Plans for the 1976 NCSL Symposium have progressed very well under the direction of Graham Cameron and Ray Sangster. This anniversary program promises to be an event you won't want to miss. If you haven't already, mark your calendar for October 6-8, 1976. More information is presented in this NEWSLETTER.

Involvement continues to be our password. Since the last NEWSLETTER we have made several changes. Joe Cameron has successfully completed more than 6 years as our Sponsor's Delegate. Bascom Birmingham has been appointed to replace Joe. We welcome Bascom aboard. Kenneth Armstrong has been appointed NCSL Secretariat, replacing Kay Etzler. Both of these new appointees reside at NBS in Boulder, Colorado.

In addition, Ron Kidd succeeded Mort Angelo and John Lee succeeded Andy Woodington. These Vice Presidency positions are very challenging and we wish continued success to Ron and John. I understand that Mort is enjoying his retirement and spends time fishing along with his other hobbies. Andy has a new position at the Navy Metrology Center in Pomona, California.

The dynamic nature of the NCSL offers quite a challenge to the Board of Directors. I recently recognized this significance to a new degree when I asked Jim Gilbert to make several last minute changes to the NCSL Directory after he had delivered it to the printer. The presses are running and Jim expects a June delivery to all NCSL Member Delegates.

This issue of the NCSL NEWSLETTER contains the prospectus on our NBS/NCSL Fellowship Program. A significant effort has been expended in developing this program under the direction of Dave Mitchell. Your responses are encouraged and welcomed.

I am pleased to report that John Minck has continued to develop our 5-year plan on schedule. John plans to present the plan for review at our Board of Directors meeting to be held at NBS in Gaithersburg, Maryland on June 17 and 18, 1976. This plan will be formally presented by John at the Member Delegates meeting to be held at the 1976 NCSL Symposium.

Mike Swasti
B. W. BIRMINGHAM OF NBS BECOMES THE NCSL SPONSORS DELEGATE

K. ARMSTRONG HEADS THE NCSL SECRETARIAT

Bascom W. Birmingham of NBS has been appointed as NCSL Sponsors Delegate succeeding 6 years of successful diligent effort by Joe Cameron, Chief of IBS Measurement Services. Ken Armstrong, also of the NBS Boulder Laboratories, will head the NCSL Secretariat succeeding Kay Etzier.

Mr. Birmingham will be the fifth NCSL Sponsors Delegate and the first one from the Boulder Laboratories of NBS. The first Sponsors Delegate and a prime mover in establishment of NCSL was Mr. Wildhack who served from 1961 to 1967. Dr. Wallenstein then served from 1967 to 1968; Dr. Ambler, from 1968 to 1969; and Mr. Cameron, from 1969 to 1976.

Bascom W. Birmingham is Deputy Director of the Institute for Basic Standards of the National Bureau of Standards and has been head of the Boulder Laboratories of NBS since 1968.

Educated at Massachusetts Institute of Technology (BSME-1948, MSME-1951), Mr. Birmingham joined the Bureau's Cryogenic Division in 1951 after several years as a consulting power engineer. In 1953 he received a Commerce Department Exceptional Service Award for his contributions to the design and installation of Boulder Laboratories' hydrogen liquefier, largest in existence at the time. He was named chief of the Cryogenics Division in 1962, and in 1966-67 spent a year as a Commerce Department Science and Technology Fellow assigned to the Atomic Energy Commission. In 1971 he was awarded the Department of Commerce Gold Medal for exceptional management of the Boulder Laboratories.

He is American editor of Cryogenics, and is a member of the Scientific Research Society of America and Tau Beta Pi. He is an Associate Fellow of the American Institute of Aeronautics and Astronautics.

Ken Armstrong has been a Public Information Specialist for the National Bureau of Standards Boulder Laboratories (NBS/BL) since 1963. He is supervisory conference coordinator and a staff writer for the NBS/BL Program Information Office. You may have seen his name as Executive Secretary of the Conference on Precision Electromagnetic Measurements, or as Administrator of the Cryogenic Engineering Conference. Ken is a member of the National Association of Science Writers and during the last year was the author of 19 published articles about the work at NBS/BL.
Photomasks now used in the manufacture of most IC devices have pattern elements whose dimensions approach the classical resolution limit of the optical microscope. Photomulsion and hard-surface nonconformable masks are used to mass produce devices with smallest pattern elements in the range 5 to 2.5 micrometers (μm); hard surface conformable masks are used to produce, in special cases, limited numbers of devices with elements as small as 0.5 μm.

A problem facing the microelectronics industry is that of making accurate dimensional measurements of such small pattern elements with the optical microscope, the usual tool for mask inspection. During a recent study of semiconductor device manufacturers, photomask producers and equipment makers by staff members of the National Bureau of Standards (NBS), serious difficulties in making linewidth measurements on the smallest pattern elements were reported. The difficulties include measurement results which depend on the specific instruments, techniques and observers used in the measurement process.

Two factors preclude the immediate resolution of these particular difficulties experienced by the IC industry:

1. An incomplete body of knowledge on the role of image-forming instruments in measurements - how they form images, what instrument parameters introduce errors, what can be done to compensate for or eliminate these errors.

2. The absence of calibrated linewidth standards in photomask materials for the critical 1 to 10 μm range and recommended procedures for their use.

NBS, which cannot currently supply such linewidth standards, has begun a program to develop them and to seek solutions to the problems related to the use of optical and scanning electron microscopes for the accurate measurement of photomask pattern linewidths.

The NBS program in photomask pattern linewidth measurements should produce within the next few years:

1. NBS-calibrated linewidth measurement standards in the form of hard surface photomasks for lines of micrometer (and eventually submicrometer) widths,

2. NBS-calibration capability for user-submitted artifacts,

3. NBS publications dealing with the testing of optical and electron microscopes in terms of the evaluation of the dimensional measurement capabilities of these instruments, and

4. NBS publications on procedures for the calibration and use of optical microscopes in measurements of micrometer-range linewidths.

*Technical work on the NBS Program in Photomask Linewidth Measurements is being performed in the Optics and Micrometrology Section, Mechanics Division, National Bureau of Standards, in Gaithersburg, Maryland. Six engineers and scientists are engaged in a formal two year program on a four man year per year basis. The program is part of a larger Program on the Advancement of Reliability, Processing, and Automation for Integrated Circuits sponsored by the Advance Research Projects Agency through the NBS Electronic Technology Division with funding provided jointly by NBS and ARPA (Order No. 2397). All work is in the public domain with results published in the open literature.
PRELIMINARY PROGRAM OF THE 1976 SYMPOSIUM 
OF THE NATIONAL CONFERENCE OF STANDARDS LABORATORIES
THE NATIONAL MEASUREMENT SYSTEM--TODAY AND TOMORROW
AN ANNIVERSARY REVIEW OF OUR NATIONAL INDUSTRIAL MEASUREMENT SYSTEM

National Bureau of Standards, Gaithersburg, Maryland, October 6-8, 1976

TUESDAY, OCTOBER 5
8:30 a.m. NCSL Board of Directors' Meeting
7-9 p.m. Registration - Holiday Inn of Bethesda
Reception (Cash Bar) - Holiday Inn
Meet the NCSL officers and fellow conference.

