



Standard Test Method for Torque Calibration or Conformance of Rheometers¹

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1. Scope

1.1 This test method describes the calibration or performance conformance for the torque signal generated by commercial or custom-built rheometers. The specific range of the test depends upon the torque range of the rheometer.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 There is no ISO standard equivalent to this test method.

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

2. Referenced Documents

2.1 *ASTM Standards:*²

E4 Practices for Force Verification of Testing Machines

E473 Terminology Relating to Thermal Analysis and Rheology

E617 Specification for Laboratory Weights and Precision Mass Standards

E1142 Terminology Relating to Thermophysical Properties

3. Terminology

3.1 Specific technical terms used in this test method are defined in Terminologies E473 and E1142. These terms include angular frequency, frequency, loss modulus, rheometer, storage modulus, strain, stress, viscoelasticity, viscometer, viscometry, and viscosity.

3.2 Definitions:

3.2.1 *torque, n*—force applied through a moment arm that produces or tends to produce rotation ($\text{N} \cdot \text{m}$).

¹ This test method is under the jurisdiction of ASTM Committee E37 on Thermal Measurements and is the direct responsibility of Subcommittee E37.08 on Rheology.

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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.

4. Summary of Test Method

4.1 A known force is applied to a rheometer coupling shaft through a moment arm to produce a torque. The torque thus applied is measured and compared to the measured torque. The ratio between indicated and applied torque is used to create a calibration coefficient that may be used in future determinations.

4.2 The known force generated by suspended precision mass or masses is transmitted to the rheometer coupling shaft by a line and an appropriate series of pulleys.

4.3 Torque is mathematically defined by Eq 1:

$$\tau = d F \sin \Phi \quad (1)$$

where:

τ = torque

d = the length of the moment arm (m)

F = the applied force (N)

Φ = the angle to the moment arm over which the force is applied ($^{\circ}$)

4.3.1 If the force is applied tangentially at right angles (that is, $\Phi = 90^{\circ}$) to the moment arm, then $\sin \Phi = 1$ and Eq 1 reduces to Eq 2:

$$\tau = d F \quad (2)$$

4.4 The moment arm in this test method is created by attaching a fixture of known radius to the rheometer coupling shaft in lieu of a geometry, tool or plate. The radius of the fixture is the value of d in Eq 2.

4.5 A force is applied to the fixture at a tangent by a suspended mass through a thin wire and a suitable pulley arrangement (see, for example, Fig. 1).

4.6 For a mass or masses of known value, the applied force is given by Eq 3:

$$F = M g f \quad (3)$$

where:

M = the suspended mass (kg)

g = standard acceleration due to gravity ($= 9.8065 \text{ m s}^{-2}$)

f = correction factor for local gravity and air buoyancy taken from Table 1 (dimensionless)