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CCSs

The following is a current list of the approved Commercial Calibration Sources authorized to calibrate acceptance equipment:

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Primary Standards Laboratory Report 1st Half 1990

Measurement Standards Department
Sandia National Laboratories
Albuquerque, NM 87185

Abstract

Sandia National Laboratories operates the Primary Standards Laboratory (PSL) for the Department of Energy, Albuquerque Operations Office (DOE/AL). This report summarizes metrology activities that received emphasis in the first half of 1990 and provides information pertinent to the operation of the DOE/AL system-wide Standards and Calibration Program.

MASTER

Foreword

This report was compiled and edited by W. G. T. Levy, Sandia National Laboratories. Additional information on the activities covered in this report may be obtained by contacting the Measurement Standards Department 7340, Sandia National Laboratories, P. O. Box 5800, Albuquerque, New Mexico 87185, telephone (505) 845-8268.

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Primary Standards Laboratory Report 1st Half 1990

1. Introduction

The Primary Standards Laboratory (PSL) operates a system-wide primary standards and calibration metrology program for the US Department of Energy, Albuquerque Operations Office (DOE/AL). The PSL mission is to develop and maintain primary standards; to calibrate electrical, physical, and radiation reference standards for member laboratories (DOE/AL integrated contractors); to conduct technical surveys and audits of these laboratories; and to recommend and implement system-wide improvements.

This report summarizes activities of the PSL for the first half of 1990 and provides information pertinent to the operation of the DOE/AL Standards and Calibration Program. Specific areas covered include development projects, improvement projects, calibration and special measurements, surveys and audits, and significant events. Appendixes cover certifications and reports, commercial calibration laboratories, PSL memoranda, National Bureau of Standards (NBS)/National Institute of Standards and Technology (NIST) test numbers, and a DOE standards and calibration memorandum.

2. Development Projects

Intermediate Pressure Standard

Phase I of the development of an intermediate vacuum pressure standard by the NIST is proceeding on schedule. This work will provide an accurate pressure standard in the range from 10^{-5} to 10^{-1} torr. At the end of Phase I, NIST will provide Sandia with a written report summarizing its investigation and will recommend a set of requirements necessary to assemble a pressure standard for the PSL. Recent communications with NIST indicate the report will be submitted in the fall of 1990.

Compare-III Leak Calibration System

The Compare-III leak calibration system is now being fabricated at NIST with completion of the hardware phase scheduled for the fall of 1990. In the interim, testing of the NIST prototype system has been progressing smoothly. These systems are based on the Sandia-designed Compare-I and -II systems that are currently used to calibrate over 80% of the gas leaks for the Nuclear Weapons Complex. The new system will incorporate an Extrel quadrupole mass spectrometer so that leaks containing gases other than helium may be accommodated. At the PSL's request, a secondary electron multiplier ion-counting technique is presently being evaluated as an adjunct to the Faraday cup detector. Preliminary results suggest that the ion-counting technique may extend the helium calibration range to 10^{-12} std-cc/sec or below.

High Vacuum Calibration System

The high vacuum system, under development for the PSL by CMR & Associates, will provide an automated calibration system and enable higher accuracy vacuum gage calibrations. Currently the orifice plate is being remachined and characterized. A calculation of the orifice conductance will be provided by NIST based on measurements of the orifice physical configuration. Initial measurements indicated a rounded orifice edge that has been remachined to provide a vertical edge. Final measurements will be completed in July 1990.

UIM and Resumption of Low Pressure Calibrations

The Ultrasonic Interferometer Manometer (UIM) has been installed in its modified laboratory area, although this area is not operational because of delays in the environmental control modifications. Fabrication of the complex vacuum and pressure control systems has been initiated and verification testing of

the UIM will begin as soon as control system fabrication has been completed. The remodeling of laboratory space associated with the UIM, which caused a hold on calibration of absolute low pressure devices earlier in the year, has been essentially completed. Low pressure calibration equipment has been moved into the area and these calibrations have resumed.

Automated Calibration System for PRT Indicators

An automated system for calibrating PRT indicators has been developed. It is expected to substantially reduce man hours expended per calibration. The Ohms function of Instrulab and Azonix PRT indicators will be calibrated. System components are standard resistors, Dataproof scanners and an HP 340 instrument controller/workstation tied to the HP 9000 computer system. Automation will allow better data analysis and characterization which should result in improved uncertainties assigned to PRT indicators.

Automated Calibration System for High Value Resistors

An automated measurement system for resistors of 100 megohms and above has been developed. It uses a Guildline Model 6500 Terraohmmeter operated by an HP 340 instrument controller/workstation tied to the HP 9000 computer system. It is expected to reduce man hours expended per calibration by a factor of four. Preliminary indications are that the new system will be more precise than the previous one which used a manually operated Terraohmmeter.

