NBS SPECIAL PUBLICATION 250-OCTOBER 1982

APPENDIX

FEES FOR SERVICES

CALIBRATION AND RELATED MEASUREMENT SERVICES

OF THE NATIONAL BUREAU OF STANDARDS

This appendix is issued in April and October of each year. If you do not have the latest issue, write or call:

Office of Measurement Services
National Bureau of Standards,
Physics Building Room B362
Washington, DC 20234
(301) 921-2805.

U.S. DEPARTMENT OF COMMERCE NATIONAL BUREAU OF STANDARDS

ANNOUNCEMENTS

The announcements which follow concern notification of changes in services and information about future NBS Measurement Seminars. Specific technical questions regarding the services described in these announcements should be referred to the points of contact indicated. General policy questions regarding NBS measurement services should be referred to the Office of Measurement Services at the address above.

It should be recognized that in many cases where NBS calibration services are no longer advertised in SP 250, special arrangements can usually still be made on a case-by-case basis (NBS workload permitting) if it can be shown that there is a critical need for an NBS calibration.

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* The prices quoted in this issue of the SP 250 Appendix are effective October 1, 1982 and apply to purchase orders accepted on or after that date. A fee of $60 will be added to customer bills for each test folder issued by the Office of Measurement Services. *

* For non-Federal sponsors, the U.S. Treasury regulations require late charges based on the current value of funds to Treasury be assessed for each 30 day period or portion thereof that the payment is delayed. Therefore, each non-Federal contract or agreement should contain terms for payment as well as a provision for imposition of late charges. *
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For full description of services available from the National Bureau of Standards, consult NBS Special Publication 250, "Calibration and Related Measurement Services of the National Bureau of Standards," 1982 edition.

W = Washington, DC 20234 B = Boulder, CO 80303

1. CLASSIFICATION OF NBS SERVICES (W&B)

NBS has recently imposed new Bureau-wide quality control requirements for all services described in this Appendix (this excludes Other NBS Services listed in Section 9.0). The NBS services listed in this Appendix will henceforth be categorized as Calibrations, Measurement Assurance Programs, or Special Tests. Calibration and Measurement Assurance Program services are identified by a *H* following the SP 250 number. All other services listed are Special Tests. Details on the meaning attached to these distinctions can be obtained from the technical points of contact in the Appendix. Additional information will be published in the next Edition of SP 250 which should be available in the Fall of 1982.

2. REDUCTION OF LITTLE USED SERVICES (W)

Several advertised services for which there is little or no demand have been removed from this Appendix. However, they may be available as a special test if needed. For futher information please refer to the points of contact listed. The items which were removed are:

1.3N Haemacytometers
Contact: W. Haight, Dimensional Calibrations, 301-921-2216.

3.2X Measurement assurance programs for dc voltage ratio, phase I
(Transport ratio standard)
3.2Y Measurement assurance programs for dc voltage ratio, phase II
(Transport measuring circuit)
Contact: N. Belecki, Electrical Measurements and Standards Division,
301-921-2715.

8.3H Correction factor for an electrometer and one associated cavity
ionization chamber, one beam quality
8.3I Correction factor for an electrometer and one associated cavity
ionization chamber, each additional beam quality
NOTE: Although these services will no longer be listed as separate items
they will continue to be provided under 8.3B and C.
Contact: R. Loevinger, Dosimetry Group, 301-921-2364.

3. LENGTH CALIBRATION SERVICES (ITEM 1.3) (W)

Due to the lack of demand the following calibration services will be eliminated by January 1, 1983:

1.3B Thermal expansion of length standards
1.3D Gage block thermal expansion
1.3E Gage block comparator stulus tip radius

For further information contact: W. C. Haight, 301-921-2216.

4. CHANGE IN DESIGNATION FOR NEAR AND VACUUM ULTRAVIOLET (ITEMS 7.6-7.7) RADIOMETRIC STANDARDS, BASIC PHOTOMETRIC CALIBRATIONS AND RADIOMETRIC AND PHOTOMETRIC GAGE CALIBRATIONS (W)

Due to administrative changes at NBS items listed under 7.5, 7.6 and 7.7 have been relabeled. This has changed our numbering system as follows:

OLD SP 250 NUMBERS	NEW SP 250 NUMBERS
7.5 S-Z	7.6 A-D
7.6 A-M	7.7 A-M
7.7 B-F	7.7 N-R

5. BETA-PARTICLE EMITTING SAMPLES (ITEMS 8.2P-R) (W)

Due to the small demand for these services, beta-particle solution calibrations will not be offered as routine tests after December 1983.

NBS MEASUREMENT SEMINARS

Seminars and workshops on the topics listed below have been announced for the 1983 series of NBS Measurement Seminars.

The seminars and workshops are NBS activities that provide advice and assistance on measurement and calibration so that laboratories outside NBS can make measurements consistent with national standards as maintained by NBS. Participation is open to a limited number of persons from measurement and standards laboratories who meet appropriate prerequisites relating to education, work experience, and current professional activity.

(continued in back)

ITEMS 1.1 THROUGH 1.9 ARE DONE ON AN "AT COST" BASIS

1.1 MASS

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* Direct inquiries to the attention of: Mass Calibration Service, Mechanical Production Metrology Division, MET--B120, National Bureau of Standards, Washington, DC 20234. Telephone: 301-921-2461. Mark shipments for the attention of: Mass Calibration Service, MET--B120, National Bureau of Standards, Rt. 270 and Quince Orchard Road, Gaithersburg, MD 20877. For weights larger than 50 lb or 30 kg, contact: J. Keller, 301-921-2461, prior to shipment. *
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	Contact, Ext.
1.1A¶ Mass measurement services	J. Keller, 2461
1.1B¶ Calibration of reference standards of mass (individual weights or weight sets)	" "
1.1C¶ Mass measurement assurance program	" "

VOLUME AND DENSITY

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* Direct inquiries to the attention of Volume, Density and Fluid Meters Group, FM--105, National Bureau of Standards, Washington, DC 20234. Telephone: 301-921-3681. Mark shipments for Volume, Density and Fluid Meters Group, FM--105, National Bureau of Standards, Gaithersburg, MD 20877. *
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1.1G¶ Volume measurement services	J. Houser, 3681
1.1H¶ Calibration of reference standard volumetric apparatus	" "
1.1P¶ Density measurement services	" "
1.1Q¶ Density determinations of liquids	" "

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* Direct inquiries to the attention of Dimensional Metrology Group, MET--B104, National Bureau of Standards, Washington, DC 20234. Telephone: 301-921-2216. Mark shipments for Dimensional Metrology Group, MET--B104, National Bureau of Standards, Gaithersburg, MD 20877. *
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1.1R¶ Reference standard hydrometers	W. Gallagher, 2216

1.3 LENGTH

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* Direct inquiries to Dimensional Metrology Group, MET--B104, National Bureau of Standards, Washington, D.C. 20234. Telephone: 301-921-2216. Mark shipments for the attention of Dimensional Metrology Group, MET--B104, National Bureau of Standards, Rt. 270 and Quince Orchard Road, Gaithersburg, MD 20877. *
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	Contact, Ext.
1.3A Special length measurement services	J. Beers, 2216
1.3B Thermal expansion of length standards	" "
1.3C¶ Calibration of gage blocks	C. Tucker, 2216
1.3D Gage block thermal expansion	" "
1.3E Gage block comparator stylus tip radius	" "
1.3H¶ Line standards--40 inches or less in length	J. Beers, 2216
1.3J¶ Tapes--steel or invar	R. Hartsock, 2216
1.3K¶ Surveyor's leveling rods	C. Carroll, 2216
1.3M Sieves	R. Davenport, 2216

1.4 LENGTH AND DIAMETER DIMENSIONAL METROLOGY

1.4A End standards of length	C. Tucker, 2216
1.4B Step gage standards of length--up to 40 inches	E. Erber, 2216
1.4C¶ Plug gages	" "
1.4D¶ Measuring wires for threads and gears	R. Davenport, 2216
1.4E¶ Spherical diameter standards--balls	W. Gallagher, 2216
1.4F¶ Internal diameter standards--ring gages	" "

¶ Calibration or Measurement Assurance Program Service

1.5 COMPLEX STANDARDS OF LENGTH AND DIAMETER

1.5A Plain conical plug and ring gages	W. Gallagher, 2216
1.5B Threaded plug and ring gages	E. Erber, 2216
1.5C¶ API threaded plug and ring gages	" "
1.5E Length and diameter calipers	W. Gallagher, 2216
1.5F Micrometer screws, dial micrometers	" "
1.5G Penetration needles	E. Erber, 2216
1.5J Two dimensional gages	" "

1.6 FLATNESS, STRAIGHTNESS, AND ROUNDNESS

1.6A¶ Optical reference planes--flats	W. Gallagher, 2216
1.6F Roundness standards	" "
1.6G Roundness calibration specimens	" "
1.6H Roundness measurements	" "

