
Switching From Chart Recorders to Data Loggers

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A few years ago word processors were invented and typewriters promptly vanished from the scene. Then CDs came along and vinyl records and cassette tapes disappeared. Today, as digital data loggers [1] take a growing share of the market for calibration lab recording devices, it appears that mechanical chart recorders might be the next technology to drop out of sight.

Calibration laboratories have long relied on chart recorders and hygrothermographs to document laboratory environmental conditions and to ensure calibration accuracy. Recently, however, many labs have started to abandon mechanical temperature and humidity sensing devices, replacing them with digital data loggers. [2]

Veriteq Instruments, a North American manufacturer of data loggers, has helped many American and Canadian companies make the shift to data loggers. Veriteq has identified four reasons why increasing numbers of calibration labs are moving to the new technology:

- Accreditation and accuracy requirements
- Better instrument reliability and longevity
- The benefits of "going digital"
- Lower total instrument costs

Accreditation and Accuracy Requirements

Temperature and relative humidity levels and variations can affect nearly every type of measurement recorded in a calibration laboratory. Therefore, temperature and humidity must be maintained within certain limits [3] to achieve repeatable results, minimize the expense of tedious corrections and meet regulatory and accuracy requirements. A recent study by the

Association for Laboratory Accreditation (A2LA) [4] showed that over 25 percent of deficiencies cited by assessors dealt with the inability of labs to properly document environmental conditions or to stop calibrations when these conditions jeopardize results (ISO/IEC 17025 Section 5.3). As a result, numerous calibration managers are re-evaluating the methods they use to monitor and document conditions in their laboratories.

Many managers have found that chart recorders, especially older ones, cannot record temperature and humidity accurately enough to satisfy quality and regulatory requirements. Dimensional labs, for example, often require a greater level of accuracy and precision than can be obtained using pen and chart paper.

Older chart recorders are often difficult to calibrate and to maintain. Many are prone to sensor drift, [5] which tends to get worse over time



A technician enters data while a small wall-mounted data logger monitors and records calibration conditions.

and which can often not be fully corrected. And because chart recorders use moving parts, they gradually deteriorate and require increasing amounts of maintenance and calibration to keep them accurate. In contrast, data loggers use digital technologies, such as advanced microprocessors, solid-state sensors and full-featured software, which maximize accuracy. With no moving parts to wear out and with powerful software compensation, data loggers can deliver greater accuracy over longer periods of time. Because of their small size and portability, they can also be moved close to the critical areas where calibrations take place, providing greater accuracy for each calibration.

Reliability and Longevity

Any device that uses sensitive moving parts can fail at any time. To prevent errors and downtime, these moving parts must be carefully maintained. Depending on the type of chart recorder, maintenance can be laborious and time-consuming. For example, the standard maintenance procedure for an organization with which Veriteq is familiar called for the following: Changing and annotating each paper chart (every week), general cleaning and inspection (every week), testing of the clock mechanism and pens (every week), and full calibration (every three months).

Because chart recorders use paper charts, the amount of data that can be recorded is limited to usually no more than seven days. If the charts are not changed on time, observations are lost and calibrations can be invalidated. In addition, the pens that chart recorders use can run out, dry out, become clogged or leak, resulting in data loss.

In contrast, data loggers use digital memory, which continues to decrease in cost. Digital memory enables data loggers to provide months and even years of storage capacity. In addition to such digital features as scheduled downloading of data, digital memory reduces the possibility of missed readings to almost none.

Because chart recorders draw power continuously and rely on a power connection to operate, they are vulnerable to power outages. Data loggers, on the other hand, are "smart" devices that draw minimal current, which allows them to operate for years on a single battery.

The Benefits of Going Digital

Chart recorders create chart paper graphs. Data loggers create digital files. Although both formats can help a lab meet its calibration requirements, the benefits of going digital are becoming increasingly attractive to cal lab managers.

A chart recorder's traditional advantage over more modern systems has been the ready visibility of chart data (it directly prints on paper for all to see), but recent digital advances have eliminated this edge. Using network software, data logger information, such as detailed graphs

and out-of-tolerance reports, can now be retrieved easily in real time at a desktop computer, displayed in several locations at once and backed up and archived automatically.

Going digital also makes remote monitoring easy. For example, Veriteq's viewLinc™ data logger software allows calibration conditions to be monitored and alarmed so that any out-of-compliance condition triggers a phone call, e-mail message or desktop alert on a computer or the company network. Digital files can also be annotated or analyzed automatically to report statistical values.

