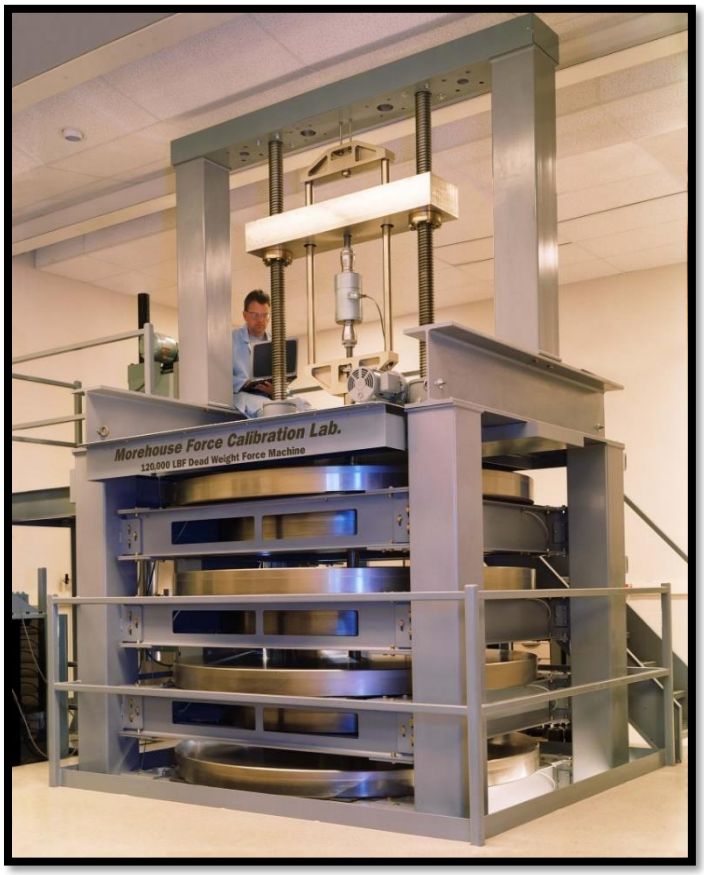
Accredited Force Calibration Service



ISO/IEC 17025 Accredited Force Calibration Service:

- Load Cells (indicated or mV/V)
- Proving Rings
- Force Gauges
- Crane Scales & Traction Dynamometers
- Brinell Calibrators
- Aircraft Scales
- Other force measuring instruments

Forces Ranging from:

- 0.1 lbf to 2,250,000 lbf in compression
- 0.1 lbf to 1,000,000 lbf tension

Unquestionable accuracy of deadweight primary standards, certified by the U.S. National Institute of Standards & Technology up to 120,000 lbf, or equivalent kgf/Newtons. All Calibrations certified traceable to SI units, through N.I.S.T.

Calibrations in accordance with ASTM E74, ISO 376, other specifications, and customer specified requirements.

ASTM E74 Class AA calibrations for capacities up to 120,000 lbf, or equivalent KGF/Newtons.

ASTM E74 Class A calibrations for capacities up to 2,250,000 lbf, or equivalent KGF/Newtons.

Calibration

Calibration is defined as "the set of operations which establish, under specified conditions, the relationship between values indicated by a measuring instrument or measuring system, and the corresponding standard or known values derived from the standard". It is not just a binding specification, but a method to obtain values that can be repeated and traced to national standards. Morehouse performs all calibrations using force standards with an unbroken chain of traceability to SI through the United States National Institute of Standards and Technology (NIST).

Most government, military, and industrial specifications, together with good judgment, dictate force measuring and calibrating instruments and systems be calibrated at specified intervals of time. The interval of time between calibrations should be established and maintained to assure accuracy and reliability.

Accreditation & Compliance

The Force Calibration Laboratory at Morehouse is accredited for calibration to **ISO/IEC 17025** and **ANSI/NCSL Z540.3** by A2LA (Certificate Number: 1398.01). This accreditation demonstrates technical competence in force calibration and the operation of a laboratory quality management system. The Force Calibration Laboratory and procedures are compliant with 10 CFR 50 Appendix B: United States Nuclear Regulatory Commission Quality Assurance Criteria for Nuclear Power Plants, 10 CFR Part 21: United States Nuclear Regulatory Commission Reporting of Defects and Noncompliance.

ISO/IEC 17025 Accredited ASTM E74 Force Calibration

ASTM E74 requires instruments used as secondary calibration standards to be calibrated by comparison with deadweights. Morehouse Instrument Company is the only commercial laboratory offering force calibration through 120,000 lbf using deadweights certified by the United States National Institute of Standards and Technology (NIST), by direct comparison to national standards of mass. Weights have been corrected for Gravity, Material Density and Air Density. Accounting for these variables Morehouse Instrument Company is able to offer force calibrations with an uncertainty of better than 0.002 % of applied force, through 120,000 lbf.