WEDNESDAY, OCTOBER 6
9:15 a.m. Keynote Session
Welcome to Symposium - J. Michael Siri, President, NCSL (Lockheed Electronics Co.)
Welcome to NBS - The Industrial Measurement System and the Founding of NBS - Director, NBS
An Anniversary Review of the Measurement System of these United States - John Q. Jefferson (NBS)
An NBS View of our Industrial Measurement System - G. A. Nowell, Director, Institute for Basic Standards, NBS
11:30 a.m. Metrology and Related Metallurgy
Session Developer: J. L. Wilson (Sandia Corp.)
The International Organization for Legal Metrology: J. French (Scientific Apparatus Makers Assoc.)
Mechanical Quantities: J. A. Singh (NBS)
Pressure, Temperature, Humidity: R. W. Hudson (NBS)
Practical Problems for the Standards Laboratory
Manager...
3:00 p.m. Where We Stand and Where We Need to Go in the Electrical & Optical Technologies
Session Developer: J. Rutelis (Guideline Inst.)
Electrical Measurements: R. T. Taylor (NBS)
Electromagnetic Measurements: R. N. Boyne (NBS)
Electronic Technology: J. C. French (NBS)
Time and Frequency: J. A. Barnes (NBS)
Optical Quantities: X. G. Kessler (NBS)
4:00 p.m. Metrology and Regulations for Safety and Health
Impact on Commercial Measurement Service
Organizations: J. Lee (Honeywell, Inc.)
Regulation of Ionizing Radiation: J. E. Leis (NBS)
Views from the Regulatory Agencies:
Bureau of Radiological Health: P. H. Schneider (NBS)
National Institute for Occupational Safety and Health:
Environmental Protection Agency - J. C. Schettino
7-9 p.m. Buffet Dinner and Awards - Holiday Inn, Bethesda

THURSDAY, OCTOBER 7
9:30 a.m. Laboratory Evaluation/Accreditation
Session Developer: R. E. Kidd (Microwave Associates)
National Laboratory Voluntary Accreditation Program - G. A. Nowell (NBS)
Accreditation of Testing Organizations in Canada - J. trous (Standards Council of Canada)
ASTM Criteria: A. M. Maher (U.S. Dept. of Commerce)
NCSL's Self Evaluation Plan - R. E. Kidd
11:30 a.m. The Measurement Trade-Off: Cost vs. Confidence
"Put Me on the MAP!" - What the Measurement Assurance Program did for...

MAP - Future Directions - J. R. Whetstone (NBS)
Findings and Direction, Product Design and Specification Committee
NCSL Round Robin Test Results - M. J. Corrigan (Lockhead Electronics Co., Inc.)
2:00 p.m. Training in the Smaller Laboratory
When Budgets Are Tight
Metrological Education in the University:
Defining the Training Needs of a Smaller Standards Laboratory -
Training Program of the NBS Quality Section - F. I. H. Heydeman (NBS)
NCSL Self-Study Manuals
3:45 p.m. Critique of the U.S. Industrial Measurement System
An NBS View: A. D. McCourey (NBS)
An IAT View: (Spokesman for NBS Institute for Applied Technology)
A Quality Control Man's Critique - NCSL View
Friday, October 8
Member Delegates Meeting (Open to all Symposium Attendees)
9:30 a.m. Review of NCSL Proposed Long Range Plan
John L. Winck, Incoming President (Hewlett-Packard Co.)
For the past year a long range planning committee has been preparing a structured plan for future operations. All member delegates will have received a copy of the plan for study and review before the meeting. The background of the plan will be reviewed and discussion from the floor will be encouraged for input to modify the plan for 1977. Please come prepared for discussion in depth of NCSL strategy and operations.
10:30 a.m. Committee Reports
Short status reports will be presented by the chairmen of these committees:
Calibration Systems Management
Biomedical Electrical Safety Standards
Sponsors and Awards
Calibration Laboratory Automation
Meetings and Programs
Newsletter
Information and Directory
Recommended Practices
Supplementary reports may be given by the committees participating in the Symposium:
National Measurement System
Measurement Assurance
Laboratory Evaluation
Education and Training
Product Design and Specification

11:15 a.m. "Meet the Scientists"
National Bureau of Standards Scientists representing major disciplines will be available in the conference area for informal discussions of technical or program matters.
2:00 p.m. Laboratory Tours of NBS
Both individual visits and group tours will be arranged in response to the interests of the conference.
REGISTRATION

NCSL members postmarked by Sept. 24: $70.00
Non-members postmarked by Sept. 24: $80.00
All registrations after Sept. 24: $90.00

To pre-register, complete the registration form and mail, with your check made payable to the 1976 NCSL Symposium (no purchase orders, please), to Dr. Raymond C. Sangster, Room 4011, National Bureau of Standards, Boulder, Colorado, USA 80302.

Conference registration will be held 7-9 p.m. at the Holiday Inn of Bethesda on Oct. 5, and beginning at 8:30 a.m. each day of the Conference at NBS. The Holiday Inn of Bethesda will be the Headquarters Hotel for the Conference.

FOR FURTHER INFORMATION CONTACT:

GENERAL CHAIRMAN
Graham Cameron
Department of National Defence
Quality Eng. Test Establishment
QETE 7
Ottawa, Ontario, Canada K1A 0K2
Telephone: 819-997-3411

ASSOCIATE CHAIRMAN
Dr. Raymond C. Sangster
Institute for Basic Standards
Room 4011
National Bureau of Standards
Boulder, Colorado, USA 80302
Telephone: 303-499-1000, x 4329

REGISTRATION

NCSL 1976
NATIONAL BUREAU OF STANDARDS
GAITHERSBURG, MARYLAND

Name___________________________________________________________
Organization____________________________________________________
Street Address____________________________________________________
City___________________________________________________________State__________Zip__________

☐ Registration fee enclosed. (Checks made payable to 1976 NCSL Symposium.)
☐ I cannot attend the Conference but wish to remain on the NCSL Member-Delegate NCSL Member Representative ☐ Non-Member
☐ NCSL Member Delegate
☐ NCSL Member Representative
☐ Non-Member
UPCOMING NCSL MEETINGS

June 16, 1976  Conference Session Developers meeting at NBS, Gaithersburg, MD.

June 17, 1976  Region 2 meeting - Bendix Corporation, Sydney, NY.

June 17-18, 1976 Board of Directors meeting at NBS, Gaithersburg, MD.

September 1976 Region 4 meeting.

October 1976 NCSL Conference at NBS, Gaithersburg, MD.

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JULY 26th IS TARGET DATE FOR NEXT NCSL NEWSLETTER

The target date for submission of material (text and photos) is July 26th, 1976.

Send material to:

Wilbur J. Anson
276.10
National Bureau of Standards
Boulder, Colorado 80302

Particularly appreciated are reports with photographs of regional activities and letters to the editor.

*****************************************************************

ANTICIPATED - In Future Issues

A report on the GIDEP Metrology meeting held on May 13th and 14th.

A Summary of the results of Questionnaire on "General Purpose Test Equipment Calibration and Maintenance Cost."

