1973 NCSL CONFERENCE SCHEDULE
November 14-16, 1973

National Bureau of Standards
Gaithersburg, Maryland

Tuesday (Nov 13)
7:00 - 9:00 PM Meet the NCSL Officers Reception
Holiday Inn of Bethesda

Wednesday (Nov 14)
9:30 - 10:30 AM Welcoming Address
A. J. Woodington, General Chairman
Keynote Address
Dr. Richard W. Roberts, Director, NBS

10:30 - 1:00 PM Session 1: Measurement Assurance & Resource Application

1:00 - 2:00 PM Luncheon

2:00 - 5:00 PM Session 2: Regulatory Agencies and Their Impact on Product Testing

7:00 - 10:30 PM Reception and Award Banquet
Holiday Inn of Bethesda

Thursday (Nov 15)
9:30 - 1:00 PM Session 3: Test Equipment Utilization and Management

1:00 - 2:00 PM Luncheon

2:00 - 5:00 PM Session 4: Measurement Problems of the Small Laboratory

Friday (Nov 16)
9:30 - 1:00 PM Member Delegates Meeting

1:00 - 2:00 PM Luncheon

2:00 - 4:30 PM NBS Tours

Registration Fees:
- NCSL Members, prior to November 1: $35.00
- Non-Members, prior to November 1: $45.00
- NCSL Members, after November 1: $45.00
- Non-Members, after November 1: $55.00
Thanks to everyone who helped make this a memorable year for NCSL. The fifteen meetings held in different regions of the country kept things going at a good pace. The two hundred attendees at these NCSL meetings went home with new ideas and, in many instances, new friends. Those who gave...received.

Thanks to the Board of Directors. You can be proud of your accomplishments in 1973. The members have received many benefits this year...a one year subscription to the "N.B.S. Current Awareness Service," the "1972 Joint Measurement Conference Proceedings," and a continuing subscription to the new "Journal of Applied Measurements" (co-sponsored by the NCSL). The new video-tape training library and the book review and discount purchasing programs have been initiated and should prove to be valuable programs for our membership.

I would like to express my appreciation to Joe Cameron, our Sponsor's Delegate. He has continued to be an inspiration to many members and has helped to keep NCSL on track.

Also, I want to acknowledge Kay Etzler, our Secretariat, for her outstanding services in 1973.

A special thanks to Mike Suraci, our Newsletter Editor. Mike has really made the Newsletter a best seller.

I also want to recognize Jim Seed for his outstanding contributions to the NCSL while conducting his National Measurement System Study.

My special personal thanks to my secretary, Polly Beckham, who has a special knack of transforming work into fun.

I felt it a privilege to have been given the opportunity to be a part of this team.

Best wishes for continued success to you and your new President, Don Greb.

P.S. Don't miss the National Conference in November. Let's make it the best attended and most productive conference ever.
On Wednesday, September 19, 1973, I visited the National Bureau of Standards and had a chance to interview the Bureau's dynamic new Director, Dr. Richard W. Roberts. Prior to the interview, Ralph J. Barra, NCSL President; Joseph M. Cameron, NCSL Sponsor's Delegate; and Dr. James R. Seed, Chairman of the National Measurement System Study met with Dr. Roberts and discussed plans for his Welcoming Address to be presented at the NCSL 1973 Conference in November. Dr. Roberts enthusiastically spoke of his interest in participating at the Conference activities and meeting with the member delegates. The new NBS Director was impressed with the high caliber program and expressed his desire that the Conference be successful.

Left to right: Joseph M. Cameron, Ralph J. Barra, Dr. Richard W. Roberts, Mike Suraci, and Dr. James R. Seed

A condensation of our interview follows:

MS: Dr. Roberts, what prompted your decision to come to NBS from a successful industrial career at General Electric?

RWR: I came because I believe the National Bureau of Standards is the best diversified laboratory in the world. The Bureau has a major role to play in addressing many of the challenges that now face society. People tend to blame many of our current problems on technology. That just isn't true, but it is true that technology can help solve many of our problems. NBS has a great tradition, an extremely fine staff, and great facilities, and I welcome the challenge of helping to apply these resources to the solution of national problems.
INTERVIEW - continued

MS: Does that mean you view NBS programs as impacting the missions of the other Federal agencies?

RWR: Very much so. We are developing methods of measuring air pollutants, such as SO2 that the Environmental Protection Agency (EPA) can use; we are working closely with Housing and Urban Development (HUD) and General Services Administration (GSA) on energy conservation; and we will provide technical support to the new Product Safety Commission in such areas as toy safety and flammable fabrics.

MS: Many of these programs are removed from the more traditional NBS role of basic measurements. Any conflict there?

RWR: Not really. NBS is still deeply involved in fundamental metrology, in fact more deeply than ever, as we try to develop laser wavelength standards and an absolute basis for mass. From this basic measurement competence, and from the need of the nation for technological solutions to complex problems, come our extensive activities in technology transfer.

MS: You've been at NBS now for seven months, long enough to get a handle on the place and its programs. What significant changes do you see ahead?

RWR: No major shake-ups. I see an evolution of our program as new challenges are identified and we respond to meet them. Practical matters, such as funding level, will probably preclude any major growth in activities, and we will try to keep a balance between fundamental research and applied technology. NBS is a unique organization, one with an extremely diverse range of competences, and we need to maximize the impact of our limited resources on a practically unlimited range of concerns. That's my major goal.

MS: Over the years NBS has cooperated with industry in a variety of ways. How do you view such interaction?

RWR: As most important. If anything, we are working with industry more closely than ever. Our calibration services and standard reference materials provide a direct measurement link between the national standards and the labs and work benches of industry. Our Research Associate Program, in which industry places a person at NBS for a year or more to work on mutual problems, is going strong, with over 50 associates at NBS right now. Guest workers from industry often come in
INTERVIEW - continued

on a less formal basis to use special facilities, we hold conferences and workshops to increase our interactions, and we serve on, with counterparts from industry, hundreds of standards committees. I encourage and welcome industrial contacts, as serving industry has been and will continue to be one of our reasons for existence.