1.7 ANGULAR

1.7A¶ Angle gage blocks	W. Gallagher, 2216
1.7B¶ Optical polygons	" "
1.7D Wedges	" "
1.7F¶ Rotary and indexing tables	" "
1.7G Autocollimating telescopes	" "
1.7H Angle generators	" "

1.8 SURFACE TEXTURE

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* Direct inquiries to and mark shipments for the attention of: Surface Characterization *
* Service, Mechanical Production Metrology Division, MET--A123, National Bureau of Standards, *
* Washington, DC 20234. Telephone: 301-921-2159. *
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1.8A¶ Instrument calibration specimens	F. Scire, 3838
1.8B¶ Surface roughness measurements	T. Vorburger, 3838
1.8C¶ Step height measurements--less than 10 micrometer	" "

1.9 IMAGE OPTICS AND PHOTOGRAPHY

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* Contact L. E. Fink, Met B306, National Bureau of Standards, Wash. DC 20234, Telephone: *
* 301-921-2791 *
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1.9C Step tablets	L. E. Fink, 2791
1.9D Microscopy resolution test charts	" "

¶ Calibration or Measurement Assurance Program Service

2.1 ACOUSTIC MEASUREMENTS

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* Direct inquiries to and mark shipments for the attention of: Acoustical Calibration *
* Service, Mechanical Production Metrology Oivision, SOUNO--A149, National Bureau of *
* Standards, Washington, OC 20234. Telephone: 301-921-3607. *
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At Cost	2.1A	Acoustical measurement services	
$ 840	2.1B¶	Microphone WE Type 640 AA or equivalent	Range--50 - 10,000 Hz
1085	2.1C¶	" " " " " " "	50 - 20,000 Hz
985	2.1O¶	Pressure calibration B&K types 4134, 4166, or equivalent	50 - 10,000 Hz
1330	2.1E¶	" " " " " " "	50 - 20,000 Hz
1080	2.1F¶	Free-field calibration B&K types 4133, 4165, or equivalent	2,500 - 20,000 Hz
935	2.1H	Earphones on NBS 9-A Coupler	125 - 8,000 Hz

ULTRASONIC MEASUREMENTS

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* Oirect inquiries to and mark shipments for the attention of: Ultrasonic Calibration *
* Service, Mechanical Production Metrology Division, SOUNO--A147, National Bureau of *
* Standards, Washington, OC 20234. Telephone: 301-921-3646. *
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At Cost	2.1R	Ultrasonic reference blocks--Calibration relative to NBS interim reference standard. For further information, contact Gerald Blessing, Telephone (301) 921-3646.
At Cost	2.1S¶	Ultrasonic transducer power and frequency measurement. For further information contact S. E. Fick, Telephone (301) 921-3646.
At Cost	2.1T¶	Calibration of acoustic emission sensors. For further information contact Frank Breckenridge, Telephone (301) 921-3646.

2.2 VIBRATION MEASUREMENTS

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* Oirect inquiries to and mark shipments for the attention of: Vibration Calibration *
* Service, Mechanical Production Metrology Oivision, SOUNO--A149, National Bureau of *
* Standards, Washington, OC 20234. Telephone: 301-921-3607. *
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			Frequency Range (Hz)	Applied Nominal Peak Accelerations (g)
$ 595	2.2A¶	Pick up sensitivity (magnitude only)	2-100	varies from 0.2 to 2
1325	2.2B¶	Pick up sensitivity (magnitude and phase)	3,000-13,000	$77.7 \times 10^{-8} f^2$
985	2.2C¶	Pick up sensitivity (magnitude only)	10-3,000	10
1725	2.2O¶	Pick up sensitivity (magnitude only)	10-10,000	10
At Cost	2.2E	Specialized vibration measurement services by prearrangement		
At Cost	2.2F	Pick up sensitivity (magnitude only) Improved Accuracy	4-10,000	10

2.3 HUMIOITY MEASUREMENTS

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* Oirect inquiries to the Humidity Group, PHYS--B252, National Bureau of Standards, *
* Washington, OC 20234. Telephone: 301-921-2794. Mark shipments for the attention of *
* S. Hasegawa, PHYS--B354, National Bureau of Standards, Rt. 270 and Quince Orchard Road, *
* Gaithersburg, MO 20877. *
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At Cost	2.3A¶	Humidity measurement services	
$ 1465	2.3B¶	Dewpoint hygrometers automatic operation	Range--25° to -15 °C
2965	2.3C¶	" " " "	-15° to -70 °C
At Cost	2.3F¶	Electric hygrometer	
At Cost	2.3G¶	Coulometric hygrometer	
At Cost	2.3H¶	Aspirated hygrometer	
At Cost	2.3I¶	Pneumatic bridge hygrometer	

¶ Calibration or Measurement Assurance Program Service

2.5 CALIBRATION OF FORCE TRANSDUCERS AND FORCE MEASUREMENT SYSTEMS

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* Direct inquiries to: Force Calibration Service, Mechanical Production Metrology Division, EM--221, National Bureau of Standards, Washington, DC 20234. Telephone: 301-921-3884. Mark shipments for the attention of: Force Calibration Service, EM--221, National Bureau of Standards, Rt. 270 and Quince Orchard Road, Gaithersburg, MD 20877.
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At Cost	2.5A¶	Capacities to 25,000 lbf, one mode
At Cost	2.5B¶	Capacities to 25,000 lbf, two modes
At Cost	2.5D¶	Capacities 25,001 to 112,000 lbf, one mode
At Cost	2.5E¶	Capacities 25,001 to 112,000 lbf, two modes
At Cost	2.5G¶	Capacities 112,001 to 300,000, one mode
At Cost	2.5H¶	Capacities 112,001 to 300,000, two modes
At Cost	2.5J¶	Capacities 300,001 to 1,000,000, one mode
At Cost	2.5K¶	Capacities 300,001 to 1,000,000, two modes
At Cost	2.5M¶	Capacities over 1,000,000 lbf, compression only
At Cost	2.5N	Special force measurement services

2.7 FLUID QUANTITY AND FLOW RATE METERS

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* Direct inquiries to Volume, Density, and Fluid Meters Group, FM--105, National Bureau of Standards, Washington, DC 20234. Telephone: 301-921-3681. Mark shipments for Volume, Density, and Fluid Meters Group, FM--105, National Bureau of Standards, Rt. 270 and Quince Orchard Road, Gaithersburg, MD 20877. Contact: Mr. K. R. Benson, telephone: 301-921-3681.
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NOTE: 5 rates of flow; 10 observations at each rate; additional rates at 10 percent of fee for each rate:

At Cost	2.7A¶	Flow rate measurement services	
$ 1850	2.7B¶	Dry gas quantity meter	up to 2,500 ft^3/hr.
1850	2.7C¶	Liquid quantity meter	up to 300 gpm
1850	2.7D¶	Flow rate meter (direct reading)	0.002 to 3,000 ft^3/min. air, 0.1 to 10,000 gpm liquid
2850	2.7E¶	Flow rate meter (orifice, nozzle, laminar flow, etc.)	0.002 to 3,000 ft^3/min. air, 0.1 to 10,000 gpm liquid
2220	2.7G¶	Meters of type 2.7E--added cost for similar multiples	

2.9 AERODYNAMICS

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* Direct inquiries to Fluid Mechanics Group, FM--105, National Bureau of Standards, Washington, DC 20234. Telephone: 301-921-3684. Mark shipments for Fluid Mechanics Group, FM--105, National Bureau of Standards, Gaithersburg, MD 20877. Contact: Mr. N. E. Mease.
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At Cost	2.9A	Aerodynamic measurement services	
$ 375	2.9B	Air speed instruments	3 to 150 mph
760	2.9C¶	Pitot-static tubes	3 to 150 mph
At Cost	2.9D¶	Dynamic response of mechanical rotary anemometers	10 fps to 45 fps
730	2.9E¶	Low air speed instruments	15 to 2,000 fpm

