Lab Manager's
Guide to

MV Calibration

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MonTech®
Rubber Testing Solutions

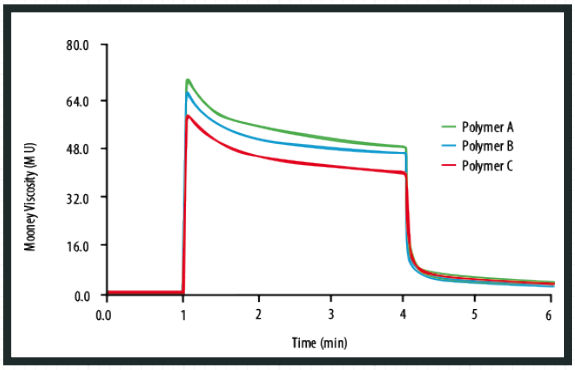
MOONEY VISCOMETER THEORY OF OPERATION

The Mooney Viscometer (*MV*) is a bench top rubber testing instrument with a pneumatic cylinder, upper and lower heated platens, upper and lower dies that create the die cavity (*test chamber*), and a motor-driven rotor that is inserted into the lower die. PT100 sensors in the dies independently measure the upper and lower die temperatures.

Mooney viscometers are mainly used to test characteristics of raw materials before mixing - to verify that they meet required standards for the formulation in which they are to be used.

To perform a Mooney Viscosity Test, the die cavity temperature is set and allowed to stabilize. Then, a specified volume of the sample material is loaded above and below the rotor and inserted into the lower die. After closing the platens, the test begins with a conditioning step; heating the sample, usually for a minute. After conditioning, the motor is started, turning the rotor at 2 RPM. The resisting torque provided by the sample is measured and recorded as Mooney units. Next, the motor is switched off - stopping the rotor abruptly while measuring the torque response over time. This measurement of torque decay over time is the *Stress Relaxation* Test.

A typical test (*ML 1+4*) involves 1 minute of preheat (*conditioning step*), plus 4 minutes of shear (*Mooney Viscosity*), plus one minute of decay (*Stress Relaxation*).



Multiple Mooney Viscosity tests performed on Mooney Viscometer.

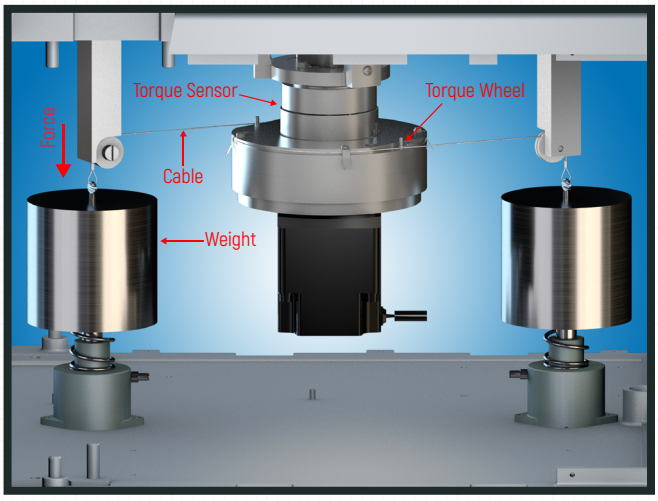
TORQUE & TEMPERATURE

Torque Calibration

Torque is the most critical point of measurement in Mooney Viscometers. Torque calibration is performed using the machine's dead weight(s) and torque wheel.

When calibration is performed, the weights are allowed to hang free - and the amount of force created by the weights' cables pulling on the torque wheel is measured. If the measurement in the torque transducer is 100 MU ± 0.5, it is within tolerance specified by the ASTM.

For further reference see: ASTM D1646-17 section 6.1.4



Dead weight calibration system of an MV 2000. During calibration, the weights hang free - pulling the cables connected to the torque arm and sensor.