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QUALITY CONTROL IN A CALIBRATION LABORATORY

An article under this title by Rolf Schumacher appeared in the January and February issues of Quality Progress, The Monthly News Magazine of the American Society for Quality Control; a more detailed paper on the subject was presented at the Fifth Annual Measurement Science Conference in San Luis Obispo in December 1975. Reprints of the paper are available by writing to

Rolf B. F. Schumacher
Autonetics D/120 HC02
3370 Miraloma Ave.
Anaheim, CA 92803

and enclosing a large self addressed envelope.
NEW MEMBERS OF NCSL

Eastman Kodak Company
Kodak Colorado Division/223 Windsor, Colorado 80551
Delegate: B. E. Jump

Hewlett-Packard Canada Ltd.
6877 Goreway Drive Mississauga, Ontario L4V 1M8, Canada
Delegate: John Leckey

Honeywell, Inc.
5558 Port Royal Road Springfield, VA 22152
Delegate: Anthony J. Martinich

Motorola, SPD - Austin Facility
3501 Ed Bluestein Blvd. Austin, Texas 78721
Delegate: Wolt Winkler

Naval Air Systems Command
Representative, Pacific
NAS North Island
San Diego, California 92135
Delegate: Arthur W. Phillips, Jr.

Raytheon Service Company
12 Second Avenue
Burlington, MA 01803
Delegate: Richard P. Robson

State of California
Division of Measurement Standards
8500 Fruitridge Road
Sacramento, California 95826

CORRECTION

An unfortunate misprint reversed the meaning of an item in the report on the Region 8 NCSL Seminar and Workshop on page 13 of the March 1976 NCSL Newsletter.

The last two sentences of the first paragraph on that page should read:

"One industry representative expressed his belief that government specifications require double calibrations, one to determine the out-of-tolerance characteristics and one to make adjustments. A government representative expressed his belief that this was not necessarily NASA's or the government's position and may have to be decided on the basis of instrument analyses."

Specifically, the debate was on NASA procedures and the reply that a double calibration is not necessarily required came from a NASA representative.

PLEASE RETURN BORROWED VIDEOTAPES

Mike Suraci, NCSL President, requests that all Video Training Tapes borrowed from the NCSL Training Library be returned to him by June 15th for inventory. All video tapes should be returned by registered mail.

Send the tapes to:
J. M. Suraci/C03
Lockheed Electronics Company, Inc.
Aerospace Systems Division
16911 El Camino Real
Houston, Texas 77058
A whole new era of transportation will come into being in the 1980's with the advent of the Space Shuttle. The Space Shuttle's versatility and reusability will truly open the door to the economical and routine use of space.

The Space Shuttle is more than a transport vehicle. The Orbiter has the capability to carry out missions unique to the Space program: To retrieve payloads from orbit for reuse; to secure or refurbish satellites in space; and to operate space laboratories in orbit. These capabilities result in a net savings in the cost of space operations while greatly enhancing the flexibility and productivity of the missions.

So often have the man-machine relationships in space been proven to be highly effective that the Space Shuttle is being designed and built to take advantage of the most efficient characteristics of both humans and complex machines. Crew members and passengers will experience a designed maximum gravity load of only 3g during launch and less than 1.5g during a typical re-entry. These accelerations are about one third the levels experienced on previous manned flights. Many other features of the Space Shuttle, such as an internal standard sea-level atmosphere, will welcome the non-astronaut space worker of the future.

Users of the versatile Shuttle system will include communication networks, research foundations, universities, observatories, federal departments and agencies, state agencies, county and city planners, public utilities, farm cooperatives, the medical profession, the fishing industry, the transportation industry, and power generation and water conservation planners. Payloads launched by the Space Shuttle will provide practical data that will affect both the daily lives of people and the long-term future of mankind.

Space Shuttle flights will be launched from two locations, the NASA John F. Kennedy Space Center (KSC) in Florida and the Vandenburg Air Force Base (VAFB) in California. Present program planning calls for a gradual buildup of 50 to 60 total flights per year into many varying orbits and inclinations.

Man goes into space to explore the unknown and to increase our understanding of the past, present, and future of the universe and humanity's place in it. When the Space Shuttle becomes operational in 1980, it will be an important tool to provide mankind with information to help in managing and preserving our crowded Earth.
CALIBRATION PROCEDURE FORMAT DISCUSSED AT NCSL SPECIFICATION COMMITTEE MEETING

The recently formed NCSL Product Design and Specifications Committee met at Beaverton, Oregon (Host: Tektronics) on May 12, 1976 to evaluate NCSL Recommended Practice #3 on Calibration Procedure Format.

This was the first working meeting of the committee following an NCSL/GIDEP Workshop last December 4th at the GIDEP Operations Center at which NCSL RP#3 was presented in detail to numerous Measuring and Test Equipment (M&TE) Manufacturers and users. At this earlier meeting, there was much discussion of the calibration procedure needs of the commercial user. It was pointed out that there is enormous industry and government waste due to duplication of writing efforts, and deficiencies in typical M&TE manufacturers procedures. Conceivably there is a potential of great savings by both the M&TE manufacturers and users if the manufacturers were to adopt standardization calibration procedure writing criteria such as NCSL RP#3.

The meeting of May 12th resulted in several specific fact finding and writing assignments due June 18th in preparation for the next steps in refining the document. The committee hopes to have a final draft and report prepared for the October NCSL Conference and Board of Directors' meeting.

Input from industry users would help the committee greatly; Committee Chairman Bob Willett solicits input and additional committee members. If you are interested in serving on the committee, contact your regional representative or Bob Willett:

Bob Willett
Collins Group
Rockwell International
420 Collins Rd. N.E.
Cedar Rapids, Iowa 52406
(319) 395-4513

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CHANGES IN NCSL OFFICERS

John Lee of Honeywell, Inc., has been appointed Vice President, Communications and Marketing, to replace Andy Woodington.

His address and telephone number is

John Lee
Honeywell Inc.
2025 Gateway Place
Suite 380
San Jose, California 95110
(408) 998-3131 x 17
BEWARE METROLOGISTS: ANTHROPOMORPHIC
UNITS WANING--A BICENTENNIAL COUP?

by John Dalke, NBS

We declared our independence two hundred years ago, yet ironically we are
only beginning to discard the cumbersome measurement system we inherited.
The system has been abandoned in the country from which we won our indepen­
dence. Not only England but all the other English speaking countries of the
United Kingdom are scrapping the customary measurement units that still
persist most strongly in the U.S.A. Whatever the relative merits of the
metric system (SI), it has won overwhelming international approval in the
last 20 years. The Chinese, Japanese, Indians and all English-speaking
nations except the U.S. have abandoned their traditional measurement language
and are going metric. Since World War II, Japan, India, Greece, Egypt,
Saudia Arabia, Pakistan, Korea, Indonesia, Vietnam, and many other nations
have changed from a wide variety of measurement systems to the metric system.
The U.S. is the last major industrial country to change. There are now only
four petite countries that are not yet switching. Legally, the U.S. has been
metric since 1866 but it has not yet become the dominant system here.

