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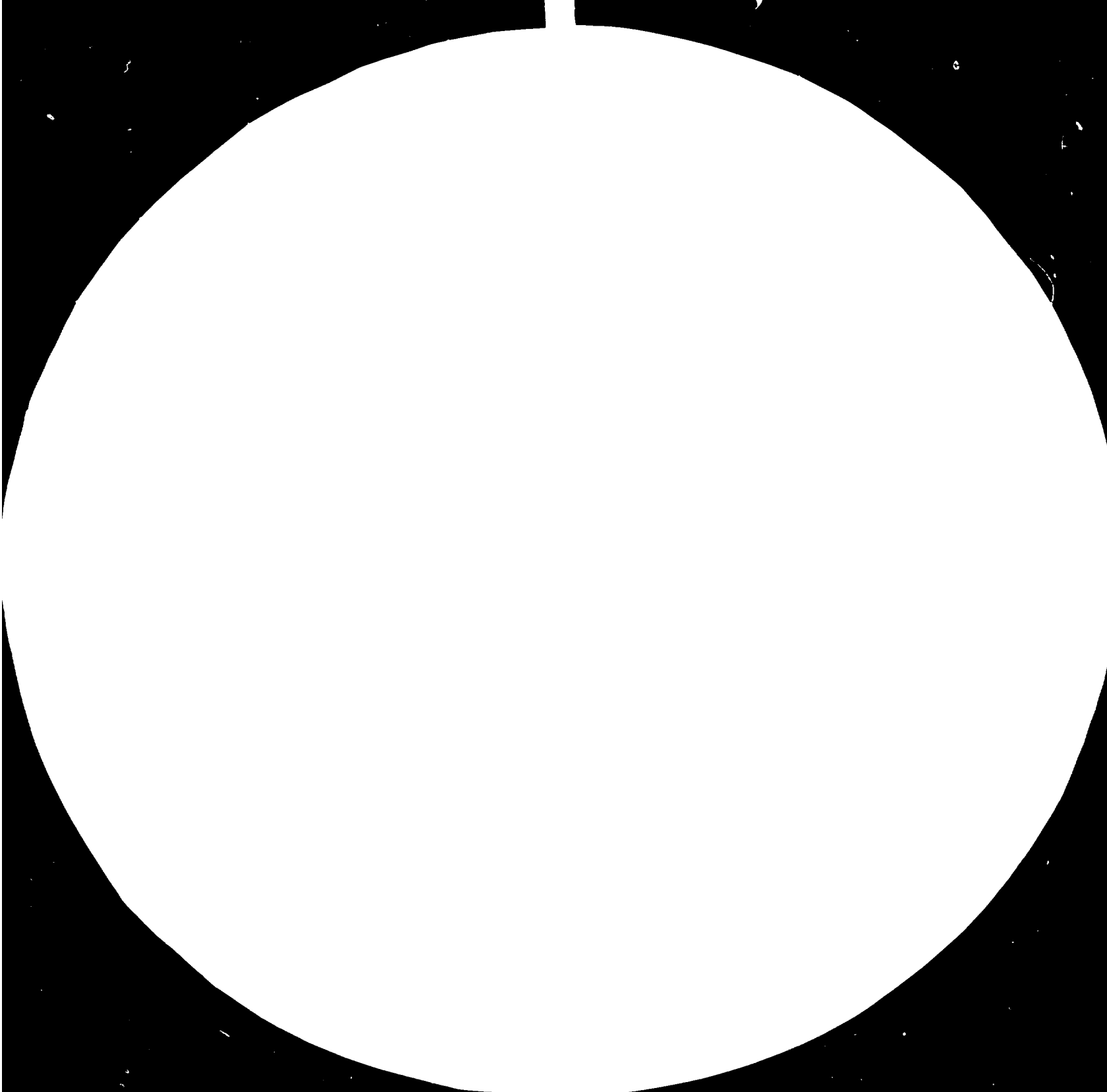

