

CCSi presents this article "*Gage Calibration Is an Investment in Quality Production*" from *Quality Digest* by Robert Palumbo of Brown & Sharpe, as it is an objective and informative overview of the importance of gage calibration and ancillary issues.

If you have questions, comments, or would like to suggest a related article for the CCSi WebSite, please e-mail techinfo@ccsi-inc.com.

Gage Calibration Is an Investment in Quality Production

by Robert Palumbo

Gage calibration is the foundation upon which a quality program can be built

Making sure that measuring instruments are properly calibrated is critical to quality manufacturing operations. A gage that doesn't read accurately and repeatably can compromise the integrity of quality control and quality assurance documentation, and destroy confidence in measuring results. At their worst, inaccurate gages can result in the production of nonconforming parts.

Gage calibration represents an important, if not fully appreciated, manufacturing discipline. It should be viewed as an investment. Gage calibration is the foundation upon which a quality program can be built.

More than simple adjustment

Gage calibration determines the deviation from the true value of the indication supplied by a measuring instrument. The results of the calibration process can be used for gage adjustment. Calibration goes beyond simple adjustment, however. A calibrated gage can be traced back to a master source. Traceability provides the value added to the calibration process.

A trained technician determines the accuracy of the gage by measuring a recognized standard master artifact traceable, in the United States, to the National Institute of Standards and Technology or similar international organizations. The calibration process is performed by following a set of test procedures developed for specific instruments. The idea is to perform the measuring operation in conditions as near to ideal as possible to assure that the readings show the real accuracy and repeatability of the gage and are not caused by intervening factors.

Gage users have a choice when it comes to the calibration process. They can set up their own calibration laboratory and perform gage calibration in-house, send gages to commercial calibration services or return gages to the original manufacturer for calibration.

Establishing an in-house calibration service represents a significant investment in facilities, equipment and trained personnel. Using independent or original equipment manufacturers' calibration services can be costly, depending upon the number and types of gages that must be calibrated, and the turnaround time is often in the three-week to six-week range. Most users who have a variety of gage types use all three approaches.

What distinguishes calibration services?

Two factors distinguish in-house calibration services from independent sources. First is the lab environment. The precision control and accurate measurement of environmental conditions is the chief difference between an average industrial gage laboratory and labs like those found at NIST. Temperature, barometric pressure, humidity, elevation above sea level and latitude as it affects the gravitational constant must be controlled if measuring instruments are to be accurately calibrated.

There are levels of laboratory environmental control, and those control levels determine the accuracies to which gages can be calibrated. Some users who require micrometer accuracy to be in the 0.0005" range might be able to calibrate them in the shop environment. When required accuracies get into the millionths, more sophisticated calibration services are needed. An industrial calibration lab could be equipped with a climate control system that regulates temperature and humidity. This type of lab would be suitable for calibrating most micrometers and calipers, for example. For a user to build and maintain a lab with more sophisticated controls, while not unreasonable, it would have to be justified by considerable use.

The other consideration is instrumentation and equipment. For example, the use of interferometers, gage block comparators, auto-collimators, rotary tables and other specialized equipment is necessary to accurately calibrate precision measuring gages. This type of equipment is expensive and is generally only found in large independent calibration labs or at international standards labs.

Most users strike a balance in their calibration program by keeping some of the service in-house and contracting the remainder to an independent service or to the gage manufacturer. The division is determined to a certain extent by cost, but more importantly by the level of instrument accuracy required and the consequent need for specialized calibration equipment.

Organization is the key to success

Regardless of how calibration services are apportioned, the calibration process itself can be made more efficient by setting up a gage control program. A gage control program is a procedure that defines how frequently measuring instruments are to be calibrated. It should be a written document, part of the company's quality control/quality assurance program, subject to the same review, revision and approval process as any other quality management procedure.