Automated Josephson Voltage Standard

The automated refrigeration system which cools the Josephson Voltage Standard has been in operation for 3100 hours. In addition to routine measurements and calibrations, the system is being operated to characterize its performance and to test the temperature dependence of the Josephson Voltage Standard. Other than a few minor problems of helium leaks, the system has been very reliable. Most importantly, the refrigerator creates no additional noise to the calibration system.

Automated Spectroradiometry

An Optronics automated spectroradiometer system has been put into service for characterizing the spectral response of optical detectors over the range

of Si: 250 - 1100 nm. Of this range, only the interval 400 - 700 nm is presently able to be traced to NIST. Problems also remain with characterizing the collimation and distribution of the output beam. Automation of the system was greatly enhanced by writing an overall control program which directs instrument setup, embeds the Optronics control programs, and stores and accesses data.

3. Improvement Projects

Refurbishment of 40 kpsi Oil Cross-Float System

All elements of the 40 kpsi Oil Cross-Float Calibration system have been delivered and installed by the supplier. Testing, procedure writing, and a complete system review have begun. Final acceptance as an online standard is expected shortly. The system provides automatic precision loading and unloading for the 26 lb weights needed to develop pressures up to 40,000 psi. In addition, the system incorporates a custom designed, precision, quartz crystal transducer as a working standard. This special type of transducer will be evaluated for use as a check standard or as a replacement for oil dead weight testers throughout the DOE/AL complex. The system was designed and developed as a result of a safety survey which identified a lifting hazard involved in positioning the 26 lb weights during cross-float calibrations.

High-Voltage Pulse Generator

The high voltage pulse generator has been operating in a normal manner. The leaks in the oil pumping/filtration system have been stopped and the pump rate is as originally intended. The overflow system for the oil tank filling operates quite satisfactorily (the oil merely returns to the storage tank over a weir), which should eliminate any inadvertent oil overflow that could occur from a failed limit switch.

Both the high voltage (to 375 kV) and the low voltage (to 75 kV) pulse transformers have been used and their operations have been as intended. The heat exchanger operates to cool the oil in the test tank to about 11°C and the cooling rate has been established. So far, we have found no significant differences in our present resistive voltage dividers at room temperature and at the reduced temperature (we can simultaneously compare a room temperature divider with one or two at the reduced temperature). We have another identical heat exchanger to install at a later date for use with heated water to allow testing at elevated temperatures.

The drawings for the system have been updated to reflect the changes that were made in placing the system into operation. They now must be reviewed to complete this work.

Upgrade of Automated Zener Calibration System

The automated Zener calibration system that has been in operation since March 1988 has been upgraded. A Dataproof scanner has been added which increases the total number of inputs available for unknown Zener taps from 15 to 47. Re-wiring for different test groups is now eliminated which is an important time savings in light of the increasing Zener work load. Also, the software has been modified to allow delayed start times and multiple runs which has resulted in significant time savings due by facilitating unattended operation. The system is being operated by the HP 9000 workstation based computer system, which also stores the calibration data.

Completed Project Reviews Place Eight Microwave Calibration Systems into Service

New and improved systems for the calibration of microwave attenuators, power meters and directional couplers have been placed in service as described in the following paragraphs:

I. Attenuation and related calibrations

A. Weinschel VM-4B Attenuation Calibration System

1. The code for certifying uncertainties of reflection coefficient measurements was upgraded to version CERT4B_BO. This upgrade reduces the time required for the certification by a factor of 2 to 3.
2. The code for calibrating step/variable attenuators was upgraded to version INC4B_A2. The new version eliminates input and output mismatch uncertainties when the attenuator under calibration is fitted with isolators on both its input and output ports.

B. HP 8902S (8902S) Attenuation Calibration System

Four newly approved calibration systems have placed the 8902S hardware into calibration service for the first time.

- a. Code CERT2S_AO certifies the uncertainties of attenuation measurements made on the 8902S system.
- b. Code ATT2S_AO manages the calibration of fixed 2-port attenuators.
- c. Code INC2S_AO manages the calibration of step/variable attenuators in the incremental attenuation mode.
- d. Code SATT2S_AO manages the calibration of step/variable attenuators in the insertion loss mode.