Early in life we learn that there are twelve inches in a foot, three feet in
a yard. As we grow older, we learn of a multitude of other quantities and
the units to express them such as rods, miles, furlongs, acres, horse power in
foot pounds per unit of time, and so on. Many of us have the vague impres­
sion that units were decreed in terms of some English King's anatomy, such as
his foot, the length of his arm, etc. Indeed, in the England of King Henry I
(850 years ago) cloth was sold by the royal arm's length, but anthropomorphic
units were in use much earlier. The word foot as a unit of measurement dates
back at least as far as 325 B.C. Various foot units have ranged from about
280 to 350 mm (11 to 14 in.). The early Egyptians used the inch only for a
special measurement of volume with a right circular cylinder whose diameter
and height were equal. The unit was two inches high and curiously enough
their inch was almost exactly equal to our current inch. The yard was not
frequently used in ancient times but when it was, the subdivisions were
binary: 2, 4, 8, and 16 parts called the half-yard, span, finger and nail.
From pyramid records it is clear that a sophisticated measurement system was
in existence about 7000 years ago. Man used his forearm and hand to measure
length. From deciphering, we know now that they used:

Digit = width of a finger
Palm = 4 digits (width of 4 fingers)
Span = 3 palms (width of outstretched hand)
Cubit = 2 spans or 6 palms (length of forearm)

Even as late as 1550 B.C., Egypt used a Royal Cubit = 7 palms (28 digits).
They also had a Remen of 5 palms. Two Remen equal the diagonal of a Royal
Cubit square and a Royal Cubit equals the diagonal of a Remen square. Thus,
the Remen digit and Royal Cubit digit differ by about 1%. The circumference
of a circle with a 7 palm (Royal Cubit) radius has essentially the same
perimeter (44 palms) as a 11 palm square. The Egyptians knew \( \pi \) as 3.14 and
the Babylonians considered \( \pi \) to be 3. The relationship between the perimeter
of a 7 palm radius circle and the perimeter of the 11 palm square apparently
is the origin of the magic numbers 7 and 11 which have received almost rever­
ent respect by many from ancient times to the present day. The pyramids
have a ratio of height to base of 7 to 11.

About 2700 years later in 12th century England we see the beginnings of our
present anthropomorphic and other English units. We find that a ship's sails
are measured in yards, depth of the sea in fathoms (out-stretched arms,
6 ft.), jewels in carats (from the carob seed), printing and typing in points
and the height of a horse in hands. Even today a sharp horse trader measures
a horse in hands and the farmer paces off his field in yards.
But alas, even our present day English measures, like the Royal Cubit, are on the road to obsolescence. Learning to count, to measure, and to calculate was a real struggle for ancient man. Progress came about slowly and as a result of social development rather than changes in biological equipment. In fact, metrology of any age characterizes civilization of that age. As is characteristic of many other social phenomena, metrology is escalating at an essentially exponential rate. Most of the measurement-sensitive extensions to man's biological equipment have grown by leaps and bounds during the past two centuries.

World wide, at the close of the 18th century, the word pound applied to 391 different units of weight. The word foot applied to 282 different units of length. This state of affairs provided the incentive to the French to introduce the metric system about 200 years ago. They had persuaded the English and others to join them but certain political problems of the day kept the English from changing their measurement system until about 200 years later. The prime mover for the British at this late date was what is known as the European Common Market.

As mentioned earlier the U.S. has been legally metric since 1866 but SI has not become the dominant system here as yet. However, there is now a substantial industrial metric "roll call" in the U.S. It includes:

<table>
<thead>
<tr>
<th>Motor Vehicles</th>
<th>Farm and Construction Equipment</th>
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<tbody>
<tr>
<td>Chrysler</td>
<td>Caterpillar Tractor</td>
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<tr>
<td>Ford</td>
<td>Clark Equipment</td>
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<tr>
<td>General Motors</td>
<td>International Harvester</td>
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<tr>
<td>Mack Trucks</td>
<td>John Deere</td>
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<th>Computers and Other Office Equipment</th>
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<tr>
<td>A. B. Dick</td>
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<td>Honeywell</td>
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<tr>
<td>IBM</td>
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<tr>
<td>Minnesota Mining &amp; Manufacturing(3M)</td>
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<tr>
<td>Xerox</td>
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<tr>
<th>Others</th>
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<tbody>
<tr>
<td>Allis-Chalmers</td>
</tr>
<tr>
<td>Armco Steel</td>
</tr>
<tr>
<td>Brown &amp; Sharpe(machine tools)</td>
</tr>
<tr>
<td>Dow Corning(chemicals, glass)</td>
</tr>
<tr>
<td>Edgecomb Steel</td>
</tr>
<tr>
<td>Exxon Res. &amp; Engineering Company</td>
</tr>
<tr>
<td>Firelands Community Bank(Huron, Ohio)</td>
</tr>
<tr>
<td>Firestone Wire &amp; Cable Division</td>
</tr>
<tr>
<td>General Tire &amp; Rubber Company</td>
</tr>
<tr>
<td>Grumman Aerospace Corporation</td>
</tr>
<tr>
<td>Hughes Aircraft Company</td>
</tr>
<tr>
<td>Inland Steel Company</td>
</tr>
<tr>
<td>Lamsons &amp; Sessions(threaded fasteners)</td>
</tr>
<tr>
<td>Montgomery Ward</td>
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<tr>
<td>New England Medical Center Hospital</td>
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<tr>
<td>Otis Elevator</td>
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<td>Rockwell Int'l.(mechanical Products)</td>
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<td>Sears, Roebuck &amp; Company</td>
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<td>Seven-Up Company</td>
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<tr>
<td>Travelers Insurance</td>
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<td>Weyerhauser</td>
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</tbody>
</table>

Metric change is, clearly, on the move. General Motors, for example, has more than 40,000 suppliers. The GM change obviously means that by and large its suppliers will need to change to SI. In turn, each supplier has a large number of employees and employees will become concerned about their children. Thus, education becomes involved. A ballooning process sets in.

The social decision to use SI has also impacted legislation. Congress, a body to whom we delegate certain social decisions, in August 1974 established Public Law 93-380 which amends the Primary and Secondary Education Act of 1965.
Congress found:

- Use of metric is increasing
- Use in U.S. inevitable and will become dominant
- No existing coordinated program to teach metric in U.S.

It is U.S. policy to encourage metric education.

The law provides for grants and contracts for metric education. They recommended ten million dollars per year be spent the next three years. (Currently, HEW is distributing two million dollars to state metric education projects.)

Many daily experiences are metrically oriented. The moon is metric, the astronauts made it so with metric instruments they carried there. The pharmaceutical industry went metric twenty-six years ago and it caused hardly a ripple. Less than 10 years ago, the lumber industry changed the dimensional standards of lumber. A present day 2x4 isn't what it used to be. Dire consequences were predicted but the change was taken in stride. Equal concern is again being expressed lest the lumber industry go to SI standards, but undoubtedly the disruption again will be minimal. Surely, the metric changeover will cause problems as it did for the French about 200 years ago. However, in addition to economic gains, we will have a more consistent system than the one adopted by our early settlers. Examples of everyday metric use are:

- PHARMACEUTICAL INDUSTRY - 1950
- MEDICAL PROFESSION
- PHOTOGRAPHY
- TOBACCO INDUSTRY
- OLYMPICS/INT'L SPORTS
- ASTRONAUTS ON THE MOON
- MATH TEXTBOOKS
- CANNED FOOD
- PINTO & MUSTANG II & CHEVETTE
- METRIC WRENCH SETS
- SEWING PATTERNS

Public Law 94-168 "The Metric Conversion Act of 1975" was signed into law on December 23, 1975. Coming just a few days before the beginning of the 1976 Bicentennial celebration, it may be considered as the final coup in freeing us from dominance of our customary system. The law serves as a national focus for the conversion and specified that implementation will be voluntary and funded as a business expense. Under the law a 17 member U. S. Metric Board with nominees from 11 sectors will:

* coordinate the voluntary changeover
* develop plans for implementation
* develop educational materials
* examine cost effectiveness and recommend actions as necessary
* make recommendations to President and Congress

In addition to legislation, several Federal Agencies are taking actions that means increased metric usage by the agencies. Doing business with the Federal Government will entail increased metric usage. Schools all over the
United States are showing a growing awareness of the need to teach more metric. Textbook publishers and producers of other educational materials are aware of this and are beginning to respond with a wide variety of teaching aids.