MS: What about interaction with NCSL?

RWR: Again, most important, NBS supported the organization when it was formed, and we support it today. Our function as Secretariat keeps us in touch with the needs and problems of a large segment of the measurement community. And it's a two-way street. NCSL members have helped tremendously in Jim Seed's study of the National Measurement System, and NCSL members have played an important role in helping us develop the Measurement Assurance Program. I look forward to extending such interactions at the Conference here at Gaithersburg in November, and hope to meet many members and Delegates at that time.
Committee 3A - Calibration Systems Management Committee

Chairman: Laurel Auxier of Beckman Instruments, Fullerton, California

The subcommittee to draft the Region 13 Position Paper on Feedback of out-of-tolerance data, headed by Rolf Schumacher of Autonetics, Region 13 Coordinator, has met to discuss the comments received concerning the proposed draft of the Position Paper presented at the May 1973 Region 13 NCSL Meeting. The draft was changed as deemed appropriate by the subcommittee; it will be submitted to the NCSL Board of Directors with a recommendation for NCSL-wide coordination.

Committee 3B - Measurement Assurance Committee

Chairman: Mike Suraci of Lockheed Electronics Company, Inc., Houston, Texas

Approximately 10 laboratories answered the "LAST CALL" for participants issued in the August 1973 issue of the Newsletter. The routing schedule for the interlaboratory intercomparison utilizing digital voltmeters and zener transport voltage standards is being set up. Mr. Norman Belecki of NBS in Gaithersburg, Maryland will act as the focal point for this round-robin. A tentative start date of December 1, 1973 is presently on target.

Committee 3C - Product Measurability Committee

Chairman: Rolf B.F. Schumacher of Autonetics, Anaheim, California

The committee has collected sample case studies of the beneficial effects of measurement awareness within manufacturing organizations. The samples are being analyzed and will serve to determine future committee action when the committee convenes at TRW Systems Group, Redondo Beach, on October 9, 1973.

Automatic Diagnostic Test Equipment Subcommittee

Chairman: Larry S. Kreyer of Science Application, Inc., Santa Barbara, California

This subcommittee has been inactive for the past few weeks because of the resignation of the past chairman, Ronald Caneveri of Telephone Systems Co. Larry Kreyer has assumed the chairmanship and will convene the subcommittee before October 31, 1973 to determine future committee action.
The seventh meeting of delegates and other interested parties for NCSL Region 3 was held at ITT-Avionics Division, Nutley, New Jersey, on Thursday, September 13, 1973.

Region 3 has met as follows:

- October 21, 1971: RCA, Moorestown, N.J.
- January 13, 1972: Lockheed Electronics, Plainfield, N.J.
- January 11, 1973: Bendix Corp., Teterboro, N.J.
- September 13, 1973: ITT-Avionics Division, Nutley, N.J.

The announced agenda for the meeting was:

- a. Report on NCSL Board of Directors Meeting
- b. Results of Region 3 Measurement Assurance Programs (M.A.P.)
- c. Discussion of M.A.P. at production level
- d. Future M.A.P. plans
- e. Surface Finish Measurements - Guest speaker: Dr. Francis T. Farago

NCSL Board Delegate Moe Corrigan reported on the NCSL Board of Directors Meeting held at the Newark Air Force Station, Ohio on May 17 & 18, 1973. The following are the highlights of his report:

Ralph Barra, NCSL President, is looking for volunteers to support the book review committee who will review and recommend books of interest to NCSL delegates and also arrange for possible discounts.

Video training tapes are available on a schedule basis. These tapes cover theory, troubleshooting and calibration. For further information, contact Moe Corrigan.

Only 60 NCSL member organizations have responded to Dr. Seed's National Measurement System Study to date. Inputs are still being accepted.

Moe Corrigan was particularly impressed with the excellent work storage facilities at the Aerospace Guidance and Metrology Center and also with the various calibration standards setups.

Moe also reported that Ralph Barra is "doing a fine job."

NBS Electromagnetic Current Awareness Service: It was pointed out that the free distribution of the Current Awareness to NCSL member delegates will be discontinued at the end of the year. At Jim Dock's suggestion, Moe Corrigan will recommend to the Board of Directors that each Region sponsor a group subscription for its respective members.
Measurement Assurance Program: Bob Verity and Joe Gyurian distributed respectively the results in chart form and the final report. Seventeen laboratories joined in the measurement round-robin, and the results indicated that the measurement techniques of each participant were in agreement with the other participants. Joe Cameron complimented Region 3 on the organization, conduct and the results of the measurement program.

Individual comments by each participating laboratory are to be sent to Bob and Joe before October 15 to be published in time for the National Conference of Standards Laboratories to be held in November.

Joe Cameron discussed the merits of a measurement assurance program and indicated the system should be periodically pulsed to ascertain if the measurement accuracy is being continued. Also, that this follow-through be carried at production or below standard laboratory level.

Jim Dock distributed a form which he employs at Bendix to check production measurement accuracy at Bendix.

Joe Cameron's remarks initiated a workshop type discussion by the attendees on measurement follow-through.

An informative and interesting talk on surface finish measurement was given by Dr. Francis Farago of Rank Precision Instruments.

NATIONAL MEASUREMENT SYSTEM STUDY

As you know, NBS is conducting a comprehensive evaluation of the National Measurement System. We are trying to understand the scope, economic dimensions, infrastructure, communication channels and impact of measurement throughout the United States. To accomplish this objective, we are attacking the "system" from many different directions:

1. We are looking at measurement labor and equipment to ascertain what percentage of the GNP it represents. Just how many dollars are spent each year in the United States on measurements?

2. We have asked NCSL member laboratories to define their own infrastructure and economic dimensions. Over 50 member laboratories have cooperated and we extend our appreciation to NCSL.

3. We have initiated 23 micro studies in which we take basic and derived units of measurement and trace their structure and application throughout the measurement system.