II. Power Meter Calibrations

A new system for rapid calibration of low-level (0.1 to 10 mW) power meters over the 10 to 18,000 MHz range has been developed and placed into service. The system utilizes a swept-frequency synthesizer featuring spectrally clean, 20 mW output to calibrate a power meter at 51 (or fewer) frequencies in a given run. Code MF1MWRO_AO manages the calibration which requires a minimum of operator interaction and features dynamic determination of calibration uncertainties. The time to perform such calibrations is approximately 20% of that formerly required.

III. Precision Calibrations of Effective Source Reflection Coefficient of Directional Couplers

Code GAMGE85_AO automates the data acquisition process when calibrating the effective source reflection coefficient, Γ_{ge} , of a directional coupler. Formerly, the same measurement technique was used, but the operator had to manually record and enter the raw data (from a Vector Automatic Network Analyzer) into a processing program. Now, the data is handled automatically from generation in the VANA to signature-ready certificate.

ITS-90 Fixed Points

The ITS-90 temperature scale requires several new fixed points not previously used. An indium fixed point from England was handcarried to the PSL in July. A mercury cell and its cooling apparatus is on order from Isotech and delivery is expected in December. This will complete the set of fixed points required to calibrate standard platinum resistance thermometers from -189 to 961°C .

4. Calibration and Special Measurements

AC/DC Precision Calibration System (PCS)

A second generation PCS is being built for the Primary Standards Laboratory by NIST, Gaithersburg, MD. The second unit has been delivered and is being checked out. It is to be capable of generating precise voltages at frequencies from mHz to MHz and is to have a current generating capability up to 100 amperes at frequencies up to 100 kHz. The new and existing PCSs are expected to be compatible over their overlapping ranges of frequency, voltage and/or current. The Digitally Synthesized Source (DSS) that provides the lower frequency capability for the new system is at the PSL and operates as intended.

Time and Frequency

The time and frequency system has maintained reliable operation since recovery from the Christmas Holiday shutdown. The 60 kHz talking clock and the CPS clock have been working satisfactorily. A new clock controlled by the Geocentric Orbiting Experimental Satellite (GOES) has been obtained and placed in service. This clock replaced an earlier model that was in need of repair. Operation now seems to be normal.

The Frequency Analysis System (FAS) continues in use in the PSL to store and analyze the data collected by the NIST Frequency Measurement System (FMS). A new version of the FMS is currently being tested at the PSL. The new system is designated a FMAS and combines the function of the FMS and the FAS. The FMAS operates, as does the FMS, to collect data representative of the performance of up to four Frequency Standards, to store the data on an internal hard disk, and to analyze the data. The

FMAS provides display of measurements of frequency stability from parts per million to parts in 10^{12} and operates with a resolution of parts in 10^{14} . A current technology LORAN receiver, computer, counter, and printer are used in the FMAS and data analysis can be effected through use of new software with the system.

New Voltage Transfer Technique Being Tested

The standard cell banks which are currently being used as a transfer standard for disseminating the Volt to the CSLs via the PSL Voltage Map program will be replaced by a solid state voltage standard in the near future. This change has been contemplated for some time and suitable candidate standards have been purchased for testing. The change over has been accelerated due to the problem and expense of shipping standard cell banks after it became necessary to ship them as hazardous material a few years ago. A candidate standard is on hand. Its voltage has been followed for the past two years and it has been found to be adequately stable in a laboratory environment. It is presently undergoing tests in order to estimate its transfer uncertainty. This device will function as an interim transfer standard during the two year period that we will be carrying out the tests that will allow us to select the ultimate transfer standard. The interim standard will go into operation in FY 91. (Standard cell banks will not be shipped in FY 91.) No significant changes in the way that the Voltage MAP program is conducted are anticipated.

Three Methods Available for Accelerometer Calibrations

The PSL has calibrated accelerometers using a vibration table having a built-in "working" accelerometer. NIST traceability was achieved using measured sensitivity ratios of a NIST calibrated accelerometer to the built-in accelerometer. These ratios were then applied to the calibration of a test accelerometer which is substituted for the NIST accelerometer. PSL continues to use this calibration method for accelerometer having an output near 15 picocoulombs per g.

For calibration of accelerometers having an output of 2 picocoulombs or less per g, a second method has been devised. Instead of using the built-in accelerometer as a working standard, an Endevco 2270M9 is mounted on the top surface of the vibration table and used as a working standard. This Endevco, having a sensitivity of 2 picocoulombs per g, is designed for mounting test accelerometers on its top surface

while attached to the vibration table. Connecting a NIST calibrated accelerometer to the Endevco's top surface, NIST traceability is again achieved through ratio measurements at frequencies from 10 to 10,000 hertz. These ratios are applied to the calibration of a test accelerometer substituted for the NIST unit. Enhanced accuracy is achieved since sensitivity ratios are kept near unity. Furthermore, since the test accelerometer's weight is near that of the NIST accelerometer, the Endevco's uncertainty in sensitivity due to load change is kept small.