Thirty-two states have had some type of formal action by their state legislatures and/or state school boards. Twenty-two school boards have adopted "go metric" resolutions. Seven state legislatures have enacted laws directing action in education. Workshops to teach teachers to teach metric are abundant.

Several states have formed metric committees to guide metrification for their states. Road signs giving distances and/or speed limits in both metric and customary units are appearing in several states.

Public Law 94-168 "The Metric Conversion Act of 1975" may be considered a climax to the NBS metric study authorized by Congress in 1968. The major thrust recommended in the NBS 1971 study report has been retained in the law. Absent, however, is a time-scale, which other converting countries have pegged nominally as ten years. This legislation does not compromise NBS responsibility for maintaining the national measurement system and coordinating the dissemination of standards which have been based on the metric system for many years.

(For more details on the history of metrology see "History of Measurement and the SI units," R. D. Stiehler, Materials Research and Standards, p. 14 Vol. 9, No. 6, June 1969.)

(The industry metric compilation was prepared by the NBS Metric Information Office.)

******************************************************************************

TOUR OF MOORE SPECIAL TOOL COMPANY IS HIGHLIGHT OF REGION 2 MEETING

Region 2 held a meeting at Moore Special Tool Company, 3 E. Hartford, CT. on February 12, 1976.

An outstanding slide program and tour of the plant was given. Some commented that the precision-built products border on the classification of "works of art."

It was reported at the meeting that the surface finish Round Robin and the Electrical Round Robin should be nearly completed by the June meeting.

Ed Turner reported on the problems of changing conditions in mass measurement, such as the variables affecting mass measurement and the need for well defined certification reports.

The next meeting is scheduled for June 17th at Bendix in Sydney, N.Y.

******************************************************************************

NCSL COMMITTEE MEETS TO REVIEW CALIBRATION PROCEDURES

The Product Design and Specification Committee met May 12th at Textronix in Beaverton, Oregon to review Calibration Procedures submitted by various M&E Manufacturers. A progress report is expected to be presented in the next Newsletter.

******************************************************************************

How can a country that has lived with feet, fathoms, furlongs, acres, B-cups, petite and Xtra large be confused by the metric system?

-Paul Sweeney in The Quarterly
Dear Sir:

The following is a response to the problem stated on page 19 of NCSL Newsletter, Volume 16, No. 1, March 1976, regarding calibration intervals for multi-chassis test consoles:

1. Establish a group of coded service intervals, with each interval having a whole multiple relationship with the longest interval. Example:

<table>
<thead>
<tr>
<th>Interval Code</th>
<th>Interval in Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
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<tr>
<td>C</td>
<td>3</td>
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<tr>
<td>D</td>
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<td>E</td>
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<td>F</td>
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<td>G</td>
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<td>H</td>
<td>16</td>
</tr>
<tr>
<td>J</td>
<td>24</td>
</tr>
<tr>
<td>K</td>
<td>48</td>
</tr>
</tbody>
</table>

2. Identify each group of chassis/instruments requiring the same service interval, assign an appropriate interval code to each group, and compose a calibration procedure that consists of two or more "coded check" sections. Each coded check would relate only to those chassis/instruments requiring service for a particular interval. Each coded check is composed as a separate entity, with references made to portions or all of the more frequently occurring checks as required to eliminate redundancy.

3. "Coded check" scheduling is a natural for data processing. Calibration of the entire console (longest interval) can be assigned some date as a reference date; shorter service intervals are then scheduled from that date as required.

A "coded check" method for calibrating and scheduling multi-chassis test/process systems has been used successfully at this GE location for eight years. Additional information may be obtained from:

A. E. Gregory
Neutron Devices Department
General Electric Company

DO YOU AGREE?!!

WHAT OTHER SUGGESTIONS DO YOU HAVE?!!

Send your input to:

Walt Cassady
Rockwell International/Tulsa Division
P.O. Box 51308
Tulsa, Oklahoma 74151
Dear Sir:

This is in response to the request in the March, 1976 NCSL Newsletter for comments regarding problems of scheduling calibrations for instruments mounted in production consoles.

It seems that this problem could be called "the discrete instrument syndrome" in that just because an instrument can be calibrated by itself the assumption is made that it must be calibrated by itself. The obvious solution to this problem is to consider the console itself as an instrument. This means that all units in the console would be calibrated at the same time as a system and that the console would get a calibration label. Individual units in the console would not get a label.

As regards the selection of a calibration interval, there is nothing to prevent the cognizant agency from selecting a reasonable interval based on the accuracy and reliability required of the whole system, rather than attempting to meet some shorter interval based on the most unreliable unit in the console.

Additionally, this method would allow some functions of some units to not be calibrated if that function were not used by the operator of the console. For example, if the oscilloscope delayed sweep function were not needed, there would be no reason to calibrate it. Since the units of the console are dedicated to the console and are not otherwise labeled, there is no danger of an uncalibrated function being used for other testing.

Other advantages, such as simplified calibration procedures and easier scheduling of console down time would also result from this method.

R. T. Clark, Jr.
Manager of Quality Assurance
Newport News Shipbuilding

DO YOU AGREE?!:
WHAT OTHER SUGGESTIONS DO YOU HAVE?!!

Send your input to:

Walt Cassady
Rockwell International/Tulsa Division
P.O. Box 51308
Tulsa, Oklahoma 74151
The Region 7 NCSL meeting was held on Thursday, April 22, 1976 at the Stanford Research Institute in Menlo Park, California. Thirty member delegates and their guests attended the meeting.

John Minck of Hewlett-Packard, Executive Vice President of NCSL, led a discussion of product design and specifications. He began with a report on the committee working with Bob Willett on the problem of the way manufacturers write specifications and manuals. The discussion covered both the quantity of specifications needed as well as the degree of conservatism desirable. The number of comments and the interest shown indicated that it was well worth some committee effort to try and reduce future calibration costs by working with manufacturers on more realistic specifications.

A discussion of recommended recall periods in manufacturer's manuals resulted in most of those attending expressing the feeling that these were more of a hindrance than a help. Don Greb of Lockheed has been running a small West Coast survey on recall periods (see the following table). The first report had a recall summary only, the report soon to be published will include "quality" numbers of in-tolerance ratios along with the recall period. Don mentioned that the results seem to show that in-tolerance quality seems unrelated to recall period, i.e., some short periods have poorer "quality" than longer ones. Does transportation have an influence?