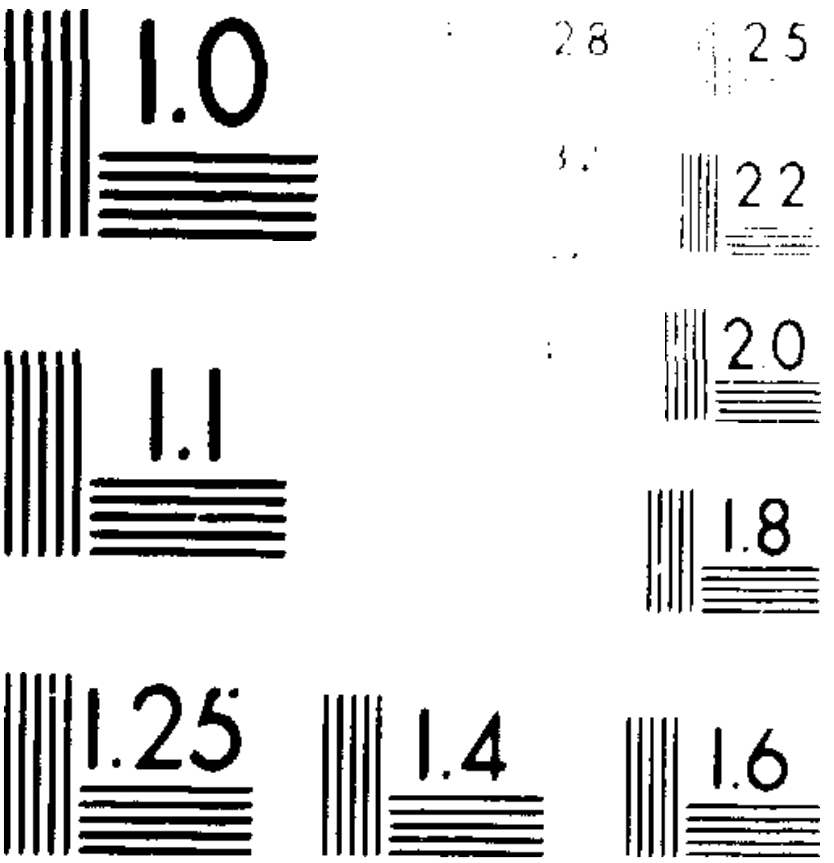

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ENGLISH

Seminar on Calibration and Metrology
held at

The China Electronic Product Reliability
and Environmental Testing Research Institute
8 March 1984 to 21 March 1984

QUALIFICATION AND SURVEILLANCE LABORATORY FOR CONSUMER ELECTRONIC PRODUCTS *

DP/CPR/81/028

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from:
Mr Seidel, D-1164

TABLE OF CONTENTS

INTRODUCTION

A seminar was conducted on electronic measuring equipment calibration and metrology at the China Electronic Product Reliability and Environmental Research Institute (CEPREI) in Guangzhou, Peoples Republic of China (PRC), from Mar 8,1984 through Mar 21,1984

The purpose of the seminar was to aquaint the metrology and test engineers of CEPREI and other organizations such as The National Institute of Metrology and The Chengdu Institute of Radio Engineering with some of the latest calibration equipment and techniques to support the respective calibration activity in these and other Institutes.

A tour of the CEPREI test and calibration laboratories was conducted prior to the seminar to aquaint me with existing calibration activity and some of the current problems.

During the seminar, information was supplied on a broad range of subjects relative to improving the knowlege of current calibration activity in the United States,and related activity in development of accreditation schemes in the U S and Europe on calibration as related to the IEC Quality program for component certification.

Travel by CAAC included round trip flight from San Francisco to Beijing, from Beijing to Guangzhou, from Guangzhou to Guilin and Guilin to Beijing.

Hotel and travel arrangements were made through the Ministery of Electronic Industries. Hotel accomodations at the Peking Hotel, the Tung Fang Hotel, the Li Jian Hotel and the Wan Shu (Longevity) Hotel were quite comfortable.

All surface transportation was provided during the stay and included both Institute vehicles and commercial taxi service.

Interpreters were provided for both myself and my wife.

AGENDA

The seminar agenda covered twelve topics. The topics were developed for the lecture from conversation with Mr Abe Okun and from first hand experience with successful operation of a commercial calibration laboratory in the United States. Communication with the Institute by letter allowed review of many of the questions later posed in the afternoon discussion sessions. The class participated well in these sessions and I am told that over four hundred questions were addressed in the twelve days of classes.

The twelve lecture titles are briefly described.

I. SPECIFICATIONS

A paper covering the importance of developing thorough familiarity with the subleties of a test instrument's published and production specifications in order to appreciate the introduction of statistical quality control to instrument performance prediction.

II. WHAT IS CALIBRATION

A paper covering the concepts currently used in the U.S.,regarding definitions of calibration and differentiating between that activity known as "test".