A technological assessment of gas and liquid flow measurements; excluding cryogenics, is being conducted by the Mechanics Division of NBS. This study, under the leadership of P. R. Compton, identifies the fluid flow measurement system as an important component of the overall National Measurement System. Pertinent fluid flow work at NBS is directed by P. S. Klebanoff, Chief of the Aerodynamics Section; F. W. Ruegg, Chief of the Fluid Meter Section; and G. Kulin, Chief of the Hydraulics Section.

Mr. Compton obtained his B.S. from Virginia Polytechnic Institute and his M.S. in aeronautical engineering from Georgia Institute of Technology. He has held management positions with Douglas Aircraft; the Aeronautics Division, Philco Corp., Ford Motor Co.; and Lockheed. He has been particularly active in operations research, long-range planning, and program development both in private industry and for the National Bureau of Standards. He brings to this evaluation of the National Measurement System pertinent experience within the private enterprise components of the NMS.

Mr. Philip R. Compton, NBS

A description is being prepared of the interrelationships that exist within and between the identifiable parts of the fluid flow measurement system. The approach of this study is to gather pertinent information
NATIONAL MEASUREMENT SYSTEM STUDY - continued

from contacts throughout the system and, recently, more than 200 contacts have been made including trade associations, government (Federal, State and local) agencies, private companies, universities and laboratories. The contacts are in the form of letters, telephone conversations and visits, all directed to learning the interests, views and contributions of persons engaged in conducting fluid flow measurements and closely related business activities.

A data base is being developed which will be helpful in recognizing major trends of future applications of fluid flow measuring devices. This data will also be useful in identifying and understanding major problems of measurement. The study will in turn develop recommendations of actions to be taken for improving the national measurement system of fluid flow particularly in liquid and gas metering, air flow, and the flow of supply and waste water. Information gathered to date is organized to highlight the following general subjects pertinent to fluid flow measurement:

1. structure of the national system;
2. capabilities and services of calibration and standards laboratories;
3. needs of fluid flow measurement in the field;
4. nature and trends of the U.S. domestic and export-import business in measurement instruments;
5. state-of-the-art changes and technological advancements;
6. and consistency of measurements.

The structure of the fluid flow measurement system is viewed presently as having more than one branch. The several branches interconnect and interact in various ways -- sometimes strongly and sometimes weakly. Correspondingly the involvement of NBS within the system varies widely. The diagram is one representation of this infrastructure within which actions and activities of measurement take place. Reading from top to bottom of the diagram, the system is shown in terms of seven major interconnected branches of fluid flow measurement:

1. Fundamental Units, Types of Fluids and Units of Measurement;
2. Reference Measurements;
3. Transfer of Measurement Capability;
4. Measurement Outputs;
5. Measurement Use;
6. Measurement Users; and
7. National Concerns Influencing and Benefiting from Measurement.
Numerous laboratories are engaged in the flow measurement of gases and liquids. The capabilities, facilities and range of services of recognized calibrations and standards laboratories are being identified; further, the study includes a comprehensive analysis of participation by these laboratories within the infrastructure of the flow measurement system.

In practice the national concerns that both influence and benefit directly from better fluid flow measurements include the development and effective utilization of energy, improvement of the quality of our environment, occupational safety and health, and equity in the exchange of goods. Needs of fluid flow measurement in the field have their origin in these national concerns. The needs identified to date include reducing the uncertainties in values of discharge coefficients for orifice meters; evaluating verified data on the performance and physical characteristics of critical flow nozzles; and providing new flow standards, preparing recommended practices, and evaluating and developing instrumentation for the measurement of low velocities and unsteady flows in air and low velocities in supply and waste water.

Information gathered for the study indicates a trend of U.S. domestic business in which total sales dollars are increasing annually for fluid flow measurement equipment. The annual volume continues to grow with mounting demands for increased accuracy and related sophistication of equipment. Further, the information indicates that in earlier testimony before the Congress, the manufacturers of scientific instruments testified in part that about 25 percent of the annual value of flow meters and flow instrumentation sold by the industry are sold abroad. The industry believes that export sales of flow meters and flow instrumentation exceed imports by more than 4 to 1, and they are the leverage for export sales of information and control systems valued at twice to three times the flow measurement products.

State-of-the-art changes and technological advancements are presently viewed to include both the more traditional instrument designs with improvements and numerous new designs that are finding applications in fluid flow measurement. The cost is rising generally to flow a unit of fluid. This trend is forcing greater investments to be made in both increased accuracy and the managing and controlling of fluid flow. Primary metering devices are becoming increasingly sophisticated. Information gathered to date indicates their basic accuracy of measurement is the cutting edge of improvements in the state-of-the-art and advancements of technologies of measurement of fluid flow.

It is clear that the implementation of new regulatory standards will increase the requirements for consistent and reliable measurements of
NATIONAL MEASUREMENT SYSTEM STUDY - continued

those fluid flow quantities that cannot be measured adequately today. These new regulations arise from the --

- Federal Coal Mine Health and Safety Act of 1969,
- Federal Standard No. 209a for Clean Room and Work Station Requirements,
- National Environmental Policy Act of 1969,
- Occupational Safety and Health Act of 1970,
- Water Pollution Control Act of 1972 and others.

The technology assessment of the national fluid flow measurement system has identified many attributes that can be used to quantify this system. For example, over 350,000 orifice meters are estimated to be in use within the gas and oil industries alone and it is believed that at least 1,000,000 orifice meters are used in the U.S. to measure flows of liquid and gas in commercial, industrial and scientific applications.

Minimum levels of air flow rates required in mine safety, industrial ventilation and indoor circulation of ventilating air involve a broad area of applications in field measurements stemming from regulatory requirements. Measurements of air flow rates also include applications to ascertain the effect of wind loadings on structures and buildings in an environment of variable winds, the gathering of climatological and weather data, and the measuring of atmospheric turbulence and transport properties in the assessing of distribution and effects of pollution associated with determinations of air quality.

