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Elements of a Standards Lab That Support a Manufacturing Facility

Bob Pitcock/Hewlett-Packard

Introduction

The purpose of a standards lab is to provide traceability from a national standard to the products being manufactured. Standards lab calibrations are generally high level calibrations that are performed under controlled conditions. This should not be confused with the basic instrument maintenance or calibration services that most manufacturing facilities provide.

This article will describe the basic, nontechnical requirements and need for a Measurement Standards Laboratory operated in a manufacturing environment.

The first thing to do is ask yourself some questions:

1. What is needed to support production? This could include equipment, personnel, expertise, training, floor space, and cost of operation.

2. Is a standards lab necessary, or would it be a burden to production? Operation of a standards lab can be very expensive. Consider return on investment and value added to manufacturing. You may also consider offering calibration services to other production entities within your company to help offset the cost of operating the lab.

3. Could the required calibrations be performed by another lab, taking into consideration quality, cost, turn around times, traceability, and standards (such as ISO9000)?

4. Is the required expertise available to operate a standards lab? As a minimum, you will need to consult with an expert in the field to determine the feasibility of a lab.

This article will describe the various functions of a standards lab that you should consider, if you are thinking about starting a lab of your own. They are:

1. Provide the traceability path for calibrations to a national standard.

2. Help determine calibration requirements for production test equipment.

3. Provide consultation services to production and engineering as required.

4. Determine what functions actually require standards lab support.

5. Perform the required calibrations.

6. Documentation and record retention.

Provide Traceability Path

Figure 1 represents a typical traceability path to a national calibration laboratory. The areas represented by the blocks must be able to show proof, by means of a calibration certificate or other acceptable methods, of traceability to the national standard. If an external calibration source is used, you must be able to verify its competence to assure its traceability to the national standard.

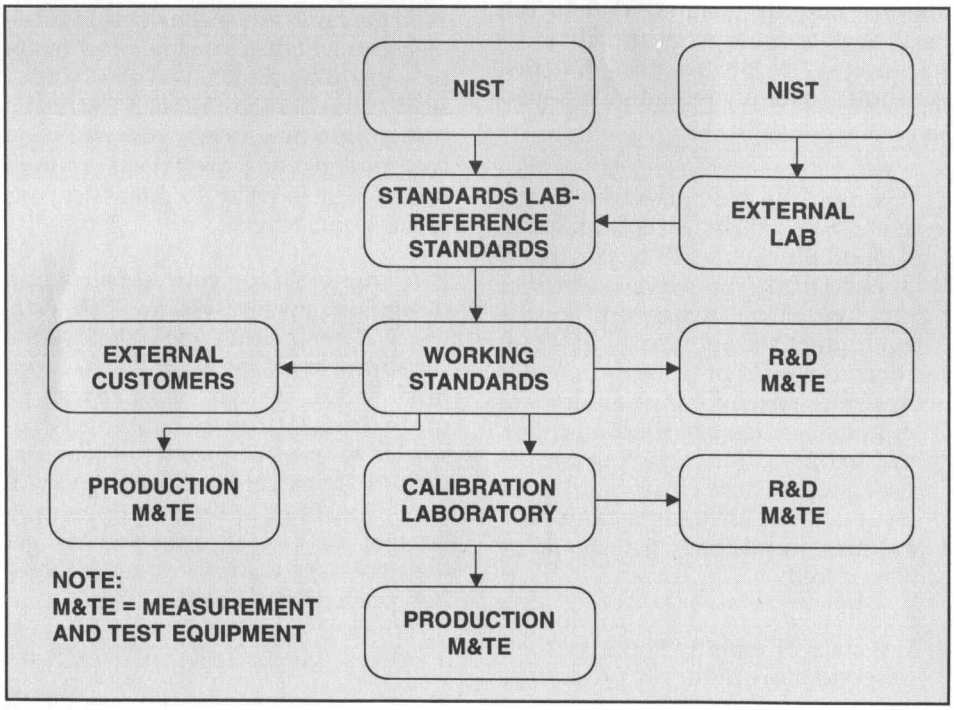

Figure 1. Typical Traceability Path

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Determine Calibration Requirements