¶ Calibration or Measurement Assurance Program Service

3.1 RESISTANCE MEASUREMENT

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* Direct inquiries to the attention of: Electrical Measurements and Standards Division, *
* MET--B146, National Bureau of Standards, Washington, DC 20234. Telephone: 301-921-2715. *
* Ship to National Bureau of Standards, Rt. 270 and Quince Orchard Road, Gaithersburg, *
* MD 20877. Attn: Electrical Measurements and Standards Division. *
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At Cost	3.1A	Special resistance measurement services by prearrangement
At Cost	3.1B¶	Resistance Measurement Assurance Programs
		Wirewound (or equivalent, dc resistance only, in oil at 25 °C or in air at 23 °C)
$ 315	3.1C¶	Std. resistors--Four terminal, Thomas type 1 Ω
410	3.1D¶	Std. resistors--Four-terminal, nominal value 10 k ohm, Evanohm wirewound high precision
205	3.1E¶	" " " " " " 0.01 ohm
205	3.1F¶	" " " " " " 1 ohm, Rosa and other than Thomas design
180	3.1G¶	" " " " " " 100 ohm, Rosa design, or other manganin wirewound
180	3.1H¶	" " --Two-terminal, nominal value 10 k ohm, Rosa design, or other manganin wirewound
180	3.1I¶	" " " " " " 1 M ohm
285	3.1J¶	" " --Four-terminal, nominal value 0.0001 ohm
		Multiple megohm, at applied voltages between 1.5 and 500 volts
285	3.1O¶	Std. resistors--10^6 Ω to 10^{10} Ω, each voltage
320	3.1P¶	" " --10^{10} Ω to 10^{12} Ω, " "
		Services 3.1Q-U are available only during May and November. To arrange scheduling contact: Avis Wise, 301-921-2715. NOTE: During these months the time available for calibration of other resistance standards is limited.
At Cost	3.1Q	Pressure coefficient, Thomas resistors
310	3.1R¶	Standard resistors for current meas. (shunts) one range, one current, not over 300A
570	3.1S¶	" " " " " " one range at one current between 300 and 1000A
115	3.1T¶	Additional determination on another range of a multi-range resistor or at another current on a single range resistor tested in 3.1R, S or T
980	3.1U	Adjustable low resistance standard (9 plug + 11 slide positions) at 30A

3.2 PRECISION APPARATUS

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* See 3.1 *
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At Cost	3.2C	Hamon devices
510	3.2Q¶	Ratio Devices, Inductive voltage dividers, single frequency and voltage to be specified, inphase and quadrature corrections, each setting of 3 most significant dials (all others at zero)
320	3.2R¶	" " Inductive voltage dividers, single frequency and voltage to be specified, inphase and quadrature corrections, each setting of most significant dial only (all others at zero)
At Cost	3.2V	Silsbee type divider (each ratio)
At Cost	3.2W	" " " internal heating effect one range at rated voltage not to exceed 1500 V

3.3 IMPEDANCE MEASUREMENTS

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* See 3.1 *
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At Cost	3.3A	Special inductance and capacitance measurement services by prearrangement
$1745	3.3B¶	Capacitance measurement assurance programs
165	3.3C¶	Inductors, fixed, self or mutual at 1 frequency (specify 100, 400, 1000, or 10 KHz)
165	3.3D¶	" " " " " additional frequency points for above

¶ Calibration or Measurement Assurance Program Service

$ 180	3.3E¶	Capacitors, standard, fixed three-terminal, coaxial connectors, at one freq. at high accuracy under controlled conditions (specify 100, 400, 1000 Hz) See NOTE and also 3.3G.
180	3.3F¶	Capacitors, standard, additional frequency points for above at high accuracy under controlled conditions
165	3.3G¶	Physical tests required to qualify three-terminal air capacitor for 3.3E and F
165	3.3H¶	Capacitors, standard, variable or decade, first point
25	3.3I	" " " additional points
590	3.3J¶	" " fixed, fused silica dielectric, 10 pF or 100 pF, one freq. (100, 400, 1000 Hz)
115	3.3K¶	Capacitors, standard, fixed, three-terminal, coaxial connectors, at one frequency (specify 100, 400, 1000 Hz), minimum uncertainty 25 ppm, under typical laboratory conditions
115	3.3L¶	Capacitors, standard, additional frequencies for above
90	3.3M¶	Capacitors, standard, fixed, two-terminal, plugs, posts or coaxial connectors, at one frequency (specify 66 2/3, 100, 300, 1 k, 10 k, 20 k, 30 kHz)
90	3.3N¶	Capacitors, standard, additional frequencies for above

NOTE: Items 3.3E, F and G refer to precision three-terminal capacitors, such as ESI SC1000 and General Radio 1404 series, only. Any three-terminal capacitance standards may be calibrated under items 3.3K or L to 25 ppm minimum uncertainty. All two-terminal standards should be done under 3.3M or N.

3.4 VOLTAGE MEASUREMENTS

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* See 3.1 *
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At Cost	3.4A	Special voltage measurement services by prearrangement
$1275	3.4B¶	Volt Transfer Program, for one group of up to six customer cells
230	3.4C¶	Standard cell calibrations, saturated std. cell groups, first cell
135	3.4D¶	" " " " " " " each additional
73	3.4E¶	Platinum thermometer temperature determination of cells supplies in air enclosures
110	3.4F¶	Standard cell calibrations, unsaturated standard cell
155	3.4G	Solid state voltage ref. devices, calib. of one output (nominally 1.02 V)
230	3.4H	" " " " " " " " " " 5 - 10 V
75	3.4I	" " " " " each additional output
30	3.4J	Special handling, equipment pickup or delivery to or from airport
56	3.4K	" " cleaning, minor repairs, return service charges

3.5 ELECTRICAL INSTRUMENTS (AC-DC)

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* See 3.1 *
****

Thermal voltage and current converters are now being calibrated on a scheduled basis. To arrange scheduling contact: Avis Wise, 301-921-2715. Send in the equipment only as scheduled to avoid a long turn-around time at NBS.

At Cost	3.5A	Special measurement services by prearrangement
$ 210	3.5B¶	RMS ac-dc transfer standard, initial determination at 1 voltage and 1 frequency up to 1 MHz or 1 current at 1 frequency up to 50 kHz
64	3.5C¶	RMS ac-dc transfer standard, additional determination at 1 frequency from 20 - 50,000 Hz
64	3.5D¶	" " " " additional determination at 1 frequency from 50 kHz - 1 MHz and from 10 kHz - 50 kHz for 1000 volt range

3.6 INSTRUMENT TRANSFORMERS AND COMPARATORS

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* Direct inquiries to: Electrosystems Division, MET--B344, National Bureau of Standards, *
* Washington, DC 20234. Telephone: 301-921-3121. Mark shipments for the attention of: *
* Electrosystems Division, MET--B344, National Bureau of Standards, Rt. 270 and Quince Orchard *
* Road, Gaithersburg, MD 20877. *
****

At Cost	3.6A	Special measurement services by prearrangement
$ 525	3.6B¶	Voltage transformers, ratio & phase angle, at 60 Hz on 1 range, 1 secondary voltage, 1 burden primary V $\leq$ 50 kV
370	3.6C¶	Voltage transformers, same test as in 3.6B additional transformers submitted at same time

¶ Calibration or Measurement Assurance Program Service

$ 81	3.6D¶	Voltage transformers, same test as in 3.6B and 3.6C but for additional burden or additional range
35	3.6E¶	Voltage transformers, same test as in 3.6B, 3.6C, 3.6D at each additional secondary voltage
At Cost	3.6G	Voltage transformers, comparators, 11 points on ratio dial and 13 on phase angle dial
505	3.6P¶	Current transformer, ratio and phase angle--1 range at 1 frequency 1 burden, secondary currents 0.5, 1, 2, 3, 4, 5 A at primary current not over 8000 A
43	3.6R¶	Current transformer, ratio and phase at 1 secondary current on additional combination of range, frequency, and burden, primary current not over 8000 A
27	3.6T¶	Current transformer, ratio and phase at each additional secondary current with same combination of range, frequency, and burden as in 3.6P or 3.6R
At Cost	3.6W	Current transformer comparator, determinations not exceeding 13 points on ratio dial and 15 points on phase angle dial at 60 Hz
At Cost	3.6X	Current transformer comparator, additional 8 determinations on second range

3.7 HIGH VOLTAGE AND ENERGY MEASUREMENTS

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* See 3.6 *
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At Cost	3.7A	Specialized high voltage measurement services by prearrangement
$ 430	3.7B¶	Resistors and resistive dividers, total resistance or voltage ratio at two direct voltage levels between 10 and 100 kV
485	3.7D¶	Watthour meters; Measurement Assurance Program
430	3.7E¶	Watthour meters--initial two determinations of percentage registration of one meter at 60 Hz
39	3.7F¶	Watthour meters--each additional determination of percentage registration of same meter at 60 Hz
410	3.7G¶	Watthour meters--initial two determinations of percentage registration of one or two meters run simultaneously with the first
33	3.7H¶	Watthour meters--each additional determination of percentage registration of the same one or two meters run simultaneously with the first
At Cost	3.7O	High voltage capacitors
At Cost	3.7P	Pulse-voltage-measuring systems including Kerr electro-optical measurements
630	3.7Q	X-ray Unit, voltage divider (cost listed is for two dividers in the same container)
At Cost	3.7Z	High voltage field calibrations

3.8 AC-DC WATTMETERS; AC RESISTORS; CALIBRATORS and VOLTMETERS (Up to 10 Hz)

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* Direct inquiries to: Electrosystems Division, MET--B162, National Bureau of Standards, *
* Washington, DC 20234. Telephone: 301-921-2727. Mark shipments for the attention of: *
* Electrosystems Division, MET--B162, National Bureau of Standards, Rt. 270 and Quince Orchard *
* Road, Gaithersburg, MD 20877. *
****

At Cost	3.8A	Special measurement services by prearrangement
At Cost	3.8B	Ac-dc wattmeters (measurement by prearrangement)
At Cost	3.8C	Voltmeters and voltage sources operable in the ranges of 0.1 Hz - 10 Hz and 0.5 mV - 7V.