A third method is used for calibration when an Endevco type accelerometer is to be calibrated. Modifying the second method described above, the Endevco type test accelerometer supplied by the customer is substituted for the working standard accelerometer. Calibration is performed using measured ratios of the NIST accelerometer to the Endevco supplied by the customer.

Glassware Stability Study

The PSL in collaboration with the Analytical Chemistry group at Sandia National Laboratories is continuing the two year study of the variability of glass volumetric flasks as a function of use. We expect to publish the results in a suitable journal after the last sequence is completed early in CY 1991. The second to last measurement sequence and data analysis should be completed around the beginning of FY 91.

Step Height Measuring Equipment Failure

The amplifier in the Talystep step height measuring instrument has failed. We have returned the amplifier to the manufacturer (Rank Taylor-Hobson) for possible repair. Due to the age of the instrument, repair may not be possible. Two options exist in the event that the amplifier cannot be repaired:

1. We will return the entire instrument to the manufacturer for a retrofit to the new amplification scheme or
2. We will request replacement of the instrument via capital equipment funding.

Laser Power Measurements

The PSL Laser Power Standard was measured using electrical substitution, a solar radiometer, and an "absolute" Si detector. All showed the standard to have decreased about 0.2% since the previous calibration. This device must next be calibrated by NIST.

Primary Lead Probe Remeasured

A second calibration at the UK's National Physical Laboratory (NPL) of lead probe JD069 taken together with a correction of the previous run gives a PSL/NPL ratio of 1.04 for pulsed neutron measurements. A program for determining corrections to the PSL data is partially completed. In order to measure laboratory attenuation and scattering corrections at NPL and the UK's secondary calibration lab, a Controlatron neutron generator was purchased and is being loaned to the UK for one year.

A computer program was completed for guiding data reduction, instrument readout and control, and data storage on the new primary calibration system. Some facets of instrument control still remain to be ironed out.

Secondary Lead Probe Calibration

In order to eliminate false counts, the amplifier gain settings used for the two models of lead probes were adjusted downward to prevent backswing after a gamma count. This backswing was found to give false counts amounting to 0.2 - 0.5% of the total.

5. Surveys and Audits

Technical Surveys

The PSL performed three technical surveys of CSLs for conformance to AL Standards and Calibration Order 57XA and to good laboratory practice. All contractors were in conformance with AL Order 57XA. In addition one survey of a proposed commercial calibration source (CCS) was also performed.

Measurement Audits

Thirty-nine measurement audit exercises were initiated with the CSLs to verify dimensional, physical, and electrical measurement capabilities. These included technical audits, blind audits, and audit packages handcarried to the contractors for measurement during technical surveys. The blind audits were randomly selected during the surveys for measurement at the PSL and for comparison of these measurements with the CSLs' current calibration data. Twenty-one reports of audit results were written, including 13 for handcarry audits that were included in Technical Survey Reports, all of which were successfully completed.

6. Significant Events

Volt – Ohm Change Tutorial

A one day course for CSL personnel on the changes in the unit of the Volt and Ohm was held at the PSL on February 13, 1990. The course consisted of a lecture by S. L. Kupferman, DC Project Leader, on some of the key features and implications of the changes followed by an extended discussion, question and answer period. Fifteen individuals from nine CSLs attended the course. After the course all the PSL projects held an open house for the visitors.

Update: Uncertainties on Resistors Reduced

In the last Semiannual Report, it was noted that uncertainties of resistors in CSL resistor sets would be reduced to 10 ppm for decade values between 0.001 ohm and 1 megohm where this could be justified by historical drift and stability data. To date this has been accomplished for five CSL sets.

New Weapons Production PSL Title II Complete

The Architect/Engineers (A/Es) renewed their work on the Title II design in February 1990. The drawings and specifications were completed and submitted to Sandia for review on April 26, 1990. After review, the drawings were returned to the A/E with corrections and changes. The changes were incorporated and the entire bid package was ready for distribution on July 11, 1990. The RFQ was published in the May 15, 1990 issue of the Commerce Business Daily. The bid opening was for August 30, 1990. The contract was awarded on September 12, to the low bidder, Bradley and Stam. Actual construction should begin in the fall of CY90.

Humidity and Temperature Workshop Conducted by PSL

A humidity and temperature measurement workshop was conducted at Sandia's Primary Standards Laboratory May 22 and 23. J. L. Hartley, the project leader, and P. J. Spellman covered topics related to temperature and humidity calibrations. Various methods were discussed for generating and measuring known moisture levels along with their application and traceability to acceptable national standards. Also the complexity of moisture measurements inside sealed components was given added attention because of its application to the weapons program.