III. MEASURMENT HIERARCHY

A paper describing the current echelon system of traceability used in the U.S.,the "National Measurement System", and type I, II,and III, calibration laboratories.

IV. ESTABLISHING CALIBRATION INTERVALS

A paper giving an overview of some of the methods which U.S. companies use in an attempt to optimize the recall interval to minimize calibration cost while meeting "calibration quality factor" goals.

V. THE MAINTENANCE PROGRAM

An outline emphasizing the separation of equipment maintenance from the calibration function. The lecture explained an economical maintenance program which conserves highley technical labor and improves test equipment reliability.

VI. PRACTICAL ON SITE CALIBRATION

A paper discussing some of the inovations which now allow effective on site calibration. The recommendation was given to analyze workload and critical need to decide which items should be field calibrated.

VII. ELECTRICAL STANDARDS

A paper describing the fundamental principles of comparison of two like devices and the introduction of the random and systematic error concepts used for the intercomparison of higher level standards.

VIII. RECORDS AND DATA

A paper stressing the importance of legitimate records and some of the uses of calibration data. The SIMCO system of controls utilizing the IBM administrative computer was also covered.

IX. REPAIR PARTS

Some of the economic considerations and philosophy of a commercial calibration and repair laboratory regarding stock level decisions, inventory control and the need for parts price mark-up were discussed.

X. QUALITY ASSURANCE MANUAL

The SIMCO Quality Assurance Manual was briefly reviewed, stressing the measurement of the quality of performance of the SIMCO calibration and repair service. The use of data from quality inspection was described. The SIMCO Quality Assurance Manual was presented to CEPREI Director, Mr Lu Chung-yu. This manual may be used as a reference should CEPREI wish to emplement a similar program.

XI. MEASUREMENT ASSURANCE

This session utilized a paper given at a National Conference of Standards Laboratories Symposium by DR. Brian Belanger of the U.S. National Bureau of Standards. The paper clearly describes how laboratories can cooperate to improve the accuracy of measurement and calibration. Other applications and variations on the Measurement Assurance Technique were described using successful examples from SIMCO.

XII. AUTOMATING CALIBRATION

Several SIMCO technical papers on this subject were covered. A presentation of SIMCO completed automatic calibration systems and of work in progress on new systems was given. This session stressed the use of measurement assurance in the software design for automatic calibration systems.

SUMMARY

The seminar consisted of morning lectures and afternoon question and discussion sessions. Test equipment manufacturer's sales literature was used extensively as was the flip chart and felt tip pen to describe systems or devices used in calibration by this author. A brief presentation on the National Conference of Standards Laboratories and the Measurement Science Conference was given. A great deal of literature in the form of publically presented papers from these conferences was used for reference and left with the CEPREI management at the conclusion of the seninar.

The SIMCO night calibration shift advantage was described. Emphasis was placed on the necessity to avoid systems which required one man to stay with one instrument through out the calibration and repair process. Reassignment of difficult jobs to the most successful or experienced personnel is very important to the efficiency of the operation.

The use of test equipment performance data to justify the extension of calibration recall intervals was suggested. This is not being done at CEPREI and could reduce the calibration workload if implemented.

Mr Jung Ming assisted by Mr Chiu Zu Dong and Mr Tan

Bu-Qiang provided the excellent seminar translation and helped to bring out analogous descriptions for those technical phrases new to all the attendees. Besides the seminar support these gentlemen accompanied myself and Mrs Quinn on various outings making the entire stay most enjoyable

The seminar was attended by twenty six regular participants and occasional participants interested in a specific topic or discussion. A list of the participants is included in appendix A.

Most of the questions asked pertained to areas of measurement or specific instrument calibration or verification problems. In some cases these questions ranged into an area of product test which I was unfamiliar with, but I attempted to suggest methods of "crosscheck" to verify test results. Notes were taken on some of the unanswered questions and follow up answers or sales information on test equipment will be supplied. One of the CEPREI problems concerned the traceable calibration of high resistance standards which the National Institute Of Metrology is not prepared to calibrate at this time. This service can be provided by the U.S.National Bureau of Standards through SIMCO.