In order to meet the requirements of calibration system standards, such as ISO Guide 25 or ANSI/NCSL Z540-1, documenting measurement uncertainties and test accuracy ratios is a must. A test accuracy ratio is the ratio of the measurement uncertainty of the measurement system to the accuracy requirement of the unit under test. In general, the accepted test accuracy ratio is 4:1. Exceptions may be made if the process is well documented and it is shown that the reduced test accuracy ratio does not affect product quality. In simple terms, if the accuracy specification of a unit under test at 1 vdc is 0.1v, then the standard used must have a total measurement uncertainty of 0.025v or less in order to achieve a test accuracy ratio of at least 4:1.

There are several acceptable methods of calculating measurement uncertainty that I will not discuss here. They generally consist of simply adding all uncertainties in the calibration system, or selecting a statistical method. There have been many very good papers written on the subject. One good document to refer to is the *ISO/TAG 4, Guide to the Expression of Uncertainty in Measurement.*

There are several items to consider about setting up a standards lab. You need to determine what functions, or parameters of production that test equipment actually requires from standards lab support:

1. It should be cost effective. Don't spend $100,000 in test equipment to support the calibration requirements of one DVM. You need to consider the "return on investment" of the equipment you purchase. In a reasonable period of time, the savings realized from calibrating equipment in house, instead of sending it out, must come close to paying for the new calibration equipment purchased. There are other factors, such as turn-around-times, that should be considered.

2. Is it state of the art? You may have to spend more money in order to be able to support this type of measurement. It can be very difficult to support a state of the art process if you rely on external calibration sources.

3. Is a standards lab operation the only way to maintain the required test accuracy ratios? You must be very careful to maintain the required measurement uncertainty for each measurement parameter. Sometimes, the only way to do that is to have more control over the traceability and uncertainty process, which means a standards lab may be necessary.

4. Turn-around-time considerations. If equipment down-time is critical, turn-around-times by a standards lab may not be acceptable. You will need to compare the cost of down-time to the cost of operating a standards lab during non-production hours. Cost of down-time is difficult to measure. It could even mean the loss of future business because of unhappy customers. You may need to consider duplication of equipment for critical operations.

Provide Consultation Services

When properly trained, standards lab personnel will be recognized as experts in their fields of measurement. You will work with R&D to determine traceability requirements for new products. This includes determining required specifications for test equipment and new calibration equipment if necessary. With the rapid advancement in technology, you will need to stay informed of new instrumentation available in your fields of expertise. As manufacturing moves into new fields, you will need to broaden your own measurement knowledge in order to maintain your status as an expert.

R&D may ask for your assistance in designing new test systems. If they do, this will ensure that you will have the capability to calibrate all of the equipment in the system. Nothing can be more frustrating than being bombarded with a test system full of equipment that you can't calibrate. You will either have to send the equipment to another lab or wait until you can get the necessary equipment and calibration procedures in place.

Perform Required Calibrations

The actual calibration process may be the easiest, most straightforward process in the operation of a standards lab. Some of the things you should consider in the calibration process are:

1. Technician training. You should have a documented training record for each employee, and a document containing the scope of each job. The training record should contain the date and name of each class taken that pertains to the employee's job.

2. Follow all procedures, including individual calibration procedures. The technician must be able to demonstrate that each procedure is being followed. Some companies actually require that calibration procedures be opened and at the workstation during calibrations.

3. Make sure that all calibration equipment is traceable and its calibration is current. An easy rule to follow is to actually look at the calibration stickers on the calibration equipment each day. If it's overdue, don't use it. If you do, the traceability chain is BROKEN.

4. Make sure all required parameters are checked and that all required documentation is completed and properly filed.

5. Update calibration recall system and records as necessary.

Documentation

Documentation and record keeping is a large part of the operation of a standards lab. Some of the records that should be kept and maintained are:

1. Department procedures or a calibration system description. This should include a simple, but complete description of the total calibration operation.

2. Calibration procedures. These procedures should include, as a minimum, procedure name, date, revision number, required equipment, required standards, unit under test specifications, uncertainties of standards, TAR, and description of process.