Implementation of the ITS90 temperature scale was the major topic of discussion during the workshop day devoted to temperature. Special attention was given to using existing test data to implement the ITS90 scale within a limited temperature range.

The problem of obtaining the required temperature fixed points was discussed along with possible commercial sources for obtaining the extended range platinum resistance thermometer.

It was learned that a number of the standards laboratories are now using the F-18 AC bridge for temperature calibration. Consequently, an informative discussion developed presenting test results used for qualifying PSL's AC bridge.

Special Training in Substitution Weighing

C. F. Pace of the PSL recently provided two days of training for a CSL employee in substitution weighing. As a result of this training, the CSL laboratory is considering implementation of this technique of weighing into their metrology program.

Primary Standards Recall System

A shipping label printing program was written and a dedicated shipping label printer was set up in the PSL staging area.

A separate error checking subroutine was written and added to all interactive recall system programs that write to the database. The subroutine identifies database lock and timeout errors and gives the user an option to quit or continue after trying the record append or record update ~~two~~ times.

The traceability table was modified to include a type or source of calibration code for the standard file number.

Flowmeter Calibration Database Created

The calibration database for critical flowmeter calibrations was created and a large program for critical flowmeter calibration data processing, certificate generation, and database updating is ready for testing.

Presentations

C. F. Pace, "Characterization and Calibration of Coordinate Measuring Machines," presented at the University of Wisconsin Seminar entitled "Methods and Equipment of Metrology," May 7-9, 1990.

P. D. Thacher, "Calibration of Optical Detectors" at the *Optoelectronics '90 Symposium*, Sandia National Laboratories, June 5-7, 1990.

Publication

C. F. Pace, "Characterization and Calibration of Coordinate Measuring Machines," in University of Wisconsin Seminar Notebook entitled "Methods and Equipment of Metrology," 1990.

R. V. Duncan, "A Refrigerated Dewar for the Josephson Array Voltage Calibration System," Conference on Precision Electrical Measurements, Ottawa, Canada, June 1990.

APPENDIX A

Certificates and Reports Issued

The certificates and reports issued by the PSL are summarized in this appendix.

Reference Standards for

Allied Signal, Inc., Kansas City Division	59
Albuquerque Microelectronics Operations	3
EG&G, Energy Measurements Inc., Las Vegas, NV	21
EG&G Idaho Inc., Idaho Falls, ID	4
General Electric Neutron Devices Department	49
Lawrence Livermore National Laboratory	5
Los Alamos National Laboratory	39
Mason and Hanger-Silas Mason Co.	62
EG&G Mound Applied Technologies, Inc.	72
Martin Marietta Energy System Inc.;	2
Oak Ridge Y-12 Plant	
EG&G Rocky Flats Plant	40
Sandia National Laboratories, Albuquerque	71
Sandia National Laboratories, Livermore	63
Westinghouse Savannah River Laboratory	8
Subtotal	<u>498</u>
Other Reference Standards and Delegated Instruments	452
Calibration to Support Audits & Surveys	30
Special Measurements	10
Subtotal	<u>492</u>
Total	<u>990</u>
 Total Active Items Currently in Recall System	 6450

APPENDIX B

Commercial Calibration Laboratories

Auxiliary Calibration Source Clarification

AL Order 57XA provides for two general types of auxiliary calibration sources to aid the DOE Contractor Standards Laboratories (CSLs) in implementing their calibration programs, i.e., other than the NIST, the PSL, or the CSLs. These are Commercial Calibration Sources (CCSs) approved for calibrating accep-

tance equipment, and Designated Commercial Standards Laboratories (DCSLs) approved for calibrating in-process equipment. As explicitly stated for CCSs, measurements for acceptance may be made on equipment calibrated by them, whereas measurements made with equipment calibrated by DCSLs are in-process type measurements. A table summarizing the attributes of CCSs and DCSLs is included.

DOE/AL-Approved Calibration Sources Other Than NIST, PSL, and DOE Integrated Contractors (CSLs)

(CCS) - Commercial Calibration Source:
(DCSL) - Designated Commercial Standards Laboratory:

Approved for Calibrating Acceptance Equipment
Approved for Calibrating In-Process Measuring and/or Test Equipment

	Attribute Summary	
	CCS	DCSL
AL Order 57XA(3/31/86)	4.g,5.a.(3),5.c.(2),	4.k,5.c.(4),
Reference Paragraphs	6.a.(4)(8)(10),6.b.(5)(d),6.b.(14), 7.a.(3),7.b.(2)(3)	6.a.(4),6.b.(5)(e),6.b.(14), 7.a.(3),7.b.(2)(3)
Can calibrate in-process measuring or test equipment	Yes	Yes
Can calibrate acceptance equipment	Yes	No
Initially certified by*	PSL	CSL
Recertified by*	CSL	CSL
Survey interval	2 Years	2 Years
Monitored by	PSL	PSL
Can calibrate any device	No**	No**

*AL Order 57XA provides for initial approval by the PSL, with the reapproval to be accomplished by the principal using CSL.

