Morehouse Instrument Company

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Force and Torque Calibration Quarterly

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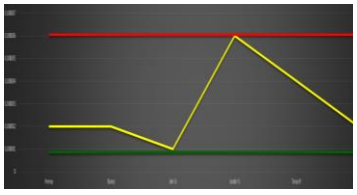
A Message from the President

Welcome to our fifth Morehouse Instrument Company Newsletter. 2015 has been an exciting year. We hired additional staff to strengthen our contract review and reorganize our IT infrastructure. We recruited an additional design engineer to focus on several new projects, including a small 1,000 LBF capacity force machine. We also plan to introduce seven additional new products this year, including a light weight 600,000 LBF capacity load cell. We listened to our customers telling us it was difficult to handle and travel with, especially when flying, heavy load cells. To solve this problem Morehouse is introducing a new light weight load cell which weighs approximately 26 LBS and is accurate to better than 0.02 % of full scale. Prototypes tested have been better than 0.02 %. Both, the light weight, high capacity load cell and small force machine will be available in March.

In an effort to live up to our reputation for great service, we are continuously taking steps to better serve our customers. Morehouse Instrument Company strives to provide superior customer service and calibration solutions while maintaining high-quality standards.

-Henry Zumbrun

Tips from the Cal Lab – SPC



Example of a control chart comparing technicians with one another.

Statistical process control (SPC) is a method of quality assurance that uses statistical methods to monitor and understand a process. SPC is an effective preventive action practice; it ensures the process operates within acceptable control limits and provides a way to intervene before things get really out of control. Morehouse has adopted SPC to monitor every one of our machines. We have developed a system that uses 3 Morehouse Ultra Precision load cells and a Morehouse 1,000,000 LBF load cell. The 1,000,000 LBF cell is calibrated at N.I.S.T. The other cells are calibrated using our dead weight frames and are used for ILC as well as SPC. The purpose of SPC is to find stable artifacts to monitor the process. Selecting the right artifacts is essential to monitoring your process. If your artifacts are not stable, you will not know if your process is in control or if the problem is caused by the artifact itself. The simplest way to monitor your process is to use a control chart (pictured left). You can control chart your calibration using "in-between" calibration checks. This can be set up in Microsoft Excel and is as simple as plotting the same calibration points with the same artifacts over time. As long as the checkpoint is between the upper and lower control limits, you are OK. Once the curve approaches or exceeds the control limits, we can investigate the root cause to determine the proper corrective action. It is important to treat the data gathered as test records. The check does not need to be a full calibration; it just needs to be consistent. SPC is essential to reducing risk and is a good check to know when your equipment needs calibration. If used properly, it can even extend or reduce calibration intervals, as appropriate.

-Henry Zumbrun

Good Measurement Practice

Keep your system in control with a 5 in 1 solution.

"Monitoring your process by putting practices in place to ensure that your measurements are accurate is essential to limiting your risk and keeping your bottom line intact."

In previous newsletters, we have been focusing on measurement errors. Good measurement practices are equally important. We often forget about those practices we put in place to make sure our equipment is working properly. Monitoring your process by putting practices in place to ensure that your measurements are accurate is essential to limiting your risk and keeping your bottom line intact. A good stable Morehouse force measurement system can be used to do the following: (1) Force Verification, (2) SPC – Statistical Process Control, (3) ILC – Intra-Laboratory Checks, (4) Proficiency Testing, and (5) A Test Standard to do repeatability and reproducibility tests used to calculate Calibration and Measurement Capability (CMC).

(1) Force Verification – Have you ever questioned if your system is functioning properly? A good force measurement system should be able to take any guesswork out of the equation. The ability to obtain objective evidence based on a quick measurement provides the verification needed to ensure proper operation.

(2) Statistical Process Control (SPC) – This process is similar to verification, with the exception of a documented control process in which an artifact is used to monitor performance of the measurement process. A good load cell system can be used as a check standard to monitor that the process is in control. It can provide the objective evidence and reduce risk. If the process is continually monitored and an out-of-control situation is found, the root cause analysis can be performed to ensure proper corrective action before the machine or process actually goes out of tolerance.

(3) Intra-Laboratory Checks (ILC) – The force system can be used to compare machines, operators or processes. If you are using control charts and the process output is approaching control limits, the system can be used to test what the issue is and to determine which machine, operator or process needs to be corrected.

(4) Proficiency testing – This often requires an artifact with a very low uncertainty. If the load cell system is calibrated by dead weight primary standards, the system can be used to satisfy Proficiency Testing requirements. This should be done immediately after the system is received.

(5) Repeatability & Reproducibility – A device with very high resolution and low overall uncertainty will allow the end user to lower their Calibration and Measurement Capability (CMC). When calculating CMC, the resolution of the system being used must be figured into the calculations. The lab will need to perform repeatability studies. An artifact with low sensitivity to side loading, temperature compensation and stability will be a lab's best asset (see note below). A good system will often decrease the variation in output between multiple measurements. It will also allow the lab to test the true performance between technicians. R & R data may be derived from control charts if they are set up properly.

"A device with very high resolution and low overall uncertainty will allow the end user to lower their Calibration and Measurement Capability."

When a buyer evaluates a system based on requirements such as cost, accuracy, and ease of use, they often forget to look at what really matters. They might even get caught by marketing claims and forget to read the fine print. A good force measurement system will allow you to keep your measurement process in control. The right system can truly kill five birds with one stone and is in line with the K.I.S.S principle (Keep It Simple Smart).