3.9 DATA CONVERTERS

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* See 3.8 *
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At Cost	3.9A¶	Special data converter measurement services by prearrangement
$ 280	3.9B¶	A/D or D/A converter, linearity errors at 1024 points, including determination of 10 bit correction coefficients, and superposition errors
52	3.9C¶	A/D or D/A converter, differential linearity errors at 2(N-1) points (N = no. of bits)
66	3.9D¶	A/D converter, equivalent rms input noise, average value
87	3.9E¶	A/D converter, equivalent rms input noise, determined at 64 randomly selected points
At Cost	3.9F	A/D or D/A converter, determination of offset and gain errors (with respect to legal volt)

¶ Calibration or Measurement Assurance Program Service

4.0 ELECTROMAGNETIC QUANTITIES

Measurements at radio, microwave, millimeter wave and laser frequencies. Shipments for electromagnetic measurement services available in Boulder should be addressed to: Measurement Services Clerk, National Bureau of Standards, Boulder, CO 80303. Inquiries on Measurements Services should be directed to the entries given for the electromagnetic quantities listed below.

Item No.	Frequencies At fixed frequencies listed unless range indicated	Magnitude Ranges	Fees Each item one magnitude at one frequency (Except for 4.1E and 4.9H)	Fees Same item each additional magnitude same frequency

4.1 ATTENUATION (Second fee column also applies to additional items, same frequency.)

Direct inquiries to the Electromagnetic Technology Division, National Bureau of Standards, Boulder, CO 80303. Telephone: 303-497-3148.

Measurements performed at cost. Initial charge for set up and first point. Reduced charge for each additional point at same frequency.

4.1A	Special Calibrations		At Cost	At Cost

Coaxial Fixed and Variable Attenuators

Range includes initial insertion loss; typical uncertainties are 0.003 dB per 10 dB at 30 MHz and 0.03 dB per 10 dB over the range 100 MHz to 18 GHz.

4.1B¶		30 MHz	0 to 140 dB	At Cost
		100 MHz to 18 GHz (ANA)	0 to 60 dB	

4.1C¶	Waveguide circular below-cutoff (piston) attenuators, coaxial connectors			
		30 MHz	0 - 140 dB Typical Uncertainties 0.003 dB per 10 dB	At Cost

Variable rectangular waveguide attenuators, attenuation difference, standard waveguide connectors, repeatability of scale setting better than ±0.1 dB; typical uncertainties, 0.05 - 0.5 dB depending on scale setting.

4.1D¶		Specify frequencies for waveguide sizes WR15*, WR28, WR42, WR62, WR90, WR137 WR187, WR284	0 - 50 dB	At Cost

*Regular services in WR15 are temporarily discontinued. Special services are available on a critical need basis.

Wideband attenuation or gain of coaxial networks. Examples are attenuators, amplifiers, filters, directional couplers, coaxial cable, etc. Pulse techniques and Fourier transforms are used to provide data over a wide frequency range. Approximately 100 data points at harmonically related frequencies are typically given for a single fee. Direct inquires to the National Bureau of Standards, Boulder, CO 80303. Telephone: 303-497-3806.

4.1E	20 kHz to 12.4 GHz	0 to 40 dB	At Cost

NOTE: The minimum fee is $315. If two or more similar items are submitted for calibration at the same time, the fee for each additional item above the first is $210.

¶ Calibration or Measurement Assurance Program Service

4.2 FIELDS (ELECTROMAGNETIC) AND ANTENNAS

Direct inquiries to the Electromagnetic Fields Division, National Bureau of Standards, Boulder, CO 80303. Telephone: 303-497-3301.

4.2A Special Calibrations — At Cost

Microwave Antenna Measurements

Accurate means of measurement of antenna gain, pattern, and polarization are generally available from about 500 MHz to about 75 GHz. However, measurements of all three characteristics may not be practical for a given antenna because the measurement accuracy, capability, and cost depend on the frequency, type and size of antenna, and the parameters to be measured. Therefore, a particular measurement must be negotiated in advance. The following methods and facilities are used for these measurements.

(1) Planar Near Field Scanning Method

With this technique, gain, pattern and polarization parameters are calculated from near-field amplitude and phase measurements taken over a plane area close to the test antenna. The absolute gain can be determined to within ±0.15 dB, polarization axial ratio to within about ±0.10 dB/dB and side lobe levels can be obtained down to -50 or -60 dB. (The exact uncertainties will depend on the frequency, type, and size of antenna, etc.) Antennas with apertures up to about 3.5 m in diameter can be managed. Measurements can be made from 750 MHz up to 75 GHz, with best results achieved above 1 GHz.

(2)¶ Extrapolation Range Measurements

In this method, the received signal transmitted between a pair of antennas is measured as a function of the separation distance between the antennas. The antennas need not be identical, and no assumptions concerning the polarization are required. The method is not well suited for pattern measurements, but it is the most accurate technique known for absolute gain and polarization measurements. Above 1 GHz, the accuracies are typically ±0.08-0.10 dB for gain measurements, and ±0.05 dB/dB for polarization axial ratio measurements. There are uppersize limitations associated with existing NBS extrapolation ranges. These limitations depend on the type of antenna, the frequency, and the desired measurements and accuracies. Therefore, negotiations must be conducted prior to submitting antennas for calibration to ascertain if all requirements can be met.

4.3 IMPEDANCE OR ADMITTANCE

(Capacitance, inductance, resistance, conductance, Q, dissipation factor impedance magnitude, phase angle, Voltage Standing Wave Ratio (VSWR), reflection coefficient, return loss). Items 4.3A, B and C utilize lumped parameter measurement techniques such as bridges, LCR Meters and resonance methods over the frequency range from 30 kHz to 250 MHz. Item 4.3F utilizes the distributed parameter measurement approach employing an automatic network analyzer (ANA) over the frequency range 0.1 to 18 GHz. In the range from 0.1 to 0.25 GHz where there is overlap between lumped and distributed parameter capabilities, NBS will choose the best method for the item to be calibrated. Items 4.3G and 4.3H pertain to rectangular waveguide items.

*For Items 4.3A through 4.3E, direct inquiries to the National Bureau of Standards, Electromagnetic Fields Division, 325 Broadway, Boulder, CO 80303. Telephone: 303-497-3609.

*For Items 4.3F through 4.3H, direct inquiries to the National Bureau of Standards, Electromagnetic Technology Division, 325 Broadway, Boulder, CO 80303. Telephone: 303-497-3148.

4.3A Special Calibrations 30 kHz to 250 MHz	Capacitance:		
	two-terminal: 1 pF to 0.1 μF	At Cost	At Cost
	three-terminal: 10^{-2} pF to 10^{3} pF	At Cost	At Cost
	Inductance: 10^{-2} μH to 1 H	At Cost	At Cost
	Resistance: 0.1 Ω to 10^{6} Ω	At Cost	At Cost
	Conductance: 1×10^{-6} S to 1×10^{-3} S	At Cost	At Cost
	Q: 1 to 10^{4}	At Cost	At Cost

¶ Calibration or Measurement Assurance Program Service

Capacitance (two-terminal); for air-dielectric capacitors with 14 mm precision coaxial connectors and nominal values within ±1 pF 50, 100, 200, 500 or 1000 pF: Typical uncertainties 0.01% to 0.08% depending on capacitance value. Dissipation factor not given for air-dielectric capacitors.

4.3B	1 MHz	$205

Capacitance (three-terminal) for air-dielectric capacitors with nominal values of 10^{-2}, 10^{-1}, 10^{0}, 10^{1}, 10^{2} and 10^{3} pF having either BNC jack or GenRad Type 874 connectors. Typical uncertainties from ±0.05% to ±2% depending on capacitance value and frequency. Dissipation factor not given.

4.3C¶	100 kHz, 465 kHz, 1 MHz	$220

Capacitance (three-terminal) for MacLeod and Hanopol pi-network type capacitors and auxiliary units; capacitance values from 0.001 to 10 pF; typical uncertainties from ±0.1% to 1% depending on capacitance value. Dissipation factor not given.

4.3D	465 kHz	$215 (main capacitor)	$ 90 (each auxiliary unit)

Q-Standards (inductive) for coils equipped with banana plug connectors spaced 2.54 cm (1") on centers having nominal inductances of 0.25 μH, 2.5 μH, 25 μH, 250 μH, 2.5 MH and 25 MH.