A discussion of the proposed NCSL liaison representative to NBS was held, John Minck outlined the desirability of this position in terms of direct access to information as to strategies, approaches and trends in calibration. It was stressed that the liaison representative would be NCSL's "man at the Bureau." It is expected that a prospectus outlining qualifications and procedures for nomination will be issued shortly.

In the area of long-range planning and organization those in attendance expressed their general satisfaction with the present organizational structure of the NCSL. Concern was expressed about the future course of MILSPEC development; it was felt that NCSL should consider this as a possible area of committee action.
<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Companies Reporting</th>
<th>Arithmetic Average</th>
<th>Shortest</th>
<th>Median</th>
<th>Longest</th>
<th>Longest Except for NCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decade Capacitors, General</td>
<td>27</td>
<td>11.4</td>
<td>6</td>
<td>12</td>
<td>24</td>
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<tr>
<td>HP 311, 312, 313, 314 Distortion Analyzers</td>
<td>19</td>
<td>5.7</td>
<td>3</td>
<td>6</td>
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<tr>
<td>Weston 431, 931 Meters</td>
<td>8</td>
<td>7.8</td>
<td>3</td>
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<td>HP 410C VVVM</td>
<td>29</td>
<td>5.5</td>
<td>3</td>
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<td>HP 650 Test Oscillators</td>
<td>23</td>
<td>6.2</td>
<td>3</td>
<td>6</td>
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<tr>
<td>HP 608 Signal Generators</td>
<td>26</td>
<td>5.7</td>
<td>3</td>
<td>6</td>
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<td>HP 463, 462 HP Amplifiers</td>
<td>17</td>
<td>8.3</td>
<td>3</td>
<td>9</td>
<td>NCR</td>
<td>12</td>
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<tr>
<td>HP 414A Power Meters</td>
<td>21</td>
<td>5.0</td>
<td>3</td>
<td>6</td>
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<td>Stoddart NM 532, RFI Meter</td>
<td>19</td>
<td>6.7</td>
<td>6</td>
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<td>HP 5211, 5212 Counters</td>
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<td>Systron/Fairchild 7050 LaW</td>
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<td>4.7</td>
<td>2</td>
<td>3</td>
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<td>Cimar 7630 LaW</td>
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<td>HP 505 LaW</td>
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<td>Tektronix C/CA Plug Ins</td>
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<td>Hamdeco 2710, 2711, 2721 Amplifier</td>
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<td>GR 1862 Nanobalance</td>
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<td>HP 7025 X-Y Recorder</td>
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<td>Sandborn 150, 150, 850 Recorders</td>
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<td>Low Precision Balances and Scales</td>
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<td>Fluke 332, 335 Voltage Standards</td>
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<td>HP 375 Series Attenuators</td>
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<td>HP 7640 thru 7670 Couplers</td>
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<td>M/M/US Gauge, etc., 1/28 Pressure Gages</td>
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<td>M/L General Purpose Load Cells</td>
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<td>Liquid-In-Class Thermometers</td>
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<td>.001 0-1 Inch Micrometers</td>
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<td>.001 0-1 Inch Micrometers</td>
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<td>Depth Micrometers</td>
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<td>Standard 6-Inch Vernier Calipers</td>
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<td>5.0</td>
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<td>AGD Via Indicators</td>
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<td>Thread Plugs - 20 or more pitch</td>
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<td>1</td>
<td>6</td>
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<tr>
<td>Thread Plugs - less than 20 pitch</td>
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<td>2.6</td>
<td>1</td>
<td>5</td>
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<td>3</td>
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<td>Sine Bars</td>
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<td>Rockwell Hardness Tester</td>
<td>22</td>
<td>5.3</td>
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<td>7</td>
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<td>Surface Plates</td>
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<td>Pi-Tubes</td>
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<td>Heise Gages</td>
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</table>
FROM NBS - A MEASUREMENT ASSURANCE PROGRAM FOR GAGE BLOCKS

A series of NBS publications is now available describing a measurement assurance program (MAP) for gage block calibration in the size range from 5 to 20 inches. These documents will be the principal means for making MAP available to metrology laboratories throughout the country.

MAP is a departure from traditional metrology. It treats measurements as a continuous process subject to control and rigorous analysis and it leads to the assignment of uncertainties based on documented, long term performance rather than on error assignment by estimation and occasional experimental verification. The MAP approach will be especially important to industries and other activities where documented proof of measurement uncertainties and close tolerance quality control are essential. The program is easily modified to serve less stringent requirements and still provide the vital monitoring presently missing in so many measurement activities.


All the information needed to establish a gage block measurement assurance program is contained in these publications. Additional publications that cover the size range below 5 inches are near completion.

*****************************************************************

GENERAL PUBLICATIONS DESCRIBE NBS ELECTRICAL STANDARDS AND RF SQUID PROGRAMS

The April 1976 issue of IEEE Spectrum magazine contains a four-page article by managing editor, Ronald K. Jurgen on the programs of the NBS Electricity Division. The article, entitled "It's 75 for NBS" carries the following sub-title, "Born in 1901 the U.S. National Bureau of Standards promotes compatibility, reliability, and availability of electrical measurements." This philosophy is well-illustrated as a description of the division's programs on electrical measurements unfolds.

The April issue of Microwave Journal International includes a descriptive feature article by R. A. Kamper of the NBS Electromagnetics Division, under the title "RF Applications of the Josephson Effect." Particularly addressed to an audience of microwave applications engineers, it describes the recent technical progress which has been made in RF detection, mixing, and parametric amplification, as well as the measurement of RF current, power, and attenuation.

*****************************************************************

METROLOGIST WANTED

Abbott Laboratories, North Chicago, Illinois 60064 is currently setting up a standards lab and needs an experienced metrologist to run it. The emphasis is on mass, temperature, and electronics. A wide variety of instrumentation is to be calibrated under the standards program. Write - Attention: Phil Hannon
CANDIDATES SOLICITED FOR NBS/NCSL FELLOWSHIP PROGRAM

The following material explains the key features of a new program which has been developed and approved by the Board of Directors. This NBS/NCSL Fellowship program is intended to provide a new focus for joint activities between NBS and NCSL member organizations on key/emerging issues.

Candidates for this prestigious appointment are currently being considered by the Board of Directors. Please submit your suggestions for candidates as soon as possible directly to J. D. Mitchell or J. Michael Suraci as indicated below.

J. Michael Suraci  
Lockheed Electronics Co.  
16811 El Camino Real  
Houston, Texas 77058  
(713) 483-4742/3893

J. D. Mitchell, Manager  
Rockwell International  
Autonetics Group  
3370 Miraloma Avenue  
Department 136-031-FC14  
Anaheim, California 92803  
(714) 632-0532

THE NBS/NCSL FELLOWSHIP PROGRAM

AN INVITATION TO MEMBER ORGANIZATIONS OF THE NATIONAL CONFERENCE OF STANDARDS LABORATORIES (NCSL) TO PARTICIPATE IN A COOPERATIVE PROGRAM WITH THE NATIONAL BUREAU OF STANDARDS (NBS) FOR THE IMPROVEMENT OF TECHNICAL COMMUNICATIONS BETWEEN GOVERNMENT AND INDUSTRY.