Note: If the load cell is not temperature compensated, the expected performance may decrease by about 0.015 % per degree Celsius, resulting in a decrease in accuracy. However, side-load sensitivity may have the most significant impact on the expected performance of the system. Morehouse has conducted several tests and has demonstrated that side-load sensitivity can vary from 0.002 % on a Morehouse shear web type load cell system to up to 0.75 % of full scale on other types of load cells. If you are buying a load cell with a 0.5 % accuracy specification, do you think it is really accurate when the slightest bit of off-center loading produces a 0.75 % error?

Calibration Intervals by Phil Smith

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Since I became involved in the calibration industry in 1972, calibration interval has been a common topic of interest and confusion. I was asked to write an article for the newsletter, and after some thought, I determined there was no need. Many people have published excellent content on the subject:

One of the best and most practical ways for a laboratory to justify calibration intervals is to maintain Shewhart control charts (SPC – Statistical Process Control charts). This is achieved by monitoring and charting key parameters of the equipment in between currently established calibration intervals for the equipment. Several established control limit criteria are then used to determine the stability of the artifact. This satisfies many requirements for ISO/IEC 17025:2005 (***Dilip Shah's "kill 5 birds with one stone" quotation – the "stone" being the SPC tools and techniques and the "birds" being the ISO/IEC requirements***).

5.5.9 When, for whatever reason, equipment goes outside the direct control of the laboratory, the laboratory shall ensure that the function and calibration status of the equipment are checked and shown to be satisfactory before the equipment is returned to service.

5.5.10 When intermediate checks are needed to maintain confidence in the calibration status of the equipment, these checks shall be carried out according to a defined procedure.

5.6.3.3 Intermediate checks

Checks needed to maintain confidence in the calibration status of reference, primary, transfer or working standards and reference materials shall be carried out according to defined procedures and schedules.

5.9.1 The laboratory shall have quality control procedures for monitoring the validity of tests and calibrations undertaken. The resulting data shall be recorded in such a way that trends are detectable and, where practicable, statistical techniques shall be applied to the reviewing of the results. This monitoring shall be planned and reviewed and may include, but not be limited to, the following:

a) regular use of certified reference materials and/or internal quality control using secondary reference materials;

5.9.2 Quality control data shall be analyzed and, where they are found to be outside pre-defined criteria, planned action shall be taken to correct the problem and to prevent incorrect results from being reported.

Having the historical data in the SPC format helps to determine and provide justification if the calibration interval needs to be shortened or lengthened. It is also a preventive tool which will help identify issues before they actually become real problems (**ISO/IEC 17025:2005 Clause 4.12**).

Please keep in mind that Dilip will be the instructor for the Morehouse workshop *Implementing Metrology and SPC concepts with MS Excel* scheduled for February 16, 2016 and again on June 13, 2016. The workshop includes Excel spreadsheet templates that can be used to customize a laboratory's individual requirements. This training will be conducted at the Morehouse facility in York, PA. Please visit our web site for more information.

Listed below are links to several articles on calibration intervals for your reference:

ILAC G24

http://www.fundmetrology.ru/depository/04_IntDoc_all/D010-e07.pdf

HBM

http://www.hbm.com/en/3283/guidelines-for-the-determination-of-calibration-intervals/

NIST

http://www.nist.gov/calibrations/recommendedcalibrationinterval.cfm

NCSLI

http://www.ncsli.org/i/i/sp/npb/rp/iMIS/Store/rp.aspx?hkey=bf3e3957-f502-484d-9842-fa5ef6325073

Fluke

http://assets.fluke.com/download/calibration/MSC2009_Deaver.pdf

Quality Digest

http://www.qualitydigest.com/inside/metrology-article/how-optimize-equipment-calibration-intervals.html

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NEW PRODUCT ANNOUNCEMENT

Upcoming Events

February 16 & June 13, 2016 *Implementing Metrology and SPC concepts with MS Excel*, Instructor **Dilip Shah**

This one-day workshop prepares the metrology professional to apply the power of Microsoft Excel's mathematical and statistical tools to assist in managing the laboratory's Quality Management System, including Measurement Uncertainty. The class serves as a prerequisite for the Measurement Uncertainty workshop and reduces the amount of time spent learning both the Excel and Measurement Uncertainty estimation techniques at the same time.

February 17-18 & June 14-15, 2016 Applied Fundamentals of Force Calibration, Instructors **Henry Zumbrun (Morehouse)** and **Dilip Shah (E=mc^3 Solutions)**

This course will cover applied force calibration techniques and will include live demonstrations using secondary standards to exhibit potential errors made in everyday force measurements. The measurement errors demonstrated and discussed will include errors associated with improper alignment, use of different and/or incorrect adapter types, thread depth and thread loading. The course will cover the basics of measurement uncertainty and will provide the tools for anyone to be able to estimate Measurement Uncertainty for a Scope of Accreditation CMC or to report a customer's measurement uncertainty.

Thank You and Future Newsletters

If you've made it this far, I would like to extend a giant "thank you" for reading our fifth newsletter.

Do you have a topic you would like to see covered, or would you like to submit a guest article for an upcoming newsletter?

Please feel free to contact us with topic suggestions, article proposals or feedback.. We are continually looking to improve the content of our newsletter!

Please email any correspondence to hzumbrun@mhforce.com

Web Page Links:

Training Class
http://www.mhforce.com/customer-education

Morehouse "Verification" System video
https://youtu.be/v0toiqoGY7U

WE CONCLUDE THIS NEWSLETTER BY INTRODUCING YOU TO OUR NEW LOGO!

MHFORCE

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