4.3E¶	50, 100, 150, 300 450, 500 kHz 1, 1.5, 3, 4.5, 5, 10, 15, 30, 45 MHz	$135 (one frequency)	$ 40 (each additional frequency)

Complex reflection coefficient Γ, and impedance Z ; typical limits of uncertainty for: Γ : 0.005 to 0.01 for Z : ±0.5 to 1%

4.3F¶	0.1 - 18 GHz (ANA)	Γ: 0.001 to 0.6 Z: 12.5 - 200 Ω	At Cost	At Cost

Reflection coefficient Γ of rectangular waveguide reflectors (mismatches) with standard flange connectors; magnitude only; range of uncertainty ±(0.00015 + 0.0035 Γ to ±(0.0008 + 0.0035 Γ)

4.3G¶	Specify frequency for waveguide sizes, WR15*, WR28, WR42, WR62, WR90, WR137	0.025 to 0.2	At Cost	At Cost

*Regular services in WR15 are temporarily discontinued. Special services are availabe on a critical need basis.

Reflection coefficient of nonreflecting rectangular waveguide ports and matched loads; magnitude only; for typical uncertainties see 4.3G.

4.3H	Specify frequency for waveguide sizes WR15*, WR28, WR42, WR62, WR90, WR137	0.0001 to 0.025	At Cost	At Cost

*Regular services in WR15 are temporarily discontinued. Special services are available on a critical need basis.

4.4 LASER PARAMETERS

Direct inquiries to William E. Case, Electromagnetic Technology Division, National Bureau of Standards, Boulder, CO 80303. Telephone: 303-497-3741.

¶ Calibration or Measurement Assurance Program Service

4.4A Special Calibration — At Cost

4.4B¶ Measurement Assurance Program for Laser Power or Energy

514.5 nm	10mW - 600 mW	$1605/yr.
632.8 nm	1mW	1605
632.8 nm	(1μW, 30μW, 100μW) (Cost is $1000 to participants of 1 mw, 632.8 nm, Laser MAP where the intercomparisons are performed together.)	1605
647.1 nm	10 mW - 200 mW	1605
1.06 μm	10 mW - 1 W	1605
1.06 μm	(Q-switched) 100 mJ - 10 J	2690
10.6 μm	5 - 50 W	2165

4.6 NOISE TEMPERATURE (EFFECTIVE) (Second fee column applies to additional items, same frequency.)

Direct inquiries to Electromagnetic Fields Division, National Bureau of Standards, Boulder, CO 80303. Telephone: 303-497-3301.

4.6A Special Calibrations — At Cost — At Cost

4.6B Coaxial noise generators: Effective noise temperature, type N precision or 14 mm connectors

30 MHz and 60 MHz; VSWR < 1.2; ENR < 18 dB		$855	$750*

*Each additional item, same frequency.

Coaxial noise generators: Effective noise temperature, type N precision or 14 mm connectors: specify dc calibration current for gas discharge type noise generators.

4.6C	2.60, 2.85, 3.00 3.25, 3.55, 3.75 3.95 GHz; reflection coeff. 0.1	700 - 300,000 K 1.5 to 30 dB ENR	$855	$750*

*Each additional item, same frequency.

A rectangular waveguide noise source is a terminated waveguide noise-tube mount: Supply complete information on the operating current of gas-discharge tube sources. Specify frequencies for waveguide sizes for calibration: Effective noise temperature: Excess noise ratio: EIA Waveguide sizes and flanges: Uncertainties for sources with effective noise temperature of approximately 10,000 K usually lie between 150 K and 350 K.

4.6D	WR62, WR75, WR90, WR284 and for WR112 & WR229 (partial coverage); VSWR of source <1.2; reflection coefficient <0.09	700 - 300,000 K	$855	$750*

*Each additional item, same frequency.

4.6E Noise Temperature (EFFECTIVE) of WR15 waveguide noise generators — $1015

¶ Calibration or Measurement Assurance Program Service

4.7 PHASE SHIFT

Direct inquiries to Electromagnetic Technology Division, National Bureau of Standards, Boulder, CO 80303. Telephone: 303-497-3753.

Measurements at cost. Initial charge for set up and first point. Reduced charge for each additional point at same frequency.

4.7A Special Calibrations — At Cost

Fixed and variable coaxial phase shifters; characteristic phase shift difference; precision connectors.

4.7B¶	30 MHz	0 - 360°	Typical Uncertainty 0.1 to 0.5 degrees	At Cost
	1-18 GHz (ANA)	0 - 360°	Typical Uncertanity 0.5 degrees or less	At Cost

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Variable rectangular waveguide phase shifters: Phase shift difference: VSWR <1.4; typical uncertainties 0.1 to 1 degree depending on scale setting.

4.7C¶	Specify frequencies for waveguide sizes WR62, WR90, WR137 WR187, WR284	Range 0 - 720°	At Cost

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Pulse time delay

Direct inquiries to the Electromagnetic Technology Division, National Bureau of Standards, Boulder, CO 80303. Telephone: 303-497-3259.

4.7D	10 to 1500 ps	At Cost	At Cost

4.8 POWER MEASUREMENTS

Schedule of Services

Regular service - measurements will be conducted according to the following schedule when purchase orders and devices arrive at the Office of Measurement Services/Boulder prior to the first day of the month in which calibration is scheduled.

Type N	Jan., Apr., June, Aug., Nov.
7 mm precision	Mar., Sept.
Rectangular waveguide	Feb., May, July, Oct., Dec.

Direct inquiries to the Electromagnetic Technology Division, National Bureau of Standards, Boulder, CO 80303. Telephone: 303-497-3210 for services at 1 GHz and above, or x3561 for services below 1 GHz.

Power Level: 10 mW (nominal)

Bolometer Units and Thermoelectric (TE) Power Sensor - Power Meter Combinations

Connector types: Coaxial; type N to 18 GHz
7 mm precision to 18 GHz

Rectangular waveguide; WR15*, 28, 42, 62, 75, 90, 112, 137, 187, and 284

*WR15 units calibrated during January and July only.

¶ Calibration or Measurement Assurance Program Service

Limits of Uncertainty

Effective efficiency, ηe, and calibration factor, K_B:

The estimated limits of uncertainty will vary from ± 0.5% to 2% approximately, depending on the frequency and the characteristics of the unit being calibrated such as connector type, reflection coefficient, and repeatability.

Reflection coefficient:

The estimated limits of uncertainty are ± (.005 + .001f) where f = frequency in GHz.

4.8A Special Calibrations (includes WR15) — At Cost

4.8B Single Frequency Measurements

Effective efficiency and reflection coefficient	$210 (first frequency)	$150 (each additional frequency)

Specify frequency in range 0.1 to 10 MHz for special low frequency bolometer units. (Values for ηe and Γ are calculated from measurements of voltage as in 4.9B and resistance as in 4.3A.)

Specify frequency for rectangular waveguide WR28, and 42.	450
Measurement of output of power ref. in TE power meters	150

4.8C Multiple Frequency Broadband Measurements

Calibration factor, effective efficiency, efficiency factor and reflection coefficient:

10 - 100 MHz*	10, 50**, and 100 MHz	$440
100 - 1000 MHz	100, 500, and 1000 MHz	440
10 - 1000 MHz*	10, 50**, 100, 500, and 1000 MHz	760

At intermediate frequencies, values of calibration factor and effective efficiency may be determined by linear interpolation.

* Only bolometer units designed for low frequency operation are calibrated below 100 MHz. Most TE sensor units can be calibrated below 100 MHz.

** Limit of uncertainty 0.5% for bolometer unit calibration.

Effective efficiency†, efficiency factor†† and reflection coefficient.

Coaxial

1 - 2 GHz	50 MHz intervals	$655
2 - 4 GHz	100 MHz intervals	655
4 - 8 GHz	200 MHz intervals	655
8 - 12.4 GHz	200 MHz intervals	655
12.4, 12.75 - 18 GHz	250 MHz intervals	655

Rectangular Waveguide

WR284	2.6 - 4.0 GHz	6 frequencies	$655
WR187	4.0 - 5.8 GHz	100 MHz intervals	655
WR137	6.0 - 8.0 GHz	100 MHz intervals	655
WR112	7.0 - 10.0 GHz	200 MHz intervals	1250
WR90	8.2 - 12.4 GHz	200 MHz intervals	655
WR75	10.0 - 15.0 GHz	250 MHz intervals	1250
WR62	12.4, 12.75 - 18 GHz	250 MHz intervals	655

† Bolometer units only
†† TE sensor--power meter units only

Coaxial peak pulse power meters; instruments of 50 ohm nominal impedance; connectors of type N, BNC, HN or 7 or 14 mm precision connectors; input peak pulse power vs scale reading of terminating-type instruments; input and/or output peak pulse power vs scale reading of feed-thru instruments. Pulse duration 2 to 10 μ sec. rep. rate 100 to 1500 pps, max. duty factor 0.0033.