THE OFFICE OF THE NBS/NCSL FELLOW AT NBS WILL BECOME THE FOCAL POINT FOR A MANAGEMENT-LEVEL INTERFACE BETWEEN NBS AND OTHER GOVERNMENT AND INDUSTRIAL ORGANIZATIONS IN AREAS OF MEASUREMENT SCIENCE, TECHNOLOGY, SAFETY, LEGAL METROLOGY, AND OTHER CRITICAL AREAS OF MUTUAL INTEREST.

WHAT IS THE NBS/NCSL FELLOWSHIP PROGRAM?

A plan in which a Fellow is resident at NBS for an agreed upon period to provide management level technical communications between NBS and NCSL member organizations and other activities concerned with measurements.

WHAT ARE THE BENEFITS TO YOUR ORGANIZATION?

* Access to the skills, resources, and management of NBS

* "Early Warning" of significant trends regarding legal aspects of metrology, safety, or measurement science
* On-the-spot representation in areas involving interaction between NCSL Member organization and other government agencies or associations.

* Full time focal point for your organization to communicate special problems directly to the proper point in NBS.

* Access to status of technical projects of interest to NCSL member organizations.

**How is the NBS/NCSL Fellowship Program Structured?**

The selected NBS/NCSL Fellow occupies an office at NBS for a specified period. The costs of the program are shared by NBS, NCSL, and the Fellow's parent organization. During the period of appointment, the Fellow acts on projects and communications of mutual benefit to members. The NBS/NCSL Fellow reports to high level NBS management to assure critical action and attention and works in close cooperation with the NCSL Board of Directors.

**Who is Eligible to Become and NBS/NCSL Fellow?**

An individual with appropriate academic background, measurement science orientation, and sufficient experience to act independently for the mutual benefit of NBS, NCSL, the parent organization, and the measurement community at large.

**How is the NBS/NCSL Fellow Selected?**

Candidates will be submitted to a committee of NCSL to be appointed by the NCSL President. The committee will submit the finalists for final selection and approval by NBS management.

**How is the NBS/NCSL Fellow Supported?**

It is expected that the NBS/NCSL Fellow will be supported financially by approximately equal contributions from the NBS, NCSL, and the parent organization as mutually agreed upon. For seniority and other benefit reasons, the NBS/NCSL support may be paid to the parent organization as an offset to his support. NBS will supply office, secretarial support, and other management items.

**What Specific Projects/Assignments Will Be Made to the NBS/NCSL Fellow?**

For each appointment there will be a goal/project identified mutually by NCSL and NBS.

**How Long Will the NBS/NCSL Fellow Work at NBS?**

Normally for a period of one to two years; programs of extended duration will be carried on by a succession of NBS/NCSL Fellows.

**When Does the NBS/NCSL Fellowship Start?**

At the date which is mutually convenient to the parent organization, NBS and NCSL. There is no fixed schedule of starting and termination dates.
WHAT ABOUT CONFLICT OF INTEREST?

Few problems are expected here, since the primary function of the NBS/NCSL Fellow is one to serve as a communications center for flow of management information and technical trends in measurement science. Nevertheless, the Fellow remains the employee of the parent organization, and it is expected that the Fellow will exercise mature judgment in structuring the job and carrying out the duties of the mutual benefit of the three sponsoring entities.

WHAT ABOUT PATENT RIGHTS?

It is not expected that the Fellow will work on projects with patentable outputs.

WHAT ARE THE BENEFITS OF THE FELLOWSHIP PROGRAM TO THE NBS/NCSL FELLOW?

The Fellow will enjoy a prestigious appointment; work on projects with a wide impact on the measurement community; and gain intimate familiarity with the national measurement system and the practical aspects of the dissemination of units of measurement from a technical and managerial point of view.

BACKGROUND OF THE NBS/NCSL FELLOWSHIP PROGRAM

The National Conference of Standards Laboratories was formed under the sponsorship of the National Bureau of Standards in the early 1960's to promote cooperation between member organizations in areas of measurement standards and calibration laboratories.

NCSL has filled a need and the organization has prospered in the intervening years. Early programs dealt with the solutions to common problems of laboratories in technology, management methods, and other areas.

Recent trends in the legal and economic climate of the USA and the world have drastically altered the business environment within which NBS and member organizations carry on their business. Such areas as product liability, OHSA, legal metrology have significant ramifications, and in most organizations the metrology group serves as the measurement technology resource.

NBS itself is moving with considerable innovation into practical metrology and is serving as the technology resource for a wide variety of important projects such as flame retardant sleepwear and building codes.

Recognizing the impact of these trends, and the importance of planning well ahead of them, NBS and NCSL have communicated intermittently with meetings, committees, and newsletters. But clearly, a full-time communications center is needed to provide management attention to the two-way flow of information which members need.