3. Calibration worksheets for production test equipment. Worksheets must contain calibration data, such as before and after adjustment data and out of tolerance data. They must

also contain instrument identification, cal date, cal due date, standards used, and other information of importance to your operation.

4. Calibration worksheets or calibration reports for standards lab test equipment and reference standards.

5. Individual training records.

6. Audit reports. These are audits performed on an outside lab used for traceability purposes and audits performed on your lab by your customers.

7. Calibration recall system and history records. Most recall systems are computer based. History records may be either on disc or hard copy.

8. Record retention process. There must be a documented procedure for the retention time for calibration records. As a minimum, records must be kept for at least one calibration cycle. Generally, records are kept for several years.

9. Capabilities chart. Figure 2 is a representation of a capabilities chart that includes function, range, frequency, and best measurement uncertainty.

Summary

Whether you decide to operate your own standards lab or utilize an out-

FUNCTION	RANGE	FREQUENCY	UNCERTAINTY
DC VOLTAGE	0 TO 1 VOLT		2 PPM + 0.5 MICROVOLTS
	1 TO 100 VOLTS		3 PPM
	100 TO 1000 VOLTS		6 PPM
AC VOLTAGE	1 TO 3 VOLTS	10 HZ	0.02%
		20 HZ TO 50 KHZ	0.01%
		100 KHZ	0.02%
		1 MHZ	0.06%
		3 TO 10 MHZ	0.12%
		20 TO 30 MHZ	0.25%
		40 TO 60 MHZ	0.5%
		70 TO 100 MHZ	1.2%
	1 TO 1000 VOLTS	10 HZ TO 10 MHZ	SAME AS ABOVE
FREQUENCY		1 TO 10 MHZ	3 X 10 TO THE -13
TIME			0.2 MICROSECONDS
TEMPERATURE	-20 TO +220 DEG C		0.01 DEG C
LASER WAVELENGTH	632 NANOMETERS		1 X 10 TO THE -9
LASER POWER	10 TO 1000 MICROWATTS	632 NANOMETERS	5%
RESISTANCE	.001 OHMS		50 PPM
	.01 TO .1 OHMS		20 PPM
	1 OHM TO 10 OHMS		10 PPM
	100 OHMS TO 1 MEGOHM		5 PPM
	10 MEGOHMS		10 PPM
	100 MEGOHMS		20 PPM
	1 GIGAOHM		.01%
	10 GIGAOHMS		1%
	100 GIGAOHMS		5%
HUMIDITY	LIMITED-BY REQUEST		

Figure 2. Standards Lab Capabilities Chart

side lab for your standards calibrations, you must remember to comply with your country's calibration system requirements. If your company is ISO9000 registered, you will probably need to comply with ISO Guide 25 (General Requirements for the Competence of Calibration and Testing Laboratories).

All calibration requirements state that you must maintain an unbroken chain of traceability from your equipment to a national standard. The most common factor that breaks the chain is using equipment that is actually overdue for calibration. If it is overdue, don't use it. It is better to take it out of service and have it calibrated than break the traceability chain. You need to have a system or a person to monitor calibration dates for all equipment, from the primary standards right down to the production test equipment.

In conclusion, always remember that the heart of quality in instrument manufacturing has a direct relationship to the integrity of your calibration system.

About The Author

Bob Pitcock received his initial electronics training at Keesler Air Force Base, Biloxi, Mississippi in aircraft navigation equipment repair. He served in the U.S. Air Force from 1961 through 1965. He received his AA degree in electronics technology from Modesto Junior College, Modesto, California in 1968. He began his career with HP in 1968 as an electronic technician in Palo Alto, California. He moved to the Santa Clara (California) Division Standards Lab in 1972 as a calibration technician. He became supervisor of the standards lab in 1986. In 1992 his role expanded to include supervision of the standards lab and electronic maintenance. For the past year Bob has served as an Engineering Specialist, Senior in the Santa Clara Division Standards Lab. He has been in the standards lab business for a total of 23 years. □

Safety-Related Service Notes

Service Notes from Hewlett-Packard relating to personal safety and possible equipment damage are of vital importance to our customers. To make you more aware of these important notes, they are printed on paper with a red border, and the service note number has an "-S" suffix. In order to make you immediately aware of any potential safety problems, we are re-highlighting safety-related service notes here with a brief description of each problem. Also, in order to draw your attention to safety-related service notes in the service note index, each safety-related service note is highlighted with a contrasting color.