**Approved calibration parameters defined at time of initial approval and updated where necessary after each survey. The CSL's lab manager, or his designee, should contact W. G. T. Levy when use of a CCS or DCSL is considered for the first time or when new or extensions of existing calibration parameters are contemplated.

CCSs

The following is a current list of the approved Commercial Calibration Sources authorized to calibrate acceptance equipment:

Source	Expiration Date
ATEC Engineering Brea, CA	8/91
DL Inc. Tempe, AZ	*
Honeywell, Ordnance Div. Hopkins, MN	8/91
Honeywell, Electronic Test Center New Hope, MN	8/91
Honeywell, Avionics Div. Ridgeway, MN	8/91
Rockwell International Tulsa, OK	11/90
Ruska Instruments Houston, TX	*
SIMCO Electronics Co. Santa Clara, CA	12/91
Teledyne Systems Co. Northridge, CA	8/91
Tekserv Chelmsford, MA	7/91

* Approval in process

DCSLs

The following is a current list of the approved Designated Commercial Calibration Laboratories in use by the CSLs:

Certifying Contractor	Expiration Date
<u>Allied Signal</u>	
American Electronics Labs Lansdale, PA	10/91
Boonton Electronics Parsippany, NJ	8/92
C. P. D. Engineering, Inc. Oconto, WI	9/91
Delta Electronics Laboratory Orlando, FL	5/92
Endevco Corp. San Juan Capistrano, CA	9/92
Eppley Laboratory, Inc. Newport, RI	6/92
ESSCO Standards Laboratory Woburn, MA	6/91
General Electric Company Computer Service Compton, CA	8/91
GenRad Co. West Concord, MA	6/91
Hayes Instrument Services Billerica, MA	6/91
Hewlett-Packard Co. Palo Alto, CA	1/92
Honeywell, Avionics Div. Minneapolis, MN	6/91
John Fluke Co. Everett, WA	9/92
Leeds & Northrup Co. North Wales, PA	10/91

Certifying Contractor	Expiration Date	Sandia National Lab at Livermore	
<u>Allied Signal</u>		Precision Labs	9/91
Lockheed Missile & Space Sunnyvale, CA	1/92	San Jose, CA	
SIMCO *	9/91		
Burbank, CA			
SIMCO Electronics Co.	12/90		
Santa Clara, CA			
Teledyne System	8/91		
Northridge, CA			
Viking Labs/Honeywell	5/91		
Mountain View, CA			

* Formerly Comtel Metrology

APPENDIX C

Listing of PSL Memoranda (PSLM)

Over the years the PSL has issued various memoranda that provide general technical requirements and standards of good practice for the CSLs. These memoranda are listed here by number. A review for possible update, addition and/or obsolescence of these PSLM is continually under way at the PSL. A copy of the latest index of the PSLM will appear in each semiannual report. The current issue reflected herein is Rev. 5 dated 7/19/89.

PSLM No.*	Date	Title
1A	7/09/80	Exceptions to Recall Requirements
2	1/14/70	(standard leak terminations)**
3B	5/16/88	Laboratory Environments
5E***	7/19/89	Calibration Obtained from Other than the Primary Standards Laboratory
11A	3/06/72	Gage Block Materials
13B	11/20/86	Packaging Requirements for Shipment of Standards
14	11/20/74	Designated Commercial Standards Laboratories
20B	1/30/89	Rating and/or Reporting for Technical Surveys and Measurement Audits
23	6/05/80	NBS Calibrated Standards
24A	7/18/86	Weights to be Calibrated by the PSL
26	3/30/83	Checking and Cross-Checking of Standards
27***	7/19/89	Reference Materials

* Missing PSLM numbers were obsoleted in this or earlier revisions.

** Denotes the subject matter of the PSLM since no official title was given when written in 1970.

*** PSLMs still in force affected in this revision (PSLMs 5E and 27, together, replace PSLM 5D, Calibration Service Not Available from the Primary Laboratory, PSLM 15, Cross Utilization of Contractor Standards Laboratories, and PSLM 22, Calibration Below Reference Standard Level).

