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Application Note

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Requirements for Calibration of Material Testing Equipment

This Application Note will provide information about Calibrating Material Test system so that the equipment owner can access the adequacy of the calibration performed on their equipment.

Attributes of a Material Tester

Material Test Equipment is also called Tensile Test system or Universal Test system. If you aren't sure, the list below lists some of the attributes of a Material Test system:

- speed can be set and controlled
- extension, travel or distance is accurately measured by a internal measuring system and can be used in control of a test
- force is measured and can be used to control a test
- the specifications for force measurement follow ASTM E4-07 guidelines requiring the load cell to be no greater than class 1, that is, the load cell tolerance is expressed as percent of reading
- the load cell is a class 1 (1.0% of reading) or class 0.5 (0.5% of reading)
- ability to change load cell capacities to match loads

Other equipment may be part of the system and include:

- LVDT's
- contact extensometers
- laser or video extensometers
- heating chambers
- cooling chambers
- additional load cells (for load vs. load results)
- software control, graphing, and data logging through a computer
- supports DAQ devices

Calibration of a Material Tester

Calibration and verification are often used interchangeably. Generally, the equipment is first verified and then adjusted, that is calibrated, if it falls outside of the manufacturer's specifications. Some technicians verify to tolerances different from the Manufacturer's. Sometimes this is because the Manufacturer may have ambiguous tolerances but, often, it is the result of not being familiar with this type of equipment or requirements. Calibration of a Material Tester should be carried out by a technician familiar with the tester using ATSM traceable standards to be compliant with ASTM E4-07. In addition, the equipment manufacturer can have specifications for the tester that exceed the ASTM requirement. Often there are special access codes or "hidden" switches for calibration adjustments for load, speed, distance and other parameters. The equipment manufacturer does this to insure only factory trained technicians can enter the calibration and maintenance mode maintaining the integrity of the equipment.

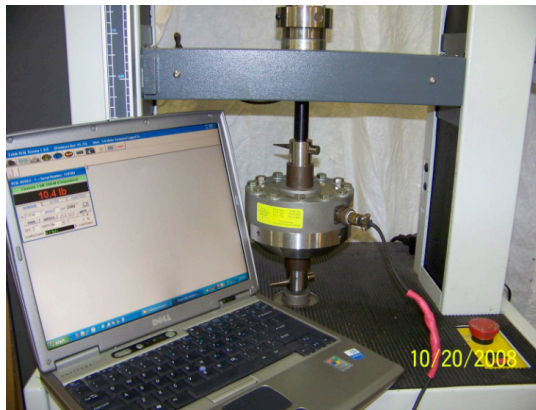
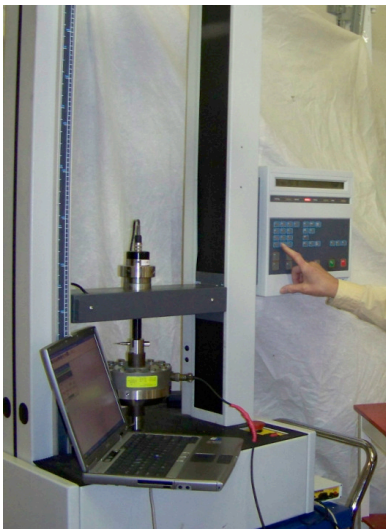
Overview of Verification and Calibration requirements

The following are general requirements for calibration and verification from manufacturer's and ASTM-E4-07.

- Force measurements are taken at approximately 20% intervals of the load cell maximum capacity to the load cell maximum capacity and adjustments are made if the load cell class tolerance (most common is 0.5%) is exceeded
- speed is measured and adjustments made if it falls outside of the manufacturer's specification
- extension is measured and adjusted if it falls outside of the manufacturer's specification
- extensometers, LVDTs, and other associated equipment are verified and adjustments made if measurements fall outside of the manufacturers specifications
- the calibration equipment is calibrated to NIST traceable standards and is current.
- the calibration equipment is capable of measuring to the necessary tolerance usually, usually 10 time more accurate than the parameter measured
- dead weights are used for load cells with a capacity of less than 100 lbf.
- the technician has special access codes, knows location of adjustment components, and/or location of "hidden" switches so adjustments to the load cell, speed, and extension of the tester can be made if they are necessary

The load cell is the most critical part of the Material Tester and verifying it and calibrating requires specialized transfer standards if certified weights are not used. A good rule of thumb is the standard should have an accuracy ten times greater than the load cell being calibrated. This is achievable with most dead weights but with transfer standard, generally a load cell, only specifically designed load cells can meet this requirement. Transfer standards accuracy should be in the range of 0.05% of reading to meet this requirement for a class 0.5 load cell. Standard hand held gages with load cells attached cannot meet this requirement. Additionally, unlike weighing scales, the load cell must be taken to full capacity in both compression (with the exception of tensile only testers) and tension directions with measurements at 20% intervals.

An example of a good calibration setup is shown below. It utilizes a precision load cell with a linearized calibration to ensure accuracy of at least 0.05% of reading and is connected to the Material Tester using the normal attachment hardware.



Examples of a compliant calibration test set up. The load cell is connected in line using the systems connection system and load resolution is 10 times better than Material Testers load cell resolution.

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A poor calibration set up is shown below and would not meet the manufacturer's specifications nor would it be compliant with ASTM E4-07. That is because this type of hand held device has poor load resolution and the accuracy that is far less than the load cell being verified.

Example of a non compliant calibration test set up.

Load cell used as a standard is not properly connected to the Material Tester's load cell and anchor pin. This gage and load cell being used as a standard is a simple force gage and is not capable of meeting the specifications of the Material Testers load cell.



Quick Check List For A Compliant Calibration

- Calibration facility is authorized by the manufacturer and has a documented procedure for entering and making calibration adjustments
- Technician has force calibration equipment capable of calibrating Class 0.5 load cells
- Calibration equipment and procedure is compliant with ASTM E4-07 requirements
- Force verifications and calibrations are done to maximum load cell capacity in compression (not done on tensile only testers) and tension
- Force verification and calibration is to manufacturer's specifications
- Speed verification and calibration is to manufacture's specifications
- Extension verification and calibration is to manufacture's specifications
- External device (extensometers, LVDT.s and etc.) verification and calibration is to manufacture's specifications
- Calibration certificates show specifications, speed, extension, force, and any other device findings and adjustments and whether or not specifications have been met

Other Considerations

Most material testers are controller by a microprocessor with firmware written by the manufacturer. Often, new firmware is released replacing older versions to fix glitches or provide enhancements to the material tester and capabilities. By having using a manufacturer authorized source for calibration and/or service, current firmware can be installed. It is S. A. Meier Co. of Milwaukee, Inc. policy to provide these upgrades at no charge during calibration, ensuring productive and trouble free operation of your equipment into the future