ASTM requires the loading range not include forces less than the first non-zero point applied during calibration. Morehouse Instrument Company follows the procedure and guidelines of ASTM-E74 by applying 11 increasing forces with the first point being well below 10 % of capacity to ensure our customers ASTM Class A lower limits comply with ASTM-E74. The first test point is the greater of 400 times the resolution for Class A, 2000 times the resolution for Class AA, or 2 % of the maximum applied force.

Morehouse provides force points below 10 %, so our customers can be in compliant with the following ASTM E74 sections:

Section 7.2.1: "If the lower limit of the loading range of the device (see 8.6.1) is anticipated to be less than one-tenth of the maximum force applied during calibration, then forces should be applied at or below this lower limit."
Section 7.2.1 of ASTM E74-13a: "In no case should the smallest force applied be below the lower limit of the instrument as defined by the values: 400 x resolution for Class A loading range and 2000 x resolution for Class AA loading range. ″
Section 8.6 of ASTM E74-13a: "The loading range shall not include forces outside the range of forces applied during the calibration. ″
Section 8 note 11 of ASTM E74-13a: "It is recommended that the lower force limit be not less than 2 % (1/50) of the capacity of the instrument. ″

Calibration Process

Prior to Calibration
We verify work instructions are clear and all equipment is in good working order.
We verify adapters such as pins, loading blocks, cables etc.., were included.
If applicable, we replace used batteries with new ones.

During The Calibration
Calibration is verified against what had been performed previously.
The results are checked to ensure the expected output is in line with previous calibrations or like instruments.

Post Calibration
Results are checked to determine if the calibration has changed significantly from the previous calibration.
Special notes are added about loading conditions, or how we loaded the device to ensure repeatable measurements the end user can replicate.
Software is programmed, if needed.
Calibration label, with QR code, to allow end user access their calibration report via the internet is printed.
If ordered, a custom foam fitted case is made.
Packing contents are checked against incoming receiving report to ensure order is complete, all incoming equipment is accounted for, and makes its way back to the customer.

Calibrations up to 2,250,000 lbf or 10MN

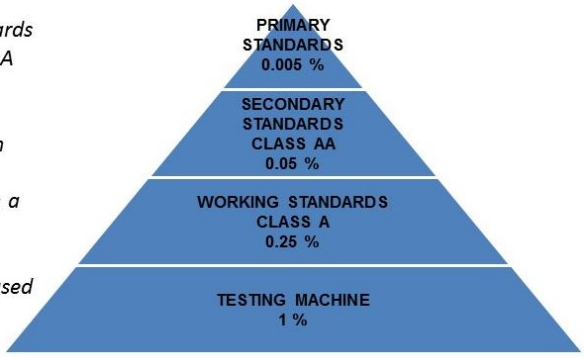
We offer calibration services in compression up to 2,250,000 lbf (10,000,000 Newtons). This is accomplished using three load cells setup in a triangular configuration. This configuration allows us to minimize cosine and bending errors that are common with using two load cells. We use our custom software to sum the output of all three load cells. The only way to assign ASTM E74 class A loading ranges is to have the secondary standard calibrated by Primary Standards. Each of these load cells is calibrated by NIST in their 1,000,000 lbf (4,400,000 Newton) deadweight frame, and assigned an ASTM E74 Class AA loading range. The three load cell's Lower Limit Factors are root sum squared, and multiplied by 2000, to give us a Class AA loading range. Morehouse can then use this system to assign Class A loading ranges.

Test Accuracy Ratio ASTM E74

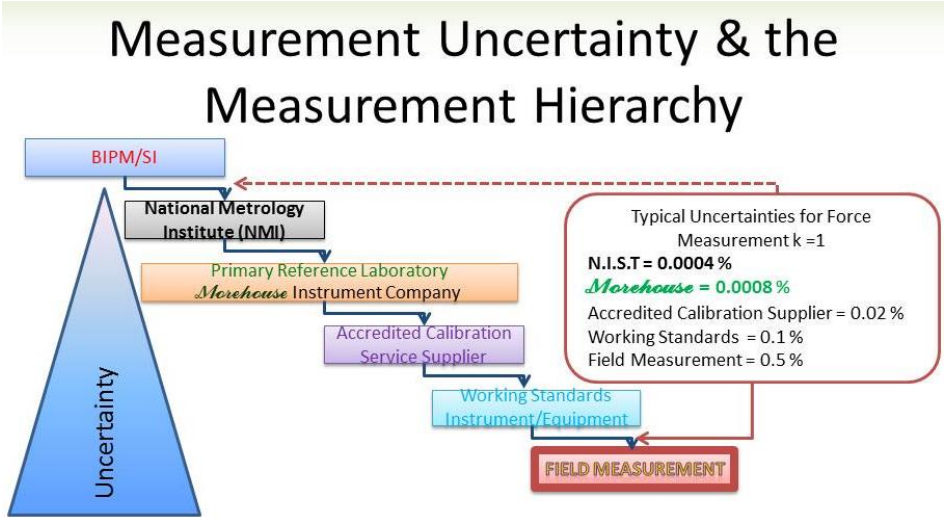
Calibration by Primary Standards is required to assign a Class AA loading range.