This study has identified several interesting aspects of supply and waste water flow. For example, it is estimated that the electric power industry uses 40 percent of all water used in this country. This amounted to 40 trillion gallons of cooling water required by the electric power generating plants alone in 1964. These enormous quantities of water raise serious problems of flow measurement in selecting power plant sites, estimating their environmental impacts and monitoring the effects during operation. An example has come to our attention of the economic incentive for accurate measurement of sewage plant effluents. A particular plant is limited by its State regulatory agency to flows of 18 million gallons per day. The measurement of efflux is considered to be accurate to 5 percent, or an uncertainty of 0.9 million gallons per day of flow. Based on a use per housing unit of 400 gallons per day of sewage water, there are approximately 2250 housing units in this uncertainty area.
NATIONAL FLUID FLOW MEASUREMENT SYSTEM

Mass (M), Length (L), Time (t) and Temperature (T)

Liquids and Gases

Flow Rates (M/t and L^3/t) and Velocity (L/t)

Government, Industry and Education Institution Laboratory Calibrations

Consultations, assistance in experimental work, requests for services, publications, conferences, symposia, standards committees, evaluation panels

Legal and Regulatory Requirements

New Measurement Methods and Techniques; and Evaluate New Instruments

Government, Industry and Education Institution Laboratory Calibrations

Evaluation of Verifiable Data

Transfer Reference Instruments

Monitoring of Measurements

Flow Reference

Government

Industries

Education Institutions

National concerns: energy conservation, quality of environment, occupational safety and health, and equity in exchange of goods
RALPH BARRA ASSIGNED TO ETIP AT NBS

Our NCSL President has been selected to participate in a Federal program designed to share managerial talent, ideas, and experiences between business and government. Ralph J. Barra, Westinghouse Electric Corporation's Manager of Product Qualification Laboratory is one of 45 business people entering a year's service in government through the President's Executive Interchange Program. Mr. Barra is assigned to the Department of Commerce where he will work on the Experimental Technology Incentives Program (ETIP) of the National Bureau of Standards. ETIP is part of the President's continuing effort to have the Federal Government work as a more effective partner with the private sector in development and application of science and technology to strengthen the nation's economy and improve the quality of life.

Now in its fourth year of operation, the President's Executive Interchange Program places executives from the ranks of middle management in challenging positions throughout the Federal Government, while outstanding government executives are assigned to responsible positions in private industry.

President's Commission on Personnel Interchange Executive Director, Jay I. Leanse, described the selection process as "rigorous." He said that the candidate must be nominated by the chief operating officer of the corporation or firm, on the basis of a proven record of leadership and managerial ability and a history of professional accomplishment. The executive must then compete for available positions throughout the Federal Government and be willing to transfer his skills and talents to the specific government job for a one-year period.

Participants in this year's program come from every geographical area of the country. The executives return to their company or Federal Government agencies when they complete their one-year assignment.
Electronic test and measuring instruments may be classified in several groups separated by factors such as price, performance, systems features, appearance, and general construction. Recently, there has been the emergence of a low-cost group where prices average less than $500. These instruments must provide the same quality and equal or greater reliability than that found in products costing many times more. Obviously these must be ensured with miniscule test costs. Similarly, there is polarization around the high-cost "smart" or systems instruments.

Early in the development cycle of any new instrument, a unique test philosophy is adopted which relates to the particular product and its selling price. The key points of the philosophy may include:

1. Determination of the worth of the test function.
2. Establishment of test time goals.
3. Design for automatic testing.
4. Establishment of an organizational structure that optimizes the engineering-manufacturing interface.

This philosophy, once established, guides the development of manufacturing methods and product test procedures. For example, it has been successful in reducing the number of calibration adjustments of a synthesizer product line. Where units once had 175 adjustments, they now have less than 10. New instrument trends will place additional burdens on the test and measurement assurance functions, since customers are buying more accurate instruments and calibrating to long-term specs to extend calibration intervals.

Features such as self-calibration and automatic error correction previously found only in expensive automated systems, will be incorporated in future modular instruments. These will reduce the test and calibration burden while improving measurement assurance at the user level.
ABSTRACTS - continued

2. "SUCCESSFUL MEASUREMENT ASSURANCE PROGRAMS -- THE MANAGEMENT CHALLENGE"

Dean R. Brungart
Manager, Metrology
Teledyne Systems Company
Northridge, California

ABSTRACT

From the beginning of the measurement history, metrologists have engaged in a never ending effort to improve our basic units of measure. Industrial standards laboratories have similarly strived towards improving their capability by improving the standard instrumentation.

Then in the late fifties and early sixties, the emphasis shifted to programs or systems. Military specifications tightened up on the recall and records of calibration, and generally the emphasis was to ensure that every measuring device was included in the system.

Now, we are embarking on a new era. The advent of computer technology, increased instrumentation sophistication, the consumer protection emphasis, the metric conversion, etc., greatly expands the metrologist role.

At the same time, we are in an economic pinch. Many of us are working to fixed price contracts which means an emphasis on lower costs.

The management challenge thus becomes creating a successful and economical measurement assurance program.

3. "DIMENSIONAL MEASUREMENT ASSURANCE PRACTICES -- AN AVENUE TO EFFECTIVE PRODUCT CONFORMANCE"

Jack A. Hall
Sr. Metrology Engineer
Autonetics Division
Rockwell International
Anaheim, California

ABSTRACT

Measurement Assurance Programs (MAP's) are perhaps considered by many to be complex statistical schemes involving computerized data processing. They are effective for reference level measurement standards, primarily in cases where the highest order of accuracy is sought. Actually, MAP's applied at the product level are surprisingly simple and cost effective.

Autonetics, a Division of Rockwell International Corporation, has a broad application for measurement assurance practices which are managed by the Metrology Laboratory. This practice is now considered no less than a healthy way of life to achieve product conformance.
ABSTRACTS - continued

Practical examples of measurement methods employed to control critical dimensions on navigation system components are demonstrated. A unique MAP for controlling personally-owned measuring tools of employees within company premises is described. This method makes use of a special verification gage nicknamed "Pretzel" and has proven successful in achieving measurement assurance in utilization of these tools to shop areas as well as calibration control.

The discussion demonstrates the role of the standards laboratory and the value of its direct involvement at the product level to achieve cost effective measurement assurance.