I wish to acknowlege the gracious support of the following CEPREI personell;

Mr Lu Chung-yu, Director of the Institute
Mr Ma Huaizu, Chief Engineer
Mr Yi Zhiun, National Project Director and UNDP Project Manager
Mr Chiu Zu Dong, Deputy NPD
Mme Zhu Tian Yue, Education director
Mme Shi Mei Juen, Purchasing engineer

Arrangements in Beijing were provided by ;
Mme Ye Lan-su, Ministry of Electronic Industries Liaison Officer
Mr Ding Hua, CEPREI Liaison officer

Arangements for Sunday trip to Guilin were provided by
Mr Zhou, of the Guilin Radio Engineering Research Institute

SCHEDULED LABORATORY SURVEYS

In order to survey support for CEPREI in metrology and calibration, two laboratories were visited.

Mr Fang Sen-li director of the Guangdong Provential Institute of Research and Metrology conducted a tour for myself and CEPREI personell. This organization developed the national standard for ultrasond instrument power calibration and retains this unusual primary calibration capability. There should be good opportunity for cooperative measurement interchanges in those diciplines which CEPREI and this Institute have similiar capability such as voltage resistance and reactance. The Provincial Institute has been named the warrenty service organization for Keithly Instruments, a quality instrument manufacturer of the United States. NCSL descriptive literature was sent to Mr Fang as requested from the region 7 membership chairman.

Mr Xu De-xiong Director of the electromagnetics division at the National Institute of Metrology introduced me to members of his staff and they described each of the laboratories we were able to visit. Very good facilities and competent personell were evident. Much modern equipment was in place and undergoing calibration. Information on equipment available for noise source calibration and the latest broad band noise sources was requested. Mr Xu introduced me to Mr Hoa Cho-lai who was refered to me by Mr Norman Belecki of the U.S. National Bureau of Standards. This gentelman had spent two years working at NBS in the Electrical Standards Section and was very knowlegable in all aspects of the NIM basic electrical standards. Since returning to the U.S.,I have received a letter from Mr Liu Ling-xiang who attended the lecture at CEPREI. Mr Liu expresses his thanks for the valuable lecture and is requesting some information on oil bath equipment available for standard cell voltage calibration. I will be pleased to help locate this information. Mr Hoa also described to me a superior resistance comparator obtained from a French Manufacturer, Setaram, which might help SIMCO improve on resistance uncertainty. These NIM metrologist certainly have the knowlege to implement or aid other laboratories to implement Measurement Assurance and advise on computer applications for calibrations. As in the U.S. this Institute is one of the great National Resources and should be maintained in high esteem.

DISCUSSIONS WITH CEPREI MANAGEMENT

Initial discussions were held to plan the format of the seminar and to arrange for copies of the presented papers to be made for each student. A wireless microphone was provided to supplement my soft speaking voice.
At the conclusion of the seminar a general session was held in the morning in which the Director Mr Lu thanked Mrs Quinn for conducting four english language classes for engineers of the institute. We were presented with ceramic keepsakes and a soft wood carving which are very beautiful.
Guests were invited to the Institute to hear my closing remarks and I gave a short summary of measurement assurance and the application of statistical quality control to automated measurements.
The training of a CEFREI metrology engineer at SIMCO for a period of four to six months was agreed pending a determination of requirement for an export licence. To date, I have not made the necessary inquiries.

The posibility of SIMCO reselling used test equipment was discussed but at this time no work has been done to gather further information.

Simco personell are presently working on a proposal requested during discussions to provide a complete SIMCO automatic meter calibration system or make alternate recommendations of state of the art equipment. This equipment also would be subject to export regulations, but I beleive there are special considerations for "NBS"type applications.

There were many additional request for specific data sheets and recommendations which I have not been able to fill but I have begun to request sales literature and do have some of the requested information collected.

The posibility of operating the CEPREI laboratory as a commercial manufacturing support service was mentioned. This is a major undertaking and I would recommend a carefull study of the logistical support that would have to be added. The service provided would reflect heavily on CEPREI credability and would be expected to be excellent in the three key elements of price, quality,/ and turnaround.

RECOMMENDATIONS AND CONCLUSIONS

No specific recommendations were made to the CEPREI management at the close of the seminar, but specific equipment such as the Keithley Instruments Model 181 Nanovolt meter and the Data Proof Model 160A Standard Cell Scanner were recommended to automate the volt programs at both CEPREI and NIM.

All of CEPREI measuring instruments are on a Three months recall interval for calibration. This is probably too frequent an interval for most of the equipment. I would recommend a program to selectively extend the intervals by three months when the instruments are shown to hold calibration for two successive intervals. This should not jeopardize the validity of the measurements providing the current crosschecks by test personell are continued. The use of inexpensive check standards is recommended and data from these test should be reviewed periodically.