Secondary Standards are then used to calibrate other force measuring devices and assign a Class A loading Range

The Class A loading range is used for ASTM E4 calibrations



Measurement Uncertainty

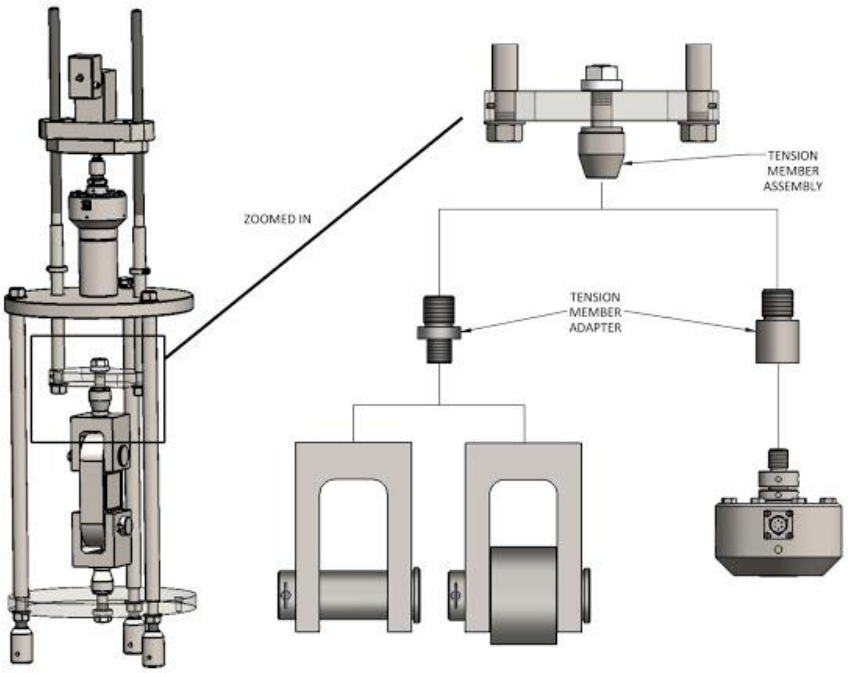


Your measurement uncertainty is directly affected by the standard used to perform the calibration**.** Morehouse primary standards have uncertainties that are typically 10 - 50 times better than accredited calibration service suppliers using secondary standards.

Measurement traceability for force traces back to the BIPM. Force is derived from the meter, second and kilogram. The next step in the pyramid is the National Metrology Institute (NMI). The NMI is where most Primary Reference Laboratories have their equipment calibrated. The purpose of the diagram on the left is to illustrate measurement uncertainty and how uncertainty increases. Morehouse offers deadweight calibrations with calibration and measurement capability of 0.0008 % (8 ppm) of applied force. When we use secondary standards, we maintain 0.005 % (50 ppm) of applied force. This is for one standard deviation and is much lower than several other primary and secondary laboratories. The reference standard uncertainty must be included in any uncertainty budget. The way we keep such low uncertainties is by manufacturing the best standards and having them calibrated by N.I.S.T.

Calibration Adapters

We take great pride in our line of accessories and adapters. We design adapters to allow us to replicate use, while eliminating off axis or eccentric loading conditions. These adapters we use in our lab are available to purchase. Our tension quick change adapters meet the requirements of the international force standard ISO 376. Section A4 of the standard states, "Loading fittings should be designed in such a way that the line of force application is not distorted. As a rule, tensile force transducers should be fitted with two ball nuts, two ball cups and, if necessary, with two intermediate rings, while compression force transducers should be fitted with one or two compression pads."



The adapters above are a result of Morehouse employees attending a lean manufacturing course. Part of this course emphasized reducing cycle time, by reducing the amount of time it would take to set up equipment for a load cell calibration.

These adapters simplified our laboratory setups, improved our performance with better alignment, and were cost-effective compared to the alternative of multiple pieces of threaded rod or multiple rod end type setups. As a result of optimizing the calibration setup, we were able to standardize production flow, provide better measurements, and free additional floor space for future expansion. A full product guide on Quick Change Tension Members can be downloaded at our web site.

Commitment to Quality

Quality manufacturing and services has been the unchanged Morehouse principle since 1925. Maintaining the most accurate standards, such as our deadweight machines, ensures Morehouse customers and their end users obtain the lowest possible uncertainties in their force measurements. Our calibration services are tailored and customized for each customer, to ensure reliable and accurate test results for their specific needs.

Call today to start improving your force measurement uncertainties.