SECOND SESSION: REGULATORY AGENCIES AND THEIR IMPACT ON PRODUCT TESTING

Developer: Theodore R. Young
Chairman, Physical Science Administration
Certification and Testing Lab
Institute of Applied Technology
National Bureau of Standards
Washington, D.C.

1. "PRODUCT TESTING AND CERTIFICATION FOR CONSUMER SAFETY"

John W. Locke
Executive Director
Consumer Product Safety Commission
Washington, D.C.

ABSTRACT

The new Consumer Product Safety Act requires that "every manufacturer of a product which is subject to a consumer product safety standard...shall issue a certificate which shall certify that such product conforms to all applicable standards and shall specify any standard which is applicable." This requirement means that every manufacturer must have the capability either in his own laboratory or in a contract laboratory to test his product according to the standard. Various kinds of tests are implied, including mechanical, electrical, flame, chemical, and in some instances, biological. Test procedures must be formal. Records are essential.

The Consumer Product Safety Commission "may by rule, prescribe reasonable testing programs for consumer products..." Labeling requirements under the Act are specific. Broadly interpreted, the Act may even authorize laboratory certification by the Commission. Past experience under the Hazardous Substances Act indicates that such certification would be desirable.

In any event, the Act clearly states that product certification is the manufacturer's responsibility, and a failure to supply such certification is a prohibited act subject to civil penalties of $2,000 for each such violation.
ABSTRACTS - continued

2. "APPROVAL OF PRODUCTS FOR OCCUPATIONAL USE"

Sil Patti
Chief, Electrical, Electronic Technical Branch
Safety and Health Administration
Department of Labor
Washington, D.C.

ABSTRACT

Product categories requiring testing and approval to meet occupational safety standards are identified. The basis for establishing product approval requirements is presented and the alternative acceptable approaches to product approval are discussed. The methods that Occupational Safety and Health Act (OSHA) will use to assure adequate implementation of product testing and approval requirements are described.

3. "NATIONAL TESTING LABORATORY EVALUATION SERVICE"

Theodore R. Young
Chairman, Physical Science Administration
Certification and Testing Lab
Institute of Applied Technology
National Bureau of Standards
Washington, D.C.

ABSTRACT

Government agencies, manufacturers, distributors and consumers seek increasing assurance that products conform to designated standards, such as those related to safety, health, quality assurance, and reciprocal trade. Product certification programs requiring use of approved testing laboratories are on-going functions of Federal, State and local governments, and of national and international organizations within the quasi-public sector. The need for qualified test laboratories is broad in scope, both in terms of constituency to be served and product testing to be covered.

This presentation describes fundamental concepts for a National Testing Laboratory Evaluation Service which has been proposed to serve as a national focus of laboratory evaluation and accreditation efforts.

THIRD SESSION: TEST EQUIPMENT UTILIZATION AND MANAGEMENT

Developer: D. R. Townsend
Lockheed Missiles & Space Company, Inc.
Sunnyvale, California
ABSTRACTS - continued

1. "THE INSTRUMENT POOL CONCEPT AT LOCKHEED MISSILES & SPACE COMPANY, INC."

D. R. Townsend
Manager, Standard Tool & Instrument Control
Lockheed Missiles & Space Co., Inc.
Sunnyvale, California

ABSTRACT
This presentation will trace the history of an inventory control system established at Lockheed Missiles & Space Company, Inc. to curtail a rapidly growing test instrument inventory. The effectiveness of the systems implemented will be demonstrated through data showing inventory reduced by 50% over a six year period and issue rates increasing from 56% to over 82%.

2. "MANAGEMENT OF CURRENT INVENTORY AT MARTIN MARIETTA, ORLANDO DIVISION"

J. Albert Roy
Manager, Technical Facilities
Martin Marietta Corporation
Orlando Division
Orlando, Florida

ABSTRACT
A system will be described for the planning and control of a reasonably large inventory (12,000 pieces) of portable electronic test equipment. The description begins with the planning procedures and techniques, acquisition and identification control, acceptance testing and calibration and assignment procedures and controls. The very significant equipment utilization measurement program which is a key feature of the overall system will be discussed in detail. Methods of measuring the effectiveness of the system will also be presented.

3. "A DOWNSTREAM LOOK AT TEST EQUIPMENT MANAGEMENT -- WHAT THE FUTURE HOLDS"

Phillip T. Chase
President, Property Management Systems
Pacific Palisades, California

ABSTRACT
The evolution of the test equipment management function in the technology organization historically goes through three phases: (1) Discovery, (2) Gimmick, and (3) System.
New management tools introduced within the last five years which will enjoy widespread application in the next five years include: (1) On-line locator systems, (2) Computer-based performance characteristics reporting systems; and (3) Practical utilization measurement and reporting systems. The wider use of such tools—which are becoming increasingly cost-effective—will be accompanied by a gradual improvement in the integration of long range equipment planning systems, equipment management organizations, and more flexible and accessible resource management data bases.

FOURTH SESSION: MEASUREMENT PROBLEMS OF THE SMALL LABORATORY

Developer: Saul Alford
Argonne National Laboratory
Argonne, Illinois

1. "ASSISTANCE AVAILABLE FROM A TEST EQUIPMENT MANUFACTURER"

John L. Minck
Program Manager, Instrument Calibration Systems
Hewlett Packard Company
Sunnyvale, California

ABSTRACT

The manager of a small calibration lab faces an overwhelming task planning the mid-70's. He needs all the help he can get. Instrument manufacturers can help in three basic areas: better instruments, better training, and better support.

Instrument design will be examined for advances in reliability, complexity vs. diagnosability, serviceability. Instrument and measurement training techniques in various areas of fundamentals, instrument, and applications can help. New support programs dealing with documentation, board exchange, parts, manuals, etc. will be presented.