Temperature Calibration

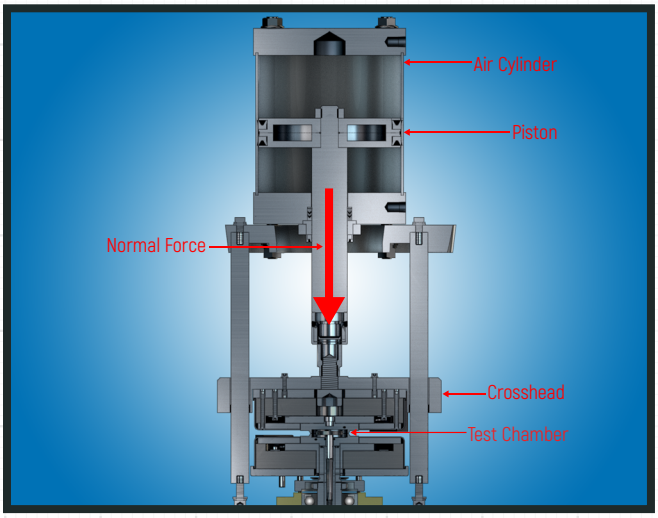
Temperature is the second most important point of measurement in Mooney Viscometer calibration. The accuracy of torque measurement is dependent on having accurate and stable temperature within the test chamber.

Temperature calibration is performed using a temperature standard. The standard is used in both the upper and lower dies to verify that the temperature control is within tolerance as specified by the ASTM. The die temperature can be set to different temperatures for calibration, depending on the specific testing needs of the laboratory - though standard butyl used for calibration is typically rated for 100°C and 125°C.

For further reference see: ASTM D1646-17 sections 6.1.3 & 6.1.1.3

Mooney Viscometer lower platen, die, and rotor. The upper and lower dies both have heaters and RTDs, which control the temperature of the test chamber and rotor.

CLOSING FORCE & MOTOR RPM



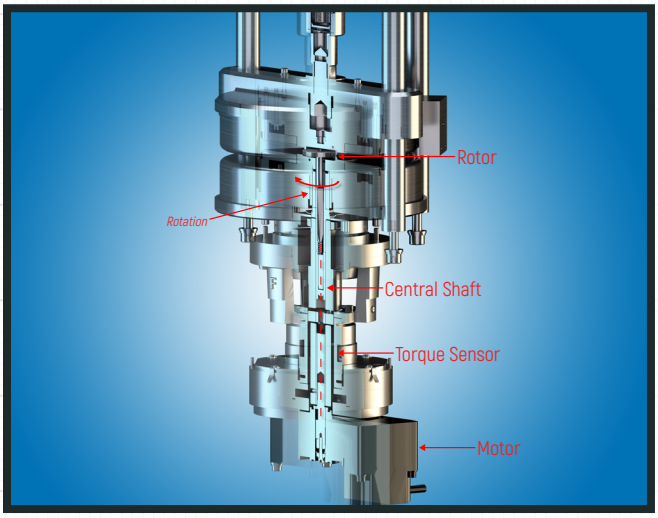
Cross-section of Mooney Viscometer air cylinder and platens. Normal force from the air cylinder is applied to crosshead to close platens and seal test chamber.

Closing Force Calibration

Closing force must be calibrated correctly to ensure a consistent material volume, cavity fill, and torque response. The ASTM specifies that closing force shall be 11.5kN ± 0.5kN, but a greater closing force may be required when testing tougher materials. The main importance is that the platens and dies remain completely closed for the duration of the test, with uniform pressure around the circumference of the dies.

Calibration is performed using a force standard to verify that the closing force is within tolerance as specified by the ASTM.

For further reference see: ASTM D1646-17 section 6.1.1.4



Cross-section showing central assembly. The motor rotates the central shaft at 2 RPM, which in turn rotates the rotor within the die cavity.

Motor RPM Calibration

Using the rotor, the motor in a Mooney viscometer rotates to apply shearing force to the sample in the test chamber. In order to get repeatable and accurate results, the rotor must turn at the correct speed - otherwise the torque measurement is subject to inaccuracy. Mooney viscometers' rotors typically rotate at 2 RPM, though some newer models like MonTech's V-MV 3000 are capable of rotating at variable speeds.