A well-designed gage control program defines the categories of inspection, measuring and test equipment covered in the program, and who is responsible for maintaining records and operating the program. The document should establish general procedures for the handling, calibration identification and intervals, calibration department responsibilities and controls for suppliers of calibration services. The gage control program should also clearly state the disposition of gages that fail to meet standards.

The real benefit of a gage control program is that it establishes an identification system that gives each measuring instrument a unique gage control number. That number and a calibration label are permanently affixed to the gage. Using this system, gage types can be grouped into families. Gages can be further grouped according to department and/or by gages that are calibrated in-house and those that are sent to outside services.

Establish procedures for success

If some calibration will be performed in-house, another set of procedures must define the operation of the calibration department. These procedures should establish a comprehensive quality assurance program for inspection, measuring and test equipment calibration standards. This program should ensure that the in-house department meets or exceeds all applicable federal and commercial specifications for calibration procedures.

It is mandatory for the in-house calibration service to have procedures established for each gage to be calibrated. Documented instructions should be provided on the use and operation of all relevant equipment and on the handling and preparation of gages for calibration. Each calibration procedure should specify the following:

- procedure identification;
- its date of issue and revised dates;
- measurement standards and equipment used;
- the required parameter, range and accuracy of the measurement standard;
- the acceptable tolerance of each instrument characteristic being calibrated;
- and any reference documentation necessary.

Calibration procedures can be developed by working directly with the original equipment manufacturer; generated from information available from the U.S. government, national or international standards bodies; or developed by in-house personnel.

How often is enough?

There are no rules and no body of knowledge that dictate how often measuring instruments should be inspected. The determining factors of calibration frequency are usage and mishandling.

Many quality control specialists assume that all measuring instruments should be calibrated annually. That is not true. Calibration should occur at regular intervals; regular is the operative word here. One benefit of regular calibration is that it provides a historical record of instrument performance. Whenever an instrument is calibrated, that calibration data should be compared with the historical data to determine if the calibration interval should be shortened or lengthened.

There are, however, some general calibration interval guidelines. Calibration should occur at intervals determined on the basis of instrument manufacturers' recommendations, stability, purpose, usage and history of repeatability. Recalibration should be performed whenever an event occurs that places the accuracy of the instrument in doubt.

How to evaluate an outside service

Many independent calibration services are available. Picking the right one depends upon your particular calibration needs. Rather than send all of your gages out for calibration, you may need an independent service to perform only certain aspects of your calibration requirements. Try to pick an accredited service. The service should provide formal evidence of competence to perform measurement accuracy assessment.

You should require that calibration services state on the calibration report the tolerances, resolutions and accuracies of measurement results, and indicate the specification or industry standards used to perform the procedure. This is important for establishing a historical base from which to determine calibration intervals, repair or replacement of gages. This documentation should be distinct from data gathered by internal calibration procedures.



Most important is the ability to perform a regular audit of the outside service. Reputable services welcome these critical visits from their customers because it gives them the opportunity to monitor their operations and correct any discrepancies that exist. Ask to review specific gage calibration procedures. Make sure they are proper for your instruments based upon your requirements for accuracy and for meeting military and government specifications. Check departmental procedures to make sure that environmental controls of temperature and humidity meet your requirements.

Gage calibration is an important ingredient in an overall quality control program. As such, it must be given the same attention as other quality programs. That means that the calibration process must be structured and administered by a trained, competent staff. Consider it an investment in quality manufacturing — insurance against the production of nonconforming parts.

About the author

For the past 12 years, Robert Palumbo has been manager of quality, repair, calibration services, precision measuring instruments, for Brown & Sharpe. He has spent more than 20 years in manufacturing positions and has a broad background in industrial metrology.

Credits:

-  Author: Robert Palumbo, Brown & Sharpe.
-  Excerpted from Quality Digest, modified in format for presentation.

Copyright © 2006 CCSi, Inc. • All Rights Reserved • Published February, 2006