Many calibration automation programs, such as Fluke's Met/Cal™, save time and increase accuracy by using the readings from data loggers to enter calibration conditions automatically in calibration records and certificates.

Lower Total Budget Costs

The current economic conditions have caused many calibration labs to tighten budgets, forego capital purchases and reduce staff. Nevertheless, many labs have decided to replace their chart recorders with digital devices, because making the switch makes good economic sense. For example, if it takes 15 minutes a week to service a paper chart recorder and a technician's time costs \$40 per hour, the annual cost of labor is \$520. If a recorder has to be calibrated three times a year, at \$100 per calibration, then the annual cost of calibration is \$300. Recorder paper costs \$20 per recorder per year. Pens cost \$30 per year. Adding everything up (\$520 + \$300 + \$20 + \$30), the total cost of maintaining and calibrating a chart recorder is \$870 per year.

In comparison, a typical laboratory-grade data logger costs \$400. Software costs \$250 and calibration costs another \$150, for a total first year cost of \$800. Because a data logger automatically collects and archives data, there is no weekly maintenance. As a result, a data logger can easily pay for itself in less than one year. After the first year, the economic advantages of using data loggers become even more significant.

Four Case Studies

Why these labs made the switch to data loggers and how they benefited

— A space center near New Orleans, LA that calibrates electronic instruments for NASA chose modern data logger technology to replace its old and outdated chart recorders. The center says the data loggers have increased calibration quality, made data collection and reporting more efficient and reduced maintenance. In particular, the data loggers have improved the center's ability to accurately monitor laboratory conditions, especially in its dimensional lab, where temperatures must stay within 0.5°F of 68.0°F.

— Tosoh SMD Inc., which manufactures high purity thin film materials in Grove City, OH, moved to data logger monitoring because the company wanted better instrument

calibrations. Tosoh wanted to switch to data loggers because of their accuracy, portability and reporting capability and because the loggers could be used at every workstation. Recently the data loggers were set to sound an alarm if they detect a deviation in environmental conditions from the company's requirements.

— InspectX Inc., a Detroit, MI-area company that performs dimensional calibration inspections for the automotive industry, moved to data loggers because it wanted to improve the quality and timeliness of its instrument calibrations. Like Tosoh SMD, InspectX wanted the accuracy, portability and reporting capability of data loggers. Also like Tosoh, InspectX now has real-time room temperature reporting at every workstation. The loggers' data storage and graphical analysis options have simplified greatly the company's monthly summary reviews.

— Richmond, British Columbia-based Wescan Calibration Services Inc., a mainstream commercial calibration lab, switched from a chart recorder to data loggers because it needed to improve the documentation required to meet ISO 17025 and 9000-2000 standards. Now it uses temperature and data loggers in its four labs and in a mobile lab.

The Future

More and more calibration labs are switching to data loggers as the modern solution for temperature and humidity recording. Does this mean the extinction of chart recorders? Not necessarily. What it does mean is that the standards for performing calibration processes are becoming more rigorous. As more companies adopt technologies that lower their costs and improve their calibration quality, more cal lab managers will have to adjust in order to compete.

References

1. Data loggers are computerized electronic devices that measure and record periodic environmental conditions. Although most data loggers are small enough to fit in the palm of a hand, they contain a microprocessor, memory, clock, battery and built-in temperature and relative humidity sensors. The loggers collect and store data at pre-defined intervals. The data can be transferred manually or automatically to a computer or computer network for monitoring, analysis, reporting or archiving.
2. The trend away from chart recorders toward data loggers was acknowledged several years ago in a study by Venture Development Corporation (VDC), a Natick, Massachusetts-based research organization. VDC forecast sales growth of data loggers of more than 20 percent per year, compared to a five percent drop in sales for chart recorders. Venture Development Corporation, "The World Chart Recorder Industry," October, 1996, Natick MA.
3. The NCSL Recommended Practice RP-14 *Guide to Selecting Standards - Laboratory Environments* (1999) and ISA RP52.1 *Recommended Environments for Standards Laboratories* (1975) set out many of the standards that govern standard lab practice.
4. Adams, Teresa C., "Most Commonly Cited Deficiencies," American Association for Laboratory Accreditation, 12/02.
5. Sensor drift refers to sensor inaccuracy over time. It is typically caused by exposure to wide variations in temperature and humidity and contact with water or chemical pollutants.

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