HP J2301B & J2302B Internet Advisor
HP J2522B & J2523B Internet Advisor

Serial Numbers Affected:

J2301B - US35340101 / US35340548

J2302B - US35340102 / US35350393

J2522B - US35300102, US35300103, and US35300788

J2523B - US35300104 and US35300105

The 0950-2937 Display Board Inverter assembly installed into the display does not meet Hewlett-Packard fire retardant standards and should be replaced. Inverter boards marked with LOT 56 on the transformer in instruments within the serial number prefixes should have this modification to prevent instrument damage.

Return your instrument to the nearest HP Service Center and it will be repaired at no charge. For more information, order Priority Safety Service Notes

J2301B-01-S - doc. ID no. 6377

J2302B-01-S - doc. ID no. 6378

J2522B-01-S - doc. ID no. 6379

J2523B-01-S - doc. ID no. 6380

from the HP FIRST system or from your nearest HP Sales and Service office.

HP 70001A & 70004A Modular Measurement Systems

Serial Numbers Affected:

The serial number range is extensive and listed within the service note text.

Faulty electrolytic capacitors on the power supply board may leak electrolytes across high voltage pc board traces leading to a potential fire hazard. Failures result in a blown main fuse, are self-extinguishing and are completely contained within the instrument housing.

Return your instrument to the nearest HP Service Center and it will be repaired at no charge. For more information, order Safety Service Notes 70001A-20-S or 70004A-15-S as document ID numbers 6320 or 6322 from the HP FIRST system or your nearest HP Sales and Service office.

HP 9470, 9472, (OT2000, OT3000, OT4000) Automatic Test Systems

Serial Numbers Affected:

The serial number range is listed within the contents of the service note.

There is a faulty diode CR8 on the TH-200 Test Head Motherboard that can defeat high voltage safety interlocks to the test head, which can cause a severe shock hazard to the operator. Note that this problem only occurs when CR8 is present on the TH-200 motherboard.

All attempts have been made to contact HP customers that purchased these systems prior to January 1995 of the potential shock hazard associated with the TH-200 Test Head. However, it is possible that there are systems with the problem that are not on our list. If you own one of these systems and have not been contacted by Hewlett-Packard, please get in touch with your nearest HP Sales and Service Office at once.

This service note is available through the HP SupportLine. □

1995 Bench Briefs' Instrument Service Note Index

HP FIRST (208)344-4809
T & M Instrument Section - Press 4
T & M Service Notes - Press 2
Enter the Password - 76683

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Service Note Types

IO	Information Only	SA	Safety
MA	Modification Available	PS	Priority Safety
MR	Modification Recommended		

Is ISO an Acronym?

Bill Sorrells/Hewlett-Packard

You are standing around discussing ISO 9000 or some of the other ISO "standards" and the question is invariably asked, "What does ISO stand for?" Since Hewlett-Packard is noted for using acronyms to describe almost everything, that question caused a great deal of discussion around our coffee pot.

Actually, ISO is not an acronym. In fact ISO is a word, derived from the Greek ISOS, meaning "equal," which is the root suffix of the prefix "iso-" that occurs in a host of terms, such as "isometric" (of equal measure or dimensions - Shorter Oxford English Dictionary) and "isonomy" (equality of laws, or of people before the law - ibid.).

From "equal" to "standard," the line of thinking that led to the choice of "ISO" as the name of the organization is easy to follow.

In addition, the name has the advantage of being valid in each of the organization's three official languages - English, French, and Russian. The confusion that would arise through the use of an acronym is thus avoided, e.g., "IOS" would not correspond to the official title of the organization in French-Organization Internationale de Normailisation.

The above information was taken from ISO on-line through the Internet. □

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