2. "OPERATION OF AN INDIVIDUAL CALIBRATION ACTIVITY"

R. A. Wilcox
Manager, Standards Laboratory
Mason-Hanger
Burlington, Iowa

ABSTRACT

A discussion of some of the solutions to measurement problems used by a small Metrology Laboratory in support of a production line.
ABSTRACTS - continued

3. "OPERATION OF AN EDUCATIONAL RESEARCH CALIBRATION ACTIVITY"
Arthur R. Vogt
Manager, Instrument Services Group
IIT Research Institute
Chicago, Illinois

ABSTRACT
Illinois Institute of Technology Research Institute (IITRI) is a large, not for profit, contract research and development organization whose work encompasses nearly all the physical and biological sciences.

The Instrument Services Group at IITRI offers participating divisions a complete equipment management program. Its purpose is to calibrate, maintain and supply instruments from an extensive instrument loan pool; give advice as to how various equipment is to be used and in general be of service where instruments are concerned. High accuracy calibration services are also provided to industry when it is not available from other organizations in the area. An attempt will be made to show how IITRI solves the unique problems that escape Pandora's Box.

4. "A COMMERCIAL CALIBRATION SERVICE"
John J. Lee
Branch Manager
Honeywell Metrology Services
Springfield, Virginia

ABSTRACT
The problems of the small commercial laboratory are manifold. While required to provide reliable and accurate measurement and calibration services, it must also produce an adequate return on investment capital. As a result, operating conditions cannot always be optimized. The speaker will deal with measurement problems, and their economically feasible solutions experienced and developed by the small commercial laboratory.

FAIRY TALE OR REALITY - CONTINUED FROM PAGE 29
The cloud of METRICATION quite definitely has a silver lining and the change to metric does not produce the mass confusion in factory operations that some people predict. Where the changeover has actually taken place, experience has shown that it was substantially easier than anticipated, especially when the decision is firm and resistance to change no longer has any opportunity to be effective.

A METRIC America is just around the corner and, when it is here, we will all look back in amazement and wonder why it took so long.
Shorty after MSFC was established in July 1960, each major organization initiated limited calibration programs. These efforts were hardly recognizable as entities since they were tailored to service the particular function of the parent organization. For example, electrical/electronic measurements were emphasized in the Guidance and Control Division while the Mechanical Engineering Division gave attention to mechanical measurements.

By the end of 1966, through a series of consolidations, mergers, and organizational changes, a centralized Metrology program evolved. This central effort is now a part of the Quality and Reliability Assurance Laboratory and is primarily quantity/quality oriented. Toward this end the Laboratory interfaces with some 150 contacts (programs and projects) in providing current services and anticipating future requirements. The Laboratory takes pride in its ability to annually process approximately 26,000 instruments, including calibration/certification, repair, modifications, pickup and delivery, and parts acquisition. Current staffing includes 4 engineers, 23 technicians, and 4 logistic/administrative personnel.

The MSFC standards, capabilities, environments, and skills are not uncommon to those found in other standards and calibration laboratories. The temperature of the dimensional area is controlled to 68°F ± 1°F with the rest of the facility controlled to 73°F ± 2°F. Relative humidity is 50 percent or less. Skills and equipment associated with the following parameters are available:

- Capacitance
- Temperature
- Attenuation
- Resistance
- Inductance
- Frequency
- Vibration
- Acoustics
- Roundness
- Pressure
- Humidity
- Hardness
- Flatness
- Surface
- Voltage
- Current
- Vacuum
- Torque
- Angles
- Length
- Optics
- Phase
- Power
- Noise
- Shock
- Force
- Mass

Other features include an isolation pad to accommodate ultrasensitive electronic standards, an RFI screen room, an acoustically isolated area for vibration measurements, and a 10-foot by 12-foot isolation pad for optical work. The corollary activities associated with a Metrology program, such as technique and procedure development, statistical and accuracy studies, and equipment acceptance and evaluation are also attended.

The Laboratory is considered to be a service organization and is frequently called upon for direct assistance or consultation in special or unique measurement situations. Metrology expertise has been rendered in measurement problems such as the following:

- * Weight verification of the Skylab solar sail *
- * Neutral buoyancy simulator instrumentation *
- * Rectifying antenna to receive solar energy *
- * Skylab communications *
- * S-IVB bearing and race wear *
- * Quartz crystal microbalance sensors *
- * Rate gyro weight verification *
- * High temperature metallograph *
- * Space Shuttle launch deflector acoustics *
- * Solar sail tensile strength *
- * Evoked cortical response test set *
- * Gun barrel
length/velocity of plasma particles * Earth resource drill * Freeing materials of electrostatic charges * Solar cell modules * Three millimeter solar astronomy facility

Space consideration prohibits elaborating on each of these problems. However, one of note is an automatic resistor probing and trimming apparatus in which laser techniques are used to trim microresistors to desired programmed values. Metrology personnel became involved in determining the accuracy, by use of resistance standards, of the internal resistance bridge. These measurements indicated marginal accuracy in the bridge. With this information engineers could compensate for the condition. At the time the bridge became suspect, the device was being used to evaluate an "Evoked Cortical Response Test Set." This system consists of a helmet fitted with microminiature circuits and components. The object being to monitor brain waves through electroencephalograph (EEG) techniques to determine hearing loss.

The MSFC Metrology and Calibration Laboratory participated in the six Apollo round-robin measurement audit packages which consisted of mass, length, voltage, resistance, attenuation, and capacitance. Results were well within the specified tolerances. The Laboratory is also participating in the NCSL round-robin audit packages.

The Editor would like to thank Dieter Grau and Gene Carpenter of the NASA Marshall Space Flight Center Quality and Reliability Assurance Laboratory in Huntsville, Alabama for this fine story on their laboratory.
MSFC METROLOGY AND CALIBRATION LABORATORY
PHOTOGRAPHS

HIGH PRESSURE LABORATORY
DIMENSIONAL STANDARDS LABORATORY

MICROWAVE LABORATORY
ELECTRICAL STANDARDS LABORATORY

VACUUM & LOW PRESSURE LABORATORY
EQUIPMENT RECEIVING AREA
CALIBRATION ON THE BASIS OF INSTRUMENT USAGE

BACKGROUND

The idea of calibrating measuring and test equipment at intervals defined by hours of usage rather than at intervals defined by calendar time has been around ever since periodic calibration began. The theory behind the idea is convincing since usage, rather than calendar time, would seem to be a better indicator of when a piece of equipment should be serviced.