Probably the most important recommendation is that the Institutes devise cooperative exchanges to begin an assesment of what level of correlation the individual labs have and if necessary they can begin to make improvements in precision and will have the measurement analysis capability in place.

I was impressed with the technical level and dedication of the CEPREI and NIM personal. They exhibit the true metrologist dedication to precision. I think they would also be able to make good contributions to such organizations as the National Conference of Standards Laboratories and the IEEE Instrumentation and Measurement Society. If it would be possible for a representative to attend some of these annual conferences I think they could bring back valuable information. If it is cost prohibitive to send a person for a one week seminar, perhaps some of the personal on assignment in the U.S. could be encouraged to attend these activities.

My general impression of the people of China is that all are working very hard and very successfully to make rapid advancement. The people generally seem happy in their work and work cooperatively.

APPENDIX A

ATTENDANCE

ELECTRONIC MEASURING EQUIPMENT
CALIBRATION AND METROLOGY
Attendance roster

DATE Mar 8, 84

NAME CHINESE	ENGLISH	
邢敏之	Xing Min Zi	广东省计量科学研究院 Research Guang Dong Beauro of INSTITUTE OF METROLOGY Machonge.
华伟	Hua Wei	[redacted] 成都宏明无线电器材厂 HenMing Factory of Radio materials Chengdu, Sichuan Province.

ELECTRONIC MEASURING EQUIPMENT
CALIBRATION AND METROLOGY
Attendance roster

DATE Mar 8, 84

NAME CHINESE	ENGLISH	
梁爱光	Liang Ai Kuang	Testing on semiconductor products in CEPREI
郑肆	Zheng Yi	

ELECTRONIC MEASURING EQUIPMENT
CALIBRATION AND METROLOGY
Attendance roster

NAME
CHINESE | ENGLISH | DATE MAR 8, 84

张振海	CHANG CHEN-HAI	G.P.O BOX 1411, CANTON, CHINA
李永才	Li Yuncai	北京仪器厂
黄文骑	Huang Wenqi	北京仪器厂
欧阳高宏	Kaa-Hong O'yang	(Shang Hai)
张荣斌	Zhang Rongbing 1413所	1413所 河北半导体研究所 Hebei Provincial Research Institute of Semiconductors

ELECTRONIC MEASURING EQUIPMENT
CALIBRATION AND METROLOGY
Attendance roster

NAME
CHINESE ENGLISH

DATE Mar 8, 84

刘群江 Liu Qun-jiang Engineer

Radio Lab. of NIM
(National Institute of Metrology)

杨增丰 Yiang Zeng-fong Engineer

Certification division of NIM.

刘令湘 Liu Ling-xiang Engineer

Electromagnetism Lab of NIM.

郑光 Zheng Guang

Liao Ning Institute of Metrology of Electronic Product.

(Shen Yang - [redacted] China)

ELECTRONIC MEASURING EQUIPMENT
CALIBRATION AND METROLOGY
Attendance roster

DATE Mar 8, 84

NAME CHINESE	ENGLISH	TYPE OF WORK
梁琼崇	Qiongchong Liang	Calibration in CEPREI
黄秉祺	Huang Bingqi	Measurement in CEPREI
许伟文	Xu Weiwen	Office of chief engineer CEPREI
张祥发	Zhang xiangfa	Testing in CEPREI
方初生	Fang Chusheng	Calibration in CEPREI (Metrologe)
裘 新	Qiu Xin	"
许乃栋	Xu Naidong	"
黄月秋	Huang Yueqiu	"
潘云华	Pan Yunhua	"
黄镛锋	Huang Yongfeng	"
马道容	Ma DaoRong	"
梁 平	Liang Ping	"
钟治平	Zhong Zhi Ping	"

APPENDIX B

DOCUMENTS SUPPLIED

CEPREI

SIMCO SALES AND TECHNICAL LITERATURE

1. Automated Calibrator Example
2. A Resistance Measurement Assurance Program With Computer Processed Histories, Roger Alcantara, NCSL Conference, 1982
3. Calibration Accuracy Assurance, A Computer-Managed Calibration System, Carl Quinn, NCSL Conference, 1980
4. The Commercial Calibration Laboratory Fulfilling Its' Responsibility, Carl Quinn DSAS/ASQC/PMA Seminar, 1983
5. Calibration Measurement Assurance, A Case For Automation, Roger Alcantara, Measurement Science Conference, 1981
6. Measurement Assurance Report For Fluke 5101A (Transparencies)
7. • Automated Calibrator Example (Transparency) (2)
   • NBS Least Square Analysis of Standard Cell Data (3) - Transparencies
8. Low Current Calibration Constant I/Current Divider Method
9. SIMCO Quality Assurance Manual for Lu-Chung-yu
10. SIMCO Sales Packets (5)
11. Slides - SIMCO Survey, Automated Calibration, Photos E. Stds & Rad