APPENDIX D

NBS/NIST Test Numbers

Following is a list of some of the presently valid NBS/NIST test numbers assigned to reports of tests performed for the PSL, including some of the more frequently used standards. However, where traceability is questioned by first-tier suppliers and others outside the DOE/AL Weapons Complex, it is the position of both the DOE/AL and PSL that the memorandum on traceability dated November 26, 1986, written with the concurrence of the DOE/AL, be used to answer such questions. A copy of this memorandum along with DOE's cover memorandum and transmittal letter are reprinted herein for ready reference.

Standard	NBS/NIST Test No.
DC Resistance	243183
DC Voltage	243273
DC High Voltage	728/243576-89
High-Voltage Pulse	722/241232-88
Gage Blocks, Long English	731/245700-90
Gage Blocks, Long Metric	731/245700-90
Gage Blocks, Angle	731/241753-88
End Standards	731/239286-87
Threadwires (English)	731/241485-88
Threadwires (Metric)	731/241134-88
Master Gaging Balls (English)	731/243729-89

Standard	NBS/NIST Test No.
Master Gaging Balls (Metric)	731/239111-87
Optical Flats	731/244765-89
Surface Roughness Standards	731/244563-89
Force (Proving Rings)	
5000 lbf	737.04/237388
10,000 lbf	737.04/236524
20,000 lbf	732.07/241956
60,000 lbf	732.07/245921
100,000 lbf	732.07/244961
Pressure, Air (Ruska-F/N 4174A)	P-8032
Pressure, Oil (Ruska-F/N 5327A)	P-8288
Pressure, Air (Ruska-F/N 2409E)	P-8196 and P-8334
Ion Gage 6508H	241647
SRG 6507H	241647
SRG 6965H	246538
Capacitance Diaphragm Gages	
1870H	241875
1871H	241875
1875H	241875
Accelerometer (Vibration)	732/24136J-88 732/246233-90
Lamps Tungsten Strip	534-242010-88-1

APPENDIX E

DOE/PSL Memoranda on Standards and Calibration Program (These memoranda are still in effect)

DOE F 1325.9

United States Government

Department of Energy

Albuquerque Operations Office

memorandum

DATE: NOV 26 1986
REPLY TO:
ATTN OF: PPB:QED:PEO (183)
SUBJECT: AL Standards and Calibration Program

TO: Those on Attached List

There have been some inquiries of AL contractors from other federal offices and contractors concerning how traceability of calibrated items is accomplished at their facilities. In response to these questions, the Primary Standards Laboratory has prepared a memo describing how traceability is accomplished throughout the AL complex, and this office has prepared a memo identifying each contractor facility participating in the AL calibration system. These memos are attached and should be provided to your contractor(s) for answering future inquiries.

Stephen J. Guidice
Director
Quality Engineering Division

Attachments

United States Government

Department of Energy

memorandum

Albuquerque Operations Office

DATE: NOV 26 1986

REPLY TO

ATTN OF: PPB:QED:PEO (178)

SUBJECT: AL Standards and Calibration Program: Traceability

TO:

One of the responsibilities of the Albuquerque Operations Office is to insure the accuracy of test and measurement equipment used for weapons design, development, and production throughout the AL complex. To assist us in meeting this responsibility, AL has tasked the Primary Standards Laboratory (PSL) at Sandia National Laboratories, Albuquerque, to provide calibration traceability for each of the following contractors:

Allied Bendix Aerospace, Bendix Kansas City Division
 General Electric Neutron Devices Department, Pinellas Plant
 Los Alamos National Laboratory
 Mason & Hanger Silas-Mason Co., Inc., Pantex Plant
 Monsanto Research Corporation, Mound
 Rockwell International, Rocky Flats Plant
 Sandia National Laboratories, Albuquerque
 Sandia National Laboratories, Livermore
 EG&G Idaho, Inc.
 EG&G Energy Measurements, Inc.
 Reynolds Electrical & Engineers Co., Inc.
 Martin Marietta Energy Systems, Inc., Y-12 Plant
 Westinghouse Hanford
 E. I. duPont de Nemours & Company Inc., Savannah River Laboratory.

Attached is a memo prepared by the PSL which contains excerpts from AL Order 57XA, "Standards and Calibration Program". It describes how traceability is achieved throughout the AL complex. If you have any further questions concerning this matter, please contact this office.

 Stephen J. Idice
 Director
 Quality Engineering Division

Attachment

PRIMARY STANDARDS LABORATORY

Sandia National Laboratories, Albuquerque, New Mexico 87185

November 12, 1986

TO WHOM IT MAY CONCERN:

The Department of Energy has the overall responsibility for all phases of the design and production of nuclear weapons, and it has placed the specific responsibility for these activities with its Albuquerque Operations Office, DOE/AL.