Pressure for usage calibration generally comes from two sources. Since calibration in most companies is an overhead cost subject to considerable scrutiny, usage calibration is often looked at as a way to effect huge reductions in cost. The other source is the manufacturers of run-time-meters and other usage measuring devices who are interested in selling their products.

Calibration by usage has been considered several times but never implemented. In spite of what is published in the literature and the good things you can read in run-time-meter advertisements, there is no practical evidence which leads to the conclusion that usage calibration is either better or cheaper than calendar time calibration. There seems to be three reasons for this situation:

1. Except for the theory itself, information needed for intelligent usage calibration is almost totally lacking and would be very expensive to generate.
2. The disadvantages and problems are many and very well-known.
3. In some measure at least, calendar time calibration is usage calibration.

UNKNOWN ELEMENTS

Although there has been and probably will continue to be much discussion and promotion of calibration on the basis of usage, the amount of such calibration being done is almost negligible. Thus the information required for intelligent usage calibration, relation between hours of usage and in-tolerance condition, is not being generated. Even instrument manufacturers seem to have little if any information of this type. Generating such information is a slow, expensive process exposed to many sources of error and, even if good information were available on certain instruments, it is not easily extrapolated and applied to others.

Even the theory itself is open to some question since there is no strong evidence that instruments, especially solid state devices, deteriorate in normal usage. Exceptions, of course, are mechanical wear areas and battery-powered instruments.

DISADVANTAGES AND PROBLEMS

The problems inherent in usage calibration per se plus the problems in partially or completely changing systems are very formidable:

1. By far the biggest problem is in defining and measuring usage itself. There are several kinds of usage measuring devices and
there is an endless number of ways to tamper with them. Some
measure pure "ON" time; some measure actual usage by an operator.
As we have found in the run-time-meter program administered by
Property Accounting, even defining what constitutes utilization
can be very difficult.

2. Many types of equipment do not lend themselves to measurement
of usage and administration of a dual calendar time/usage system
would be miserable from our standpoint and almost certainly unac-
ceptable to the customers. Items which are difficult or impossible
to measure usage on are pressure and temperature gages, flow meters,
mechanical and optical devices, RF equipment, transducers, weights,
balances and scales, and many more.

3. Procurement, installation, and monitoring of usage measuring
devices is itself expensive and fraught with difficulties.

CALENDAR TIME CALIBRATION

Calendar time calibration indirectly takes instrument usage into account in two
ways. First, calendar time is in fact a measure of usage since the longer an
item of equipment is available the more usage it is likely to get. Admittedly,
correlation between calendar time and physical usage will vary from extremely
good to extremely poor. However, there is no denying the fact that calendar
time is some measure of usage and, considering the difficulties with utilization
measuring devices, perhaps it is a better measure than we think. Even in places
where utilization is easily and accurately measured, such as automobile mileage,
lubrication and oil changes are made on the basis of mileage or time, whichever
occurs first, thus recognizing calendar time as an important element in equip-
ment maintenance.

Secondly, calendar time recall periods are adjusted on the basis of in-tolerance
reliability and failure rate, both of which can be related to usage. If heavy
usage contributes to out-of-tolerance conditions, the data will be affected and
the recall period will need to be shortened. On the other hand, if heavy use
does not cause instruments to go out of tolerance or to fail prematurely, there
is no logic in frequent calibration because of usage. This process of recall
period adjustment is akin to "having your cake and eating it too." Where usage
negatively affects performance, the data shows it, the recall period is adjusted
downward, and calibration is done more frequently, reflecting the heavy use.
But where usage does not adversely affect performance, the item is not penalized
just because it is used a lot.

CONCLUSION

Although the calendar time recall period system is not without fault, it is
satisfactorily employed by the vast majority of calibration laboratories. Cali-
bration by usage is a good idea in theory, but there is little factual information
to support its superiority or to implement it.

The potential for reduction of calibration costs is much greater in such areas
as storage and retirement of equipment and recall period extensions, and our
efforts should be directed toward those areas.

Don Greb, Lockheed Missiles & Space Co.
FAIRY TALE OR REALITY

The time is 5 o'clock on a Monday night in late November and the work day is over. You lock your desk, grab your coat, go out the plant gate, and get into your car. You notice that you are low on gas so you drive over to the Shell station and tell the attendant to fill your tank and check the oil. He puts in 62.7 liters of gas and a liter of oil.

On your way home you listen to the weather report. "Cool tonight and tomorrow with showers expected. Low tonight 4 degrees with a high of 13 degrees tomorrow. Winds from the southwest at 20 kilometers per hour. Up to 8 millimeters of rain expected."

As you get to the shopping center near home you stop at Safeway and pick up a 550-gram package of ground beef and, just to be sure, you get a liter of vodka and a half-liter of vermouth so you won't run out of martinis during the Monday night football game between the San Jose Metrics (formerly the San Francisco 49ers) and the New England English Units (formerly the New England Patriots).

You get home just in time to hear Howard Cosell, Jr. introducing the starting lineup of the Metrics. "At defensive left end is Joe Metre, an eight-year veteran from Grambling, standing 201 centimeters and weighing 126 kilograms."

You sit down and watch the game which you thoroughly enjoy because, as was expected, the Metrics thoroughly trounced the English Units. You wake up with a slight hangover the next morning but figure it was worth it to see your Metrics clobber that old-fashioned New England outfit.


By 1988? A 100% certainty.

What is it all about? In a word, METRICATION, which means the common everyday use of the International System of Units (SI)--commonly called the metric system--in the United States. This change, programmed to take place over the next 10-15 years, is already well underway and will mean discarding forever such traditional English units of measure as the inch, foot, yard, mile, ounce, pound, pint, quart, gallon, acre, degrees Fahrenheit, and endless others.

The only common unit which will not change is the unit of time, the second, even though there is nothing of a fundamental nature which would prevent the second from being redefined so that time would be decimalized like all other units. If this were to happen, the new second would be about 15% shorter than the old and there would be 100,000 seconds in a day, 100 seconds to the minute, 100 minutes to the hour, and 10 hours in the day. Under such a time system, 5:00 would correspond to 12:00 noon, 8:75 would correspond to 9:00 p.m., etc.