Calibration for motor RPM is performed using a timing standard to verify the correct speed.

For further reference see: ASTM D1646-17 section 6.1.2.2

MOTOR RPM & ROTOR HEIGHT / DIMENSIONS

Physical / Dimensional Calibrations

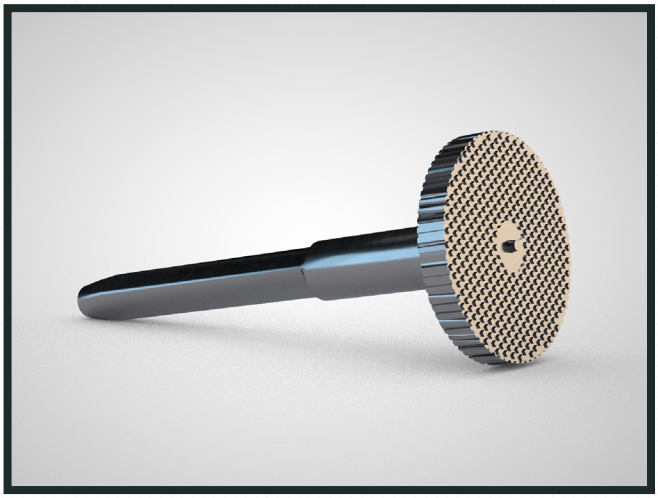
In addition to cleanliness of the rotor, dies, and seal, the following typical dimensional characteristics that need to be paid attention to are:

- *rotor height within the die cavity*
- *rotor diameter & thickness*
- *rotor dimensions*

- *condition of the rotor seal*
- *condition and sharpness of the rotor*
- *condition of the dies*

- *centering of the lower die to the platen*
- *centering of the central shaft to the platen*
- *centering of the upper die to the lower die*
- *parallelism of the upper and lower dies*

These conditions and measurements are all critical to accuracy and repeatability of the Mooney Viscometer. Because of wear, rotors are typically changed annually, and dies are changed every two years. Your service provider should be using specialty tools for centering (*rotor, dies, central shaft*) and alignment (*die parallelism*).



Small rotor for a Mooney Viscometer. Dimensional calibration verifies that the rotor is not excessively worn.

For further reference see: ASTM D1646-17 section 6.1.2

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WHAT DOES ISO/IEC 17025 ACCREDITATION MEAN?

Why calibrate?

All process and measuring instruments experience degradation over time. This can lead to a drift away from product quality specifications. Calibration is a process of comparing instrument (*Mooney Viscometer*) measurements to traceable standards. This means you will be able to use metrics to ensure product quality by verifying measurements are in tolerance.

What is ISO/IEC 17025 Accreditation?