TECHNICAL PAPERS PRESENTED AT OPEN CONFERENCE (OTHER THAN SIMCO's)

1. "Tolerancing From A System Engineering Viewpoint", Nat'l. Conf. of Standard Labs, 1978 Workshop (Transparencies)

2. Overview of Measurement Assurance Program Services From NBS, Dr. Brian Belanger, 1983 (Transparencies)

3. Quality Verification of Personally Owned Measurement Hand Tools, Metrology Laboratory Memo, Rockwell Int.

4. Determine Frequency of Recall for Calibration, EMC Operation and Data Control, TRW (Pg. 16)

5. NBS Discussion Material for the Keynote Session, NCSL Region 7 Meeting

6. Measurement Standards and Calibration Services in Hong Kong, NCSL 1983 Workshop, Boulder, Colorado

7. Automatic In-Place Calibration in the Field, Lockheed

8. Calibration Interval Algorithms - Where are We?, Dennis Friday, NBS, NCSL 1983, Boulder, Colorado

9. Reliability Optimization for Calibration Intervals, Metrology Engineering Center, Pomona, CA, 1983

10. Metrology Laboratory Measurement Assurance, A Total Concept Program, D. R. Workman, 1981

11. Equipment Management Now And In The '80's, A. A. Strand, TRW, 1979

12. Reverse Resistance MAP Experiment, Arno Ehman, Beckman Instruments, NCSL 1983

13. An Interlaboratory Comparison Program For The Measurement Of AC Voltage, John Wehrmeyer, Eastman Kodak, NCSL 1983

14. 1984 IEEE Instrumentation & Measurement Technology Conference (2)

15. 7th Measurement Science Conf., CA State Univ., Long Beach 1977

16. 6th Cal Poly Measurement Science Conf., 1976

CEPREI

PUBLICATIONS - PERIODICALS - ARTICLES

1. Ad Hoc Committee on International Calibration Reciprocity-Proposed Terms of Reference, CQ '84
2. Tektronix Announcement of their Product Service Center in Peking, China
3. ASTM Standards InfoBriefs, 1983
4. NSCL, "Metrology & Calibration Systems Management"
5. Benefits of Calibration, F nk Elardo, Tektronix
6. National Bureau of Standards Approach To Quality, Dr. John Simpson, NBS
7. Quality Control, Gaining Recognition and Trust From Customers, 1984
8. "Key" - A Product And A Philosophy", Craig Walter, HP
9. Two PIND Shock Tests - Separate and Equal?, Jack Brown, B&W Engineering
10. Electrostatic Discharge Testing and Prevention
11. Western European Calibration Cooperation
12. International Certification for Electronic Components, Harvey S. Berman, Underwriters Laboratories
13. International Electrotechnical Commission Quality Assessment System for Electronic Components (IECQ)
14. NCSL Newsnotes - U.S. and China Labs Cooperating on Measurement Technology Modernization
15. The Gate - "SIMCO Ad and Accreditation Appeal Article"
16. World Industrial Standards Speedy Finder Handbook
17. Test & Measurement Work, Feb. 1984

CEPREI

U.S. PUBLICATIONS DEPT. OF COMMERCE

1. NVLAP News

2. NBS Special Publication 250, "Calibration and Related Measurement Services of the National Bureau of Standards, 1980 Edition

3. NBS Special Publication 260, NBS Standard Reference Materials Catalog, 1979-80 Edition

4. NBS Special Publication 250 - October 1982, Appendix Fees For Services, Calibration & Related Measurement Services

5. NBS Standard Reference Materials 1982-83 Price List

DRAFT STANDARDS

1. ISA, "Recommended Practice, Recommended Environments For Standards Laboratories", 1975

2. NCSL, "Evaluation Of Measurement Control Systems And Calibration Laboratories", 1979

3. ANSI, "American National Standard For Calibration Systems", Draft 2, Rev. 3, 1983

4. NATA, Rules, Memorandum Articles, Bylaws, 1981

OPEN ORGANIZATION LITERATURE

1. National Conference of Standards Laboratories

2. Precision Measurement Association