Why do we want to discard the system we have used for 200 years and incur the vast expense and inconvenience of a new system of measurements? The conversion costs will be many billions of dollars for equipment, training, and conversion of documentation such as specifications and standards.

There are two reasons why the United States must change to the metric system. First and foremost, our position as a first-rate power in international trade is very seriously jeopardized by our inability to buy and sell in metric units.
FAIRY TALE OR REALITY - continued

Since the adoption of the metric system in France in 1790, all the countries of the world have been changing until, with the recent change in Britain, Canada, Australia, New Zealand, and South Africa, the United States is the only industrial nation in the world not on or converting to metric.

Even today, estimates of economic loss to our country because of using English units of measure run to several billion dollars per year and are increasing each year. With the balance of payments situation as poor as it has been for the last few years, we can hardly afford to let it get worse by our inability to function in the international marketplace. With many "American made" products today containing parts and components manufactured all over the world, the need for a uniform and international system of measurement can be readily appreciated. So, in spite of the high cost of metric conversion, in the long run it will be much cheaper than sticking with the present English units.

Secondly, even disregarding the international implications, our measurement system is unbelievably clumsy and difficult to learn and use compared to the fully decimalized metric system. We do not fully realize its inherent awkwardness because we have grown up with it and are accustomed to it, as bad as it is. The complexity of the system can perhaps be compared to that of the recently discarded (1971) British monetary system of pounds, shillings, pence, and farthings which had been used for about 800 years in the British Isles. In this system, there were 4 farthings to the pence, 12 pence to the shilling, and 20 shillings to the pound. Can you imagine how difficult and slow it must have been to teach a 4th or 5th grader how to add, subtract, multiply, and divide in these units. As a matter of actual fact, a recent UNESCO study of 13 European countries showed that English and Scottish children were deficient in arithmetic, a fact attributed at least in part to complicated units of measure.

To make a couple of simple comparisons, 8,460 feet is 1 mile, 3,180 feet or 1.60227+ miles, depending upon how you choose to express it. However, 8,460 meters is simply 8,460 kilometers and that is all there is to it. By the same token, 75 ounces is 4 pounds, 11 ounces (assuming avoirdupois weight as opposed to troy weight) or 4.6875 pounds, but 75 grams is simply .075 kilograms.

It has been estimated by some educators that adoption of the metric system would reduce grade school arithmetic by two years.

The impact of the metric system will be greatest in the engineering and design groups where drawings and specifications may be "double-dimensional" (both English and metric) and later on straight metric, and in the manufacturing shops where machinists and inspectors will be dealing in millimeters, centimeters, and meters rather than feet and inches. The standard 1" micrometer will eventually be replaced by the 25-millimeter micrometer, and the 6" caliper will be replaced by a 150-millimeter caliper. The most difficult conversion of all will be to metric threads because of the complete non-interchangeability involved.

The impact in test areas will be relatively minimal because electrical units are already metric and such things as temperature, pressure, vacuum, force, and flow are easily converted.

--CONTINUED ON PAGE 22--
This is the emblem for the third manned Skylab mission. It will be a mission of up to 59 days. Skylab is an experimental space station consisting of a 100-ton laboratory complex in which medical, scientific, and technological experiments will be performed in Earth orbit. The members of the prime crew of this mission will be Astronaut Gerald P. Carr, commander; Scientist-Astronaut Edward G. Gibson, science pilot; and Astronaut William R. Pogue, pilot. The symbols in the patch refer to the three major areas of investigation proposed in the mission. The tree represents man's natural environment and relates directly to the Skylab mission objectives of advancing the study of Earth resources. The hydrogen atom, as the basic building block of the universe, represents man's exploration of the physical world, his application of knowledge, and his development of technology. Since the Sun is composed primarily of hydrogen, it is appropriate that the symbol refers to the solar physics mission objectives. The human silhouette represents mankind and the human capacity to direct technology with a wisdom tempered by regard for his natural environment. It also directly relates to the Skylab medical studies of man himself. The rainbow, adopted from the Biblical story of the flood, symbolizes the promise that is offered man. It embraces man and extends to the tree and the hydrogen atom, emphasizing man's pivotal role in the conciliation of technology with nature.
UPCOMING MEETINGS

1973 NCSL STANDARDS LABORATORY CONFERENCE  November 13-16, 1973
N.B.S., Gaithersburg, Maryland  A. J. Woodington, Conf. Chairman

3RD CAL POLY MEASUREMENT SCIENCE CONFERENCE  Nov 30 - Dec 1, 1973
California Polytechnic State University, San Luis Obispo, California  Fee: $25

"STANDARDS AND CALIBRATION LABORATORIES"  December 3-7, 1973
George Washington University  N.B.S., Washington, D.C.  Fee: $325

2ND JOINT CONFERENCE ON THE SENSING OF ENVIRONMENTAL POLLUTANTS
Sheraton-Park Hotel  Washington, D.C.  December 10-12, 1973
Sponsors: Instrument Society of America
American Chemical Society
American Meteorological Society
American Institute of Aeronautics & Astronautics
Institute of Electrical & Electronics Engineers

DIRECT ENERGY CONVERSION SHORT COURSE  January 7-11, 1974
Arizona State University, Tempe, Arizona  Fee: $300

MEASUREMENT SYSTEMS ENGINEERING SHORT COURSE  March 18-23, 1974
Arizona State University, Telephone: 602-965-3124  Fee: $300

1974 CONFERENCE ON PRECISION ELECTROMAGNETIC MEASUREMENTS (1974 CPEM)
London, England  July 1-5, 1974
Contact: Lawrence Gatterer, NBS, Boulder
Abstracts due by October 31, 1973

1974 URSI SYMPOSIUM ON ELECTROMAGNETIC WAVE THEORY
London, England  July 9-12, 1974
Contact: IEE Conference Dept., Savoy Place
London WC2R0BL, England