4.8I	300 to 500 MHz	0.001 to 5000 W	$265	$ 81
	950 to 1250 MHz	0.001 to 5000 W		
	4000 to 4400 MHz	0.001 to 500 W		

4.9 VOLTAGE (Second fee column applies to each additional voltage or different frequency, same item.)

NOTE: Direct inquiries to the Electromagnetic Technology Division, National Bureau of Standards, Boulder, CO 80303. Telephone: 303-497-3561 (4.9A - 4.9E, 4.9R), x3806 (4.9H - 4.9J).

4.9A Special Calibrations		At Cost	At Cost

Thermal Voltage Converters (TVC's): RF - DC Difference, percent

4.9B¶ Low frequency TVC (0.03 - 100 MHz)

TVC's in the 0.1 to 200 V range can be calibrated at the frequencies listed up to 100 MHz.

0.03, 0.1, 0.3, 1, 3, 10, 30, 100 MHz	0.1 to 50 V	$110	$ 54
0.03, 0.1, 0.3, 1, 3, 10, 30, 100 MHz	50 to 200 V	$110	$110

Limits of Uncertainty

The estimated limits of uncertainty: ± 0.05% to ± 1.0% depending upon frequency and the frequency vs RF-DC difference response.

4.9C¶ High Frequency TVC

TVC's with a built-in "T" connector in the 0.1 to 7 V range can be calibrated at any of the frequencies listed below:

10, 30, 100, 200 MHz 300, 400, 500, 600 MHz 700, 800, 900, 1000 MHz	0.1 to 7.5 V	$215	$110

Limits of Uncertainty

The estimated limits of uncertainty: ± 0.1% to ± 1.0% depending upon frequency.

RF Micropotentiometers: RF - DC Difference, percent

4.9D¶ RF Micropotentiometers

Any frequency within

0.05 to 900 MHz	1 to 100,000 μV	$110	$110

Limits of Uncertainty

The estimated limits of uncertainty: from ± 2% to ± 5% depending upon frequency and the RF-DC difference vs frequency response.

¶ Calibration or Measurement Assurance Program Service

4.9E As a special service, rf micropotentiometers with output voltages greater than 200 μV can be calibrated from 0.05 to 1000 MHz, with reduced limits of uncertainty varying from ± 0.2% to ± 2%. This uncertainty is dependent on frequency, output level and the rf-dc difference vs frequency response. For further details on this special calibration, call the Electromagnetic Technology Division, Telephone: 303-497-3561.

Impulse generator spectrum amplitude in dBμV/MHz for a 50 ohm termination. 50 to 100 data points are given over a wide frequency range for a single fee.

4.9H¶ At Cost
(Typical fee is $525)

Pulse Generator Transition Duration (Rise Time)

4.9I¶ >10 ps At Cost
(Typical fee is $525)

Low-Pass Filter Transition Duration (Rise Time). Examples are coaxial adapters, etc.

4.9J¶ >5 ps At Cost
(Typical fee is $525)

4.9R Interference (electromagnetic) Measurements

Direct inquiries to the Electromagnetic Technology Division, National Bureau of Standards, Boulder, CO 80303. Telephone: 303-497-3321.

5.0 TIME AND FREQUENCY

5.1 Dissemination Services

Direct inquiries to: Time and Frequency Division, National Bureau of Standards, Boulder, CO 80303. Telephone: 303-497-3281.

For details on NBS Time and Frequency Dissemination Services, see NBS Special Publication 432.

5.2 Frequency Measurements

Calibrations are provided primarily for precision oscillators and only when the above dissemination services are not readily available, adequate or direct comparison to the NBS frequency standards can be justified. Advance arrangements must be made.

Direct inquiries to and mark agreed-to shipments for the attention of: Time and Frequency Division, National Bureau of Standards, Boulder, CO 80303. Telephone: 303-497-3276.

5.2A Special time/frequency measurements At Cost

5.2B Precision Oscillator Frequency Calibrations: At nominal frequencies of 0.1, 1.0, 5.0, 10 MHz with the reference standard accuracy of the order of 1×10^{-13}. At Cost

5.2C Precision Oscillator Noise Measurements At Cost

Such measurements can be characterized in two ways: (a) time domain; measurements of the stability, $\sigma_y(\tau)$ at signals of nominal frequency (see list above). When pairing the unknown precision oscillator with the NBS-6 frequency standard $\sigma_y(\tau) = 2 \times 10^{-12}\ \tau^{-\frac{1}{2}}$. τ is the sample time in the comparison in seconds, or (b) frequency domain; measurement of phase-noise $S\phi(f)$ on signals of nominal frequency (see list above). For f = 1 Hz measurements of the order of -150 dB are possible and for f = 1 kHz this figure becomes -175.

5.2D Time Pulses (one per second) with a measurement accuracy of the order of 0.1 nanosecond. At Cost

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¶ Calibration or Measurement Assurance Program Service

6.0 CRYOGENICS

6.1 Cryogenic Flow Measurements — At Cost

Direct inquiries to the Thermophysical Properties Division, National Bureau of Standards, Boulder, CO 80303. Telephone: 303-497-3611 or 5878.

Fluids
Liquid nitrogen and liquid argon

Temperature Range
72 - 90 K liquid nitrogen, 85-100 K liquid argon

Pressure Rate
.14 - .69 Pa

Flow Rate
76 - 757 liters/minute

The tests run depend on the flowmeter type. In addition to a rangeability test which tests the flowmeter over a range of temperatures, pressures and flow rates, long term stability tests and tests to investigate subcooling requirements can also be performed.

Please contact the Thermophysical Properties Division before submitting flowmeters for test.

6.2 Liquefied Natural Gas Density Reference System — At Cost

Direct inquiries to the Thermophysical Properties Division, National Bureau of Standards, Boulder, CO 80303. Telephone: 303-497-5878.

Fluids
Liquid methane and liquified natural gas

Temperature and Pressure Ranges
109 to 130K, 1 to 10 atm. (along saturation line)

Density Range
400 to 500 kg/m^3

The program is directed toward calibrating transfer standards or providing portable density standards for other densimeter calibration facilities.

7.1 LABORATORY THERMOMETERS

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* Direct inquiries to and mark shipments for the attention of: Temperature and Pressure Measurements and Standards Division, PHYS--A242, National Bureau of Standards, Washington, DC 20234. Telephone: 301-921-2087. Only thermometers identified uniquely by serial number will be accepted. Clinical thermometers are no longer tested. *
****

At Cost	7.1A	Thermometry services		
$ 35/pt	7.1B¶	Laboratory thermometers	Range--0 to 150 °C	32 to 300 °F
63/pt	7.1C¶	" "	151 to 300 °C	301 to 600 °F
105/pt	7.1D¶	" "	301 to 500 °C	601 to 950 °F
45/pt	7.1E¶	" "	-1 to -110 °C	31 to -166 °F
			Liquid N_2 (-196 °C) or (-320 °F)	
120/pt	7.1F¶	" "	Liquid O_2 (-183 °C) or (-297 °F)	
240	7.1G¶	Calorimetric thermometer		
255	7.1H¶	Beckmann thermometer		
12	7.1I	Preliminary examination or ineligible thermometer		
8	7.1J	Additional copy of report		
35/pt	7.1K	Thermometers, special test	Range--0 to 150 °C	32 to 300 °F
63/pt	7.1L	" "	151 to 300 °C	301 to 600 °F
105/pt	7.1M	" "	301 to 500 °C	601 to 950 °F
45/pt	7.1N	" "	-1 to -110 °C	31 to -166 °F
120/pt	7.1O	" "	Liquid N_2 (-196 °C) or (-320 °F)	
			Liquid O_2 (-183 °C) or (-297 °F)	

QUANTITY DISCOUNT FOR SIMILAR THERMOMETERS--Groups of similar thermometers which can be calibrated in batches will receive reduced calibration fees.

