5 mm (1/2 t), since the measurement plane moves closer to the lens.

According to ASTM E83, an optical extensometer must be verified at the same WD or within the same WD range at which it will be used. The AVE3 was engineered with this principle in mind and has a WD optimization software feature called Thickness Compensation. Its architecture ensures reliable performance across a range of working distances, not just a single fixed point. Extensive verification data supports its ability to meet accuracy requirements at each of these distances.

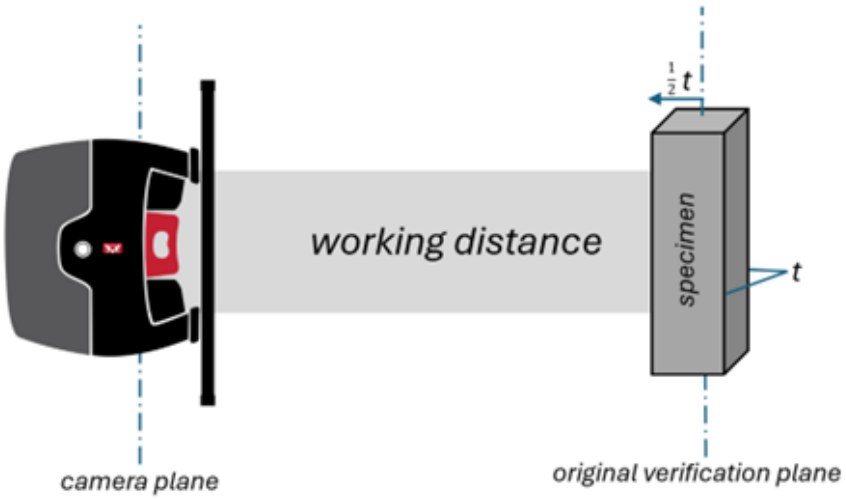


Figure 3: Working Distance Visualization

LENS

Since the initial working distance for the AVE3 is dependent upon the specific test frame the device is mounted to, the values are expressed in terms of specimen thickness or diameter. Verification data remains valid across the indicated specimen size range, as determined by the lens in use.

6 mm	9 mm	16 mm	35 mm
0 - 80	0 - 80	0 - 60	0 - 35
Specimen Thickness	Specimen Thickness	Specimen Thickness	Specimen Thickness

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