The NBS/NCSL fellowship will report at high level in NBS and will participate in NCSL board meetings. He will be available to host visits by member delegates to NBS or to respond to special information requests by members. He is their representative at NBS.
<table>
<thead>
<tr>
<th>Date</th>
<th>Conference/Conference</th>
<th>Location</th>
<th>Further Information</th>
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<tbody>
<tr>
<td>July 11</td>
<td>RF Electrical Measurements</td>
<td>Univ. of Lancaster, Lancaster, England</td>
<td>Contact: IEEE, Savoy Place, London, W.C. 2P QN England</td>
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<tr>
<td>July 12-13</td>
<td>Grounding</td>
<td>Washington, DC</td>
<td>Contact: Don White Consultants, Inc., International Training Institute, 1400 Springfield Road, Germantown, MO 20777, Phone: 301/984-0228</td>
</tr>
<tr>
<td>July 12-23</td>
<td>Lasers</td>
<td>UCLA Extension, Los Angeles, CA</td>
<td>Contact: Short Courses &amp; Conferences, Engineering/ Mathematics, UCLA Extension, 6266 Boelter Hall, Los Angeles, CA, 90024</td>
</tr>
<tr>
<td>July 13-15</td>
<td>Electromagnetic Compatibility</td>
<td>Washington, DC</td>
<td>Contact: W. C. Green, W. C. Green Associates, 1625 Eye St., N.W., Wash., DC 20006</td>
</tr>
<tr>
<td>July 15-16</td>
<td>Shielding</td>
<td>Washington, DC</td>
<td>Contact: Don White Consultants, Inc., International Training Institute, 1400 Springfield Road, Germantown, MO 20777, Phone: 301/984-0228</td>
</tr>
<tr>
<td>July 19-23</td>
<td>Microwave Semiconductor Devices, Circuits, and Applications</td>
<td>University of Michigan</td>
<td>Contact: Engineering Summer Conferences, 400 Chrysler Center, North Campus, The University of Michigan, Ann Arbor, MI, 48109, Phone: 313/764-8490</td>
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<tr>
<td>July 26-30</td>
<td>Integrated Circuits</td>
<td>University of Michigan</td>
<td>Contact: Engineering Summer Conferences, 400 Chrysler Center, North Campus, The University of Michigan, Ann Arbor, MI, 48109</td>
</tr>
<tr>
<td>July 26-30</td>
<td>Technology Assessment and Forecasting</td>
<td>The University of Michigan</td>
<td>Contact: Engineering Summer Conferences, 400 Chrysler Center, North Campus, The University of Michigan, Ann Arbor, MI, 48109</td>
</tr>
<tr>
<td>Sept. 12-17</td>
<td>Inter-society Energy Conversion Engineering Conf.</td>
<td>Teheran, Tehran, Iran</td>
<td>Contact: D. Jernigan, Industrial and Scientific Management, Inc., 222 West Adams St., Chicago, IL</td>
</tr>
<tr>
<td>Sept. 14-16</td>
<td>Electro-optics/Laser Conf. and Expo</td>
<td>New York City</td>
<td>Contact: WESCON, 3600 Wilshire Blvd., Los Angeles, CA, 90010</td>
</tr>
<tr>
<td>Sept. 14-17</td>
<td>Western Electronic Show &amp; Convention (WESCON)</td>
<td>Los Angeles Conv. Ctr., Los Angeles, CA</td>
<td>Contact: Prof. Eng. P. deSantis, Conference Chairman, Selenia S.p.A., Via Tiburtina Rm., 12,400,00131 Rome, Italy</td>
</tr>
<tr>
<td>Sept. 14-17</td>
<td>6th European Microwave Conference/Microwave 76</td>
<td>Palazzo dei Congressi, Rome, Italy</td>
<td>Contact: Dr. Raymond C. Sangster, Institute For Basic Standards, Room 4011, National Bureau of Standards, Boulder, CO 80302, Phone: 303/499-1000, x 4129</td>
</tr>
<tr>
<td>Oct. 6-8</td>
<td>NCSL Conference</td>
<td>NSB, Gaithersburg, MD</td>
<td>Contact: R. E. McIntosh, Dept. of EE, Univ. of Mass., Amherst, MA, 01002</td>
</tr>
<tr>
<td>Nov. 9-11</td>
<td>1976 Government Microcircuit Applications Conference</td>
<td>Dutch Inn, Lake Buena Vista (Orlando Area), FL</td>
<td>Contact: Mr. Conrad H. Fischer, U. S. Army Electronics Command, ATTN: ANSELTL-IC, Fort Monmouth, NJ 07703, Comm. Phone: 201/564-8547/AutoNo. 495-4547</td>
</tr>
<tr>
<td>Dec. 3-4</td>
<td>6th Measurement Science Conference</td>
<td>Cal Poly, San Luis Obispo, CA</td>
<td>Contact: K. J. O'Callaghan, Conference Coordinator, Autometrics Group, Rockwell International, Anaheim, CA 92503, Phone: 714/432-2923</td>
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<tr>
<td>Date</td>
<td>Course &amp; Conference</td>
<td>Location</td>
<td>Further Information</td>
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<tr>
<td>May 17-21</td>
<td>The Design of Optical Systems</td>
<td>Dept. of Engineering, Univ. of Wisconsin-Extension</td>
<td>Contact: University of Wisconsin-Extension, Dept. of Engineering, 432 North Lake Street, Madison, WI 53706</td>
</tr>
<tr>
<td>May 18-20</td>
<td>Aerospace Electronics Conference (NAECON)</td>
<td>Dayton Conv. Ctr., Dayton, OH</td>
<td>Contact: J.T. Singer, NAECON 76, 140 E. Monument Ave., Dayton, OH 45402</td>
</tr>
<tr>
<td>May 19-20</td>
<td>Radar Systems PRT Remote Sensing</td>
<td>Univ. of Kansas Lawrence, KS</td>
<td>Contact: Conferences and Institutes, Continuing Education Building, Univ. of Kansas, Lawrence, KS 66045</td>
</tr>
<tr>
<td>May 24-26</td>
<td>Hybrid Microelectronics</td>
<td>University of Pittsburgh</td>
<td>Contact: Office of Continuing Education 231 Benedum Engineering Hall, University of Pittsburgh, Pittsburgh, PA 15261</td>
</tr>
<tr>
<td>May 27-28</td>
<td>Problem Analysis &amp; Effective Decision Making</td>
<td>The Wisconsin Center Madison, Wisconsin</td>
<td>Contact: Fred Schwez, University of Wisconsin-Extension, Department Business &amp; Management, 432 North Lake Street, Madison, WI</td>
</tr>
<tr>
<td>June 3-4</td>
<td>19th Annual Frequency Control Symposium</td>
<td>Howard Johnson's Hotel Atlantic City, NJ</td>
<td>Contact: Commander: U.S. Army Electronics Command, ATTN: ANSEL-TEL-MF (Dr. J. K. Vig) Fort Monmouth, NJ 07703</td>
</tr>
<tr>
<td>June 6-11</td>
<td>The Management of Technology: Effective Management of Engineers and Scientists</td>
<td>University of Colorado Boulder, Colorado</td>
<td>Contact: Center for Management &amp; Technical Programs, P. O. Box 80300, Boulder, CO 80301</td>
</tr>
<tr>
<td>June 7-9</td>
<td>Physical Electronics Conference (APS)</td>
<td>Madison, Wisconsin</td>
<td>Contact: Technical Director, American Society for Quality Control, 161 West Wisconsin Ave., Milwaukee, WI 53201</td>
</tr>
<tr>
<td>June 7-9</td>
<td>Annual Quality Control Conference</td>
<td>Toronto York Hotel Toronto, Ontario</td>
<td>Contact: Dr. Carl Hammer, Director of Computer Sciences, Sperry-Univac Washington, DC</td>
</tr>
<tr>
<td>June 7-10</td>
<td>AFIPS National Computer Conference</td>
<td>Coliseum, New York City</td>
<td>Contact: IMAGE Processing Course The Institute of Optics, Univ. of Rochester, Rochester, NY 14627 Phone: 716/275-2322</td>
</tr>
<tr>
<td>June 7-11</td>
<td>Digital &amp; Optical Image Processing</td>
<td>The Inst. of Optics &amp; Dept. of EE, Univ. of Rochester</td>
<td>Contact: ICC-78, P.O. Box 8357, Philadelphia, PA 19101 Phone: 215/764-8990</td>
</tr>
<tr>
<td>June 14-16</td>
<td>1976 International Conference on Communications</td>
<td>Philadelphia Marriott Motor Hotel</td>
<td>Contact: ICC-78, P.O. Box 8357, Philadelphia, PA 19101 Phone: 215/764-8990</td>
</tr>
<tr>
<td>June 14-16</td>
<td>Int'l Microwave Symposium</td>
<td>Cherry Hill Inn Cherry Hill, NJ</td>
<td>Contact: Bernard Demurinix, ITT DCD, 492 River Road, Nutley, NJ 07110</td>
</tr>
<tr>
<td>June 28 - July 1</td>
<td>5th Biannual Int'l CODATA Conference</td>
<td>Boulder, Colorado</td>
<td>Contact: H. van Olphen, NAS, 2101 Constitution Ave., Washington, DC 20418</td>
</tr>
<tr>
<td>July 5-7</td>
<td>2nd Symposium on Frequency Standards &amp; Metrology</td>
<td>Copper Mountain, Colorado</td>
<td>Contact: Patry J. Tominaga, National Bureau of Standards, 325 Broadway, Boulder, CO 80302</td>
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