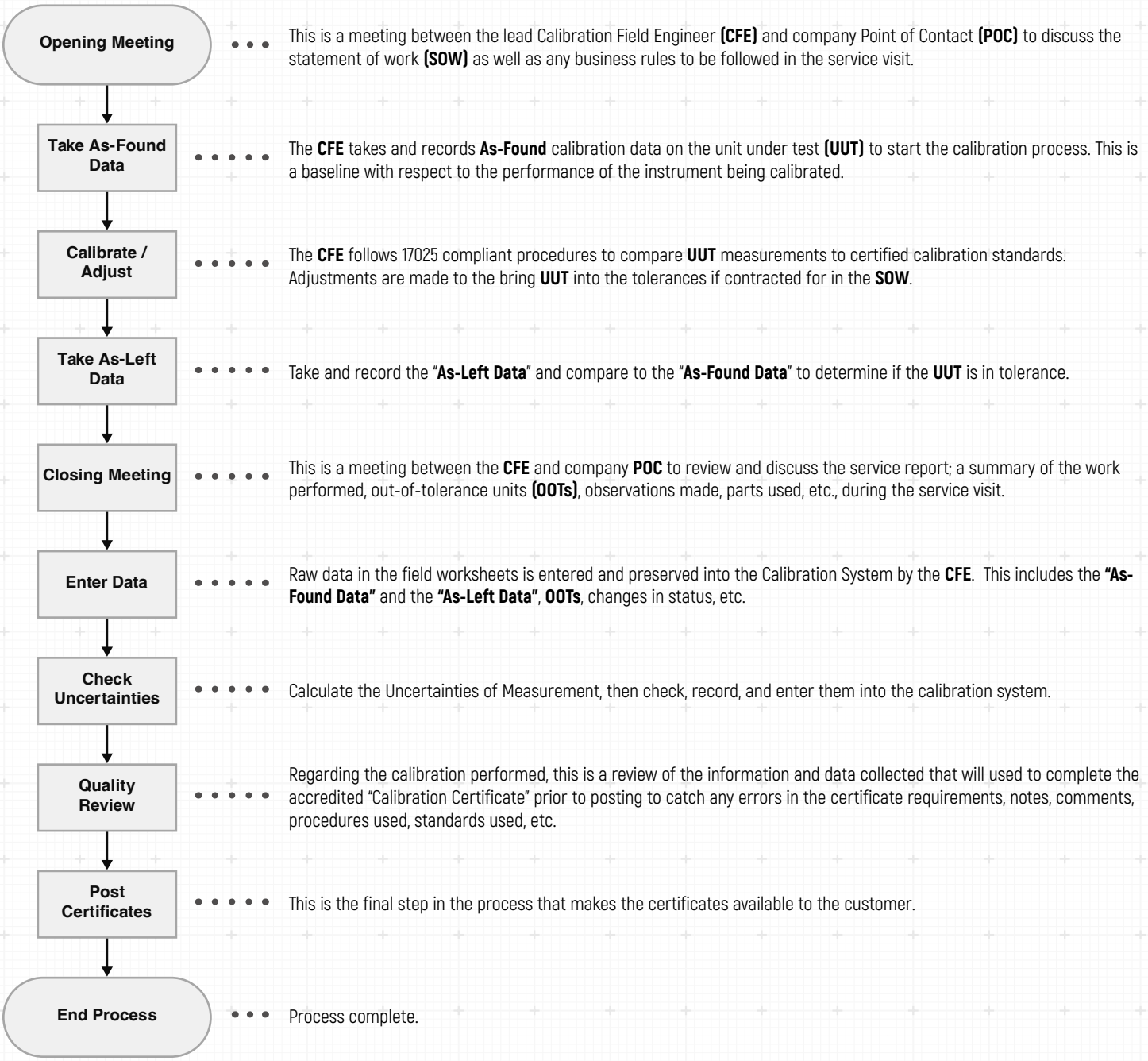
ISO 17025 provides the general requirements for the competence of testing and calibration laboratories. This standard is used by calibration laboratories in developing their management system for quality, administrative, and technical operations.

Typically, calibration standards are 3 to 10 times the accuracy of the instrument under test, while providing traceability of measurements to either the International System of Units (SI) or industrial reference materials (*IRM*). To ensure consistency and reliability for ISO 17025 laboratories, part of the requirements of accreditation is verifying that the technicians are well-trained, knowledgeable, and properly follow standard procedures. Accredited technicians' training includes instrument principles of operation, observations by a senior metrology technician in performing calibrations, and proficiency testing to complete training in the following disciplines and ASTMs:

- *Torque*
- *Temperature*
- *Force*
- *Frequency*
- *Time*
- *Physical/Dimensional*
- *ASTM D1646-17 (Viscosity, Stress Relaxation, and Pre-Vulcanization Characteristics - Mooney Viscometer)*

WHAT CAN YOU EXPECT IN THE ON-SITE CALIBRATION PROCESS?

When receiving on-site ISO/IEC 17025 calibration services, it is important to know what to expect. Here is a breakdown of the sequence of events in a typical calibration process performed by an accredited service provider:



About Us

With a 40 page scope of capability, **MonTech USA** has been providing 17025 accredited calibrations dedicated to the rubber and polymer industry for over 45 years.

CLICK HERE TO REQUEST CALIBRATION SERVICES

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