Considering the nature of these nuclear devices, the reliability requirement is extremely high. All aspects of Quality Assurance are given high priority by DOE/AL in carrying out its responsibilities for the nuclear weapons program. One of the particularly important quality elements is the assurance that test and measuring equipment used throughout all phases of the program is providing proper measurements.

One of the documents relating to the requirements for the prime contractors engaged in the various phases of the nuclear weapons program, one which addresses in substantial detail the means for assuring that proper measurement results are being obtained, is AL Order 57XA, "Standards and Calibration Program", dated March 31, 1986. This Order provides for a Primary Standards Laboratory (PSL) and reference level calibration laboratories at each of the prime contractors, i.e., Contractor Standards Laboratories (CSLs) and states the requirements of the PSL and CSLs, as well as DOE/AL, their Area Offices, and other DOE Operations Offices, in the implementation of the standards and calibration program to insure the accuracy of measurements made for the nuclear weapons program.

The purpose and scope of AL Order 57XA as stated therein is as follows:

1. Purpose. The purpose of this order is to set forth the requirements of, and assign responsibilities related to, the AL Standards and Calibration Program. This program provides for a standards and calibration system to insure the accuracy of instruments, gages, and testers used in the pre-production, production, and stockpile evaluation of weapons material throughout the AL weapons design and production system.
3. Scope. This order sets forth the minimum quality requirements for DOE contractors and DOE offices engaged in the calibration of measurement and test equipment used in the design, production, and evaluation of weapons unless specifically exempted by AL in writing.

One of the most important aspects of the AL Standards and Calibration Program is "Traceability", which is defined in paragraph 4.s. as follows:

- 4.s. Traceability. The ability to relate individual measurement results through an unbroken chain of comparisons to national standards maintained by the National Bureau of Standards (NBS) or to accepted values of fundamental physical constants or values

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derived by the ratio-type of self-calibration techniques or those obtained using nationally accepted measurement systems.

Paragraph 5.d. of AL Order 57XA establishes Sandia National Laboratories as the Primary Standards Laboratory for the DOE/AL Weapons Complex as follows:

- 5.d. Sandia National Laboratories is assigned the task of providing a PSL function for the AL Standards and Calibration Program. This function shall be performed in accordance with the technical requirements (see 6.a.) contained herein.

The requirements most closely concerned with traceability for the PSI and CSLs in this regard are covered in paragraphs 6.a.(1) and (2) and 6.b.(1) and (2), respectively as follows:

6.a. Primary Standards Laboratory:

- (1) develops and maintains, or specifies, primary reference standards for the weapons production system, periodically certified as being traceable per paragraph 4.s., Traceability.
- (2) calibrates and/or certifies the reference standards for the AL production system contractors and approves procedures for obtaining calibration and certification from other sources; maintains documentation of the calibration/certification; and reports significant out-of-tolerance conditions to appropriate users.

6.b. DOE Contractors:

- (1) maintain certified reference standards and associated laboratory equipment to properly calibrate transfer standards, working standards, and measuring equipment. Ultimate traceability shall be as defined in paragraph 4.s., Traceability. In most cases the traceability to the NBS will be through the PSL.
- (2) select and maintain the calibration of transfer and working standards which are used to calibrate measuring devices. Each item calibrated shall be labeled and records of calibration shall be maintained. A supplementary label, or other documentation properly identified and dated, may be used to convey certification information when space is not available on the calibration label.

The calibrations certified by the Primary Standards Laboratory and Contractor Standards Laboratories at their respective levels are covered by the above requirements.

In accordance with AL Order 57XA, the Director of DOE/AL's Quality Engineering Division reviews and performs periodic surveys of the operation

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of the PSL and the CSLs for conformance to its requirements. In addition, the PSL performs periodic technical surveys of the CSL operations and operates a technical audit measurement program for all of the CSLs per AL Order 57XA. The PSL also routinely participates in Measurement Assurance Programs (MAPs) sponsored by the NBS to insure that the continued calibration capabilities are maintained at a high point of proficiency.

Evidence of traceability is maintained on file in the Primary Standards Laboratory along with detailed documentation of each calibration. The Primary Standards Laboratory publishes a semiannual report of its major activities which includes a section on applicable National Bureau of Standards Test Numbers. Each CSL also maintains detailed evidence of traceability in their files for instruments calibrated in their laboratory,

R. T. Johnson, Jr., Manager
Measurement Standards
Department 7240

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Distribution

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- END -

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