7.2 THERMOCOUPLES AND THERMOCOUPLE MATERIALS

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* Direct inquiries to and mark shipments for the attention of: Temperature and Pressure Measurements and Standards Division, PHYS--B128, National Bureau of Standards, Washington, DC 20234. Thermocouples by common carrier to the attention of: Temperature and Pressure Measurements and Standards Division, PHYS--B230, National Bureau of Standards, Rt. 270 and Quince Orchard Road, Gaithersburg, MD 20877. Telephone: 301-921-2069. *
****

At Cost 7.2A Thermocouple measurement services

Comparison calibration, temperature measured with thermocouple:

Fee	Item	TC Type	Temp. Range °C	Points	Minimum Length mm	Temp. °C	Estimated Uncertainties °C
$180	7.2B¶	S	0 - 1450	Table at 1° intervals	700	0 to 1100	0.5
						1450	2
180	7.2C¶	R	0 - 1450	" " " "	700	0 to 1100	0.5
						1450	2
180	7.2D¶	B	0 - 1100	" " " "	1000	0 to 600	(3 μV)
						600 to 1100	0.5
180	7.2E¶	B	800 - 1750	" " " "	1000	800 to 1100	0.5
						1450	2
						1750	3
180	7.2F¶	E	0 - 1000				
		J	0 - 760	4 to 15	700		1
		K	0 - 1100				
		T	0 - 400				
180	7.2G¶	Thermocouple materials tested against Pt standard		4 to 15	700		
59	7.2H¶	Comparison calibration, two point minimum, per point					

¶ Calibration or Measurement Assurance Program Service

Calibration at metal freezing points, minimum diameter 0.4 mm, freezing point determination at Au, Ag, 630.74 °C, and Zn

$ 550	7.2K¶	S	0 - 1450	Table at 1° intervals and equations to generate table	1000	at freezing points	0.2
						0 to 1100	0.3
						1450	2

165/pt	7.2L¶	Type S, freezing point determination, per point, two point minimum
38	7.2M¶	Each additional table of results at 1° intervals, for Type S, R, or B

Calibration of pyrometer indicators

115	7.2N¶	Portable potentiometer, first dial or range
46	7.2O¶	Portable potentiometer, each additional dial or range

Comparison calibration or thermocouple materials tested against Pt thermoelectric standard, temperature measured with platinum resistance thermometer, minimum length 36 inches, two point minimum.

62/pt	7.2R¶	Range -110 to +300 °C and Liquid N_2 (-196 °C) or -166 to 600 °F and Liquid N_2 (-320 °F)
105/pt	7.2S¶	301 to 538 °C or 601 to 1000 °F
120/pt	7.2T¶	Liquid O_2 (-183 °C) or (297 °F)
43	7.2U¶	Table at one degree intervals for Type T thermocouple for any of the following options: (The cost of the table will be in addition to the calibration per point covered under fee schedule items numbered 7.2R, 7.2S, and 7.2T.)

OPTION 1: Table from -190 to +300 °C (-310 to +572 °F), calibration points at -183, -110, -50, +100, 200, 300 °C.

OPTION 2: Table from -190 to +100 °C (-310 to +212 °F), calibration points at -183, -110, -50, +50, +100 °C.

OPTION 3: Table from -110 to +300 °C (-166 to +572 °F), calibration points at -110, -50, +100, 200, 300 °C.

OPTION 4: Table from -110 to +100 °C (-166 to +212 °F), calibration points at -110, -50, +50, +100 °C.

OPTION 5: Table from 0 to 300 °C (32 to 572 °F), calibration points at 100, 200, 300 °C.

OPTION 6: Table from -110 to 0 °C (-166 to +32 °F), calibration points at -110, -50 °C.

OPTION 7: Table from -190 to 0 °C (-310 to +32 °F), calibration points at -183, -110, -50 °C.

*Test results are available in °F upon request.

7.3 RESISTANCE THERMOMETERS

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* Direct inquiries and purchase orders to the attention of: Temperature and Pressure Measurements and Standards Division, PHYS--B04, National Bureau of Standards, Washington, DC 20234. Telephone: 301-921-2757. Direct shipments of thermometers by common carrier to the attention of: Temperature and Pressure Measurements and Standards Division, PHYS--B05, National Bureau of Standards, Rt. 270 and Quince Orchard Road, Gaithersburg, MD 20877. Telephone: 301-921-2757.

****

At Cost	7.3A	Resistance thermometry measurement services	
$ 675	7.3B¶	Long stem PRT	-50 °C - 500 or 630 °C
895	7.3C¶	" " "	-183 °C - 500 or 630 °C
920	7.3D¶	Calorimetric type PRT	-50 °C -150 °C
2020	7.3E¶	Capsule type PRT	13 K - 150 °C
725	7.3F¶	" " " (including mounting)	-183 °C - 300 °C
39	7.3G¶	Additional copy of table from results from 7.3A to 7.3F	at time of test
73	7.3H¶	" " " " " " " " " "	at later date
78	7.3I¶	Minimum charge for unsuitable thermometer	
At Cost	7.3J¶	Measurement assurance program analysis of user measurement capability	
At Cost	7.3K	Comparison of thermometric fixed point devices	
1045	7.3P¶	Germanium resistance thermometer capsule type	2K - 20K

¶ Calibration or Measurement Assurance Program Service

7.4 RADIATION THERMOMETRY

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* Direct inquiries to and mark shipments for the attention of: Ernest Lewis, Radiometric *
* Physics Division, PHYS--A223, National Bureau of Standards, Washington, DC 20234. *
* Telephone: 301-921-3613. *
****

At Cost	7.4A	Radiation thermometry measurement services		
$1000	7.4B¶	Optical pyrometers	one range between 800 °C and 2400 °C	(4 to 12 values)
715	7.4C¶	" "	per range in addition to 7.4B	up to 4200 °C
29/pt	7.4D¶	Additional interpolated values for 7.4B or 7.4C (per point)		
525	7.4E¶	Optical pyrometers	3 or fewer values	800 °C to 4200 °C
855	7.4F¶	Ribbon filament lamp	6 to 16 points	800 °C to 2300 °C
700	7.4G¶	" " "	5 or fewer points	800 °C to 2300 °C

7.5 RADIOMETRIC STANDARDS

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* Direct inquiries to and mark shipments for the attention of: John K. Jackson, Radiometric *
* Physics Division, PHYS--A221, National Bureau of Standards, Washington, DC 20234. *
* Telephone: 301-921-3613. *
****

At Cost	7.5A	Radiometric measurement services	
$2385	7.5B¶	Spectral radiance standard ribbon filament lamp, 30A/T24/13, 225 nm to 2400 nm	34 wavelengths,
2325	7.5C¶	" " " " " " " " " 225 nm to 800 nm	20 "
2240	7.5D¶	" " " " " " " " " 650 nm to 2400 nm	17 "
1770	7.5G¶	Spectral irradiance standard quartz-halogen lamp, 1000 watt, 250 nm to 1600 nm	26 "
1030	7.5H¶	Photodiodes spectral response transfer program. Rental of a radiometer calibrated in absolute units (A/W) in the range 257 nm - 1064 nm.	
1315	7.5J¶	Spectral irradiance standard, deuterium lamp, 200 nm to 350 nm	16 "

7.6 NEAR AND VACUUM ULTRAVIOLET RADIOMETRIC STANDARDS

****
* Contact J. M. Bridges, Atomic and Plasma Radiation Division, PHYS--A167, National Bureau *
* of Standards, Washington, DC 20234. Telephone: 301-921-2356. *
****

At Cost	7.6A	Special vacuum ultraviolet radiometric measurement services
$1450	7.6B	Spectral irradiance standard, ARGON MINI-ARC, 140 nm to 330 nm
1450	7.6C	Spectral radiance standard, ARGON MINI-ARC, 115 nm to 330 nm
At Cost	7.6D	Spectral irradiance standard, deuterium arc lamp, 165 nm to 200 nm

7.7 PHOTOMETRIC STANDARDS

****
* Direct inquiries to and mark shipments for the attention of: D. A. McSparron, Radiometric *
* Physics Division, MET--B306, National Bureau of Standards, Washington, DC 20234. *
* Telephone: 301-921-3613. *
****

At Cost	7.7A	Photometric measurement services	
$ 580	7.7B¶	Luminous intensity standard, 100 W inside frosted tungsten lamp	at approximately 90 candelas
805	7.7C¶	" " " " " " " " "	at color temp. 2700 K
805	7.7D¶	" " " " " " " " "	at color temp. 2856 K
565	7.7E¶	" " " 500 " " " " "	at approximately 700 candelas
785	7.7F¶	" " " " " " " " "	at color temp. 2856 K
565	7.7G¶	" " " 1000 " " " " "	at approximately 1400 candelas
785	7.7H¶	" " " " " " " " "	at color temp. 2856 K

¶ Calibration or Measurement Assurance Program Service

$ 330	7.7I¶	Luminous flux standard 25 W vacuum lamp about 270 lumens
330	7.7J¶	" " " 60 W gas filled lamp about 870 lumens
330	7.7K¶	" " " 100 " " " " " 1,600 "
330	7.7L¶	" " " 200 " " " " " 3,300 "
330	7.7M¶	" " " 500 " " " " " 10,000 "
550	7.7N¶	Color temperature standard (airway beacon lamp), 500 watt, 1 point in range 2000 - 3000 K
300	7.7O¶	As in 7.7N for each additional color temp.
945	7.7P¶	As in 7.7O 4 color temperature and interpolation equation
330	7.7Q¶	Luminous flux standards, miniature lamps, 7 sizes, 6 - 400 lumens, each lamp
195	7.7R¶	Luminous directional transmittance standard, 2 inch square flashed opal glass

7.8 SPECTROPHOTOMETRIC STANDARDS

****
* Direct inquiries to and mark shipments for the attention of: Victor R. Weidner, Radiometric Physics Division, MET--B306, National Bureau of Standards, Washington, DC 20234. Telephone: 301-921-2453. *
****

At Cost	7.8A	Spectrophotometric measurement services
$ 325	7.8B¶	Spectral transmittance standard, cobalt blue glass, 20 wavelengths from 390 to 750 nm
305	7.8C¶	Spectral transmittance standard, copper green glass, 15 wavelengths from 390 to 750 nm
305	7.8D¶	Spectral transmittance standard, carbon yellow glass, 19 wavelengths from 390 to 750 nm
305	7.8E¶	Spectral transmittance standard, selenium orange glass, 10 wavelengths from 560 to 750 nm
335	7.8I¶	Wavelength standard, holmium oxide glass, 240 to 650 nm at less than 2 nm bandpass

7.9 PRESSURE AND VACUUM MEASUREMENTS

****
* Direct inquiries to: Temperature and Pressure Measurements and Standards Division, PHYS--B128, National Bureau of Standards, Washington, DC 20234. Telephone: 301-921-2121. *Please call to arrange scheduling of the calibration before shipping any instruments.* Mark shipments for the attention of: Temperature Measurements and Standards Division, MET--A53, National Bureau of Standards, Washington, DC 20234. *
****

At Cost	7.9A	Special pressure and vacuum measurements services
At Cost	7.9B¶	Deadweight piston gages
At Cost	7.9C¶	Controlled clearance piston gages
At Cost	7.9D¶	Mercurial barometer manometers
At Cost	7.9E¶	Pressure gages and transducers
At Cost	7.9G¶	Low and medium vacuum gages, 10^{-1} to 10^{5} Pa
At Cost	7.9H¶	High vacuum gages, 10^{-4} to 10^{-1} Pa

¶ Calibration or Measurement Assurance Program Service

8.1 NEUTRON SOURCES AND DOSIMETRY STANDARDIZATION

****

* Inquiries should be addressed to: Neutron Field Standards Group, REACT A-157, National *
* Bureau of Standards, Washington, DC 20234. Telephone: 301-921-2421. Shipments, when *
* approved, should be addressed to: Health Physics/Neutron Field Standards Group, *
* RAD PHYS--B131, National Bureau of Standards, Quince Orchard and Clopper Roads, *
* Gaithersburg, MD 20877. *

****

At Cost	8.1A	Special measurement services
$ 710	8.1B¶	Emission rate of unknown source in manganous sulfate bath, 10^5 to 10^8 neutrons per second
1065	8.1C¶	Emmission rate of unknown source in manganous sulfate bath, 10^8 to 10^{10} neutrons per second
At cost	8.1H	Neutron personnel protection instrumentation, thermal beam: 3×10^5 n/(cm^2·s), 1 rem/h
At cost	8.1I	Neutron personnel protection instrumentation, 2 keV filtered beam: 1×10^3 n/(cm^2·s), 4 mrem/h 24 keV filtered beam: 1.2×10^3 n/(cm^2·s), 8 mrem/h 144 keV filtered beam: 2.6×10^3 n/(cm^2·s), 70 mrem/h
At cost	8.1J	Neutron personnel protection instrumentation-californium sources: fission spectrum: 1.3×10^4 n/(cm^2·s), 1.6 rem/h; moderated: 1.1×10^5 n/(cm^2·s), 3 rem/h
At cost	8.1K	Neutron personnel protection instrumentation--Van de Graaff: 0.2-1.2 MeV: 1.5×10^3 n/(cm^2·s), 170 mrem/h; 14 MeV: 60 n/(cm^2·s), 80 mrem/h
290	8.1P¶	Activation foil irradiation--thermal neutrons external beam (fully moderated): 2×10^7 n/(cm^2·s); cavity (isotropic, fully moderated): 1×10^{11} n/(cm^2·s); thermal density standard (undermoderated): 4000 n/(cm^2·s)
480	8.1Q	Activation foil irradiation--californium fission neutrons, maximum fluence (typical): 1×10^{13} neutrons/cm^2 in 140 h.
430	8.1R	Activation foil irradiation--^{235}U cavity fission source, maximum fluence: 2×10^{15} in 24 h.

8.2 RADIOACTIVITY

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* Direct inquiries to: Radioactivity Group, RAD PHY--C114, National Bureau of Standards, *
* Washington, DC 20234. Telephone: 301-921-2665. Shipments should be addressed to: *
* Health Physics/Radioactivity Group, RAD PHY--B131, National Bureau of Standards, *
* Quince Orchard and Clopper Road, Gaithersburg, MD 20877. *

****

At Cost	8.2A	Radioactivity measurement services and tests
$ 580	8.2C¶	Calibration of gamma-ray emitting samples (with half lives greater than 15 days) 0.4 to 400 MBq, Na-22, Sc-46, Fe-59, Co-60, Y-88, Ag-110m-Ag-110, Eu-152, Eu-154, Ra-226 2 to 60 MBq, Cr-51, Mn-54, Co-57, Zn-65, Se-75, Sr-85, Cd-109-Ag-109m, Sn-113-In-113m, Ba-133, Cs-134, Cs-137-Ba-137m, Ce-139, Ce-141, Eu-155, Yb-169, Au-195, Hg-203
730	8.2D¶	Calibration of gamma-ray emitting samples (with half lives less than 15 days) 0.4 to 400 MBq, Na-24, Ga-67, Ba-140-La-140 2 to 60 MBq, K-42, Mo-99-Tc-99m, Tc-99m, In-111, I-123, I-131, Hg-197, Au-198, Tl-201, Pb-203
570	8.2H¶	Alpha-particle solid sources, NBS $2\pi\alpha$ proportional counter, 1.5 Bq to 1.1×10^4 Bq
570	8.2I¶	" " " " NBS $0.8\pi\alpha$ defined-solid-angle-counter, 1.9×10^2 Bq to 1.1×10^4 Bq
760	8.2J¶	" " " " calibration of the same sources using both counters
1590	8.2P	Beta-particle emitting samples, liquid scintillation counting, 20 to 200 kBq g^{-1}, H-3, C-14, Cl-36, Sr-90-Y-90, Tl-204
3030	8.2Q	" " " " $4\pi\beta$ proportional counter, 20 to 200 kBq g^{-1}, P-32
1915	8.2R	" " " " $4\pi\beta$ proportional counter, 20 to 200 kBq g^{-1}, Sr-89, Pm-147

¶ Calibration or Measurement Assurance Program Service

8.3 X-RAY AND GAMMA-RAY MEASURING INSTRUMENTS

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* Inquiries and shipments by U.S. Postal Service should be addressed to: Dosimetry Group, *
* RAD PHY--C210, National Bureau of Standards, Washington, DC 20234. Telephone: *
* 301-921-2361. Shipments by common carrier other than the Postal Service should be *
* addressed to: Dosimetry Group, RAD PHY--C210, National Bureau of Standards, Rt. 270 and *
* Quince Orchard Road, Gaithersburg, MD 20877. *
****

At Cost	8.3A	Special measurement services
$ 550	8.3B¶	Calibration/correction factor for a radiation detector, one beam quality
290	8.3C¶	" " " " " " " each additional beam quality or condition
405	8.3D¶	Tests of charge sensitivity of a high-gain electrometer, one set of switch positions, in conjunction with 8.3B and 8.3C. By previous arrangement only.
390	8.3M¶	Irradiation of not more than six passive dosimeters at one set-up, one beam quality
155	8.3N¶	" " " " " additional passive dosimeters at the same set-up and beam quality
At Cost	8.3R¶	Calibration of a penetrameter (Ardran-Crookes type). Cost will depend on service requested.

LIGHTLY FILTERED X RAYS

Beam Code	Constant Potential	Distance	Added Filter* Al	Half-Value Layer Al	Homogeneity Coefficient (1st Al HVL/ 2nd Al HVL)	Exposure Rate Min	Exposure Rate Max
	kV	cm	mm	mm		μR/s	R/s
L-B	10	25	0	0.029	0.79	1.0	1.7
L-C	15	25	0	0.050	0.74	1.0	4.2
L-D	20	50	0	0.071	0.76	1.0	3.3
L-E	20	50	0.5	0.23	0.78	1.0	0.13
L-G	30	50	0.5	0.36	0.64	1.0	0.3
L-I	50	50	1.0	1.02	0.66	1.0	0.4
L-K	75	50	1.5	1.86	0.63	1.0	0.4
L-M	100	50	2.0	2.78	0.59	1.0	0.4

*The inherent filtration is approximately 1.0 mm Be.

MODERATELY FILTERED X RAYS

Beam Code	Constant Potential	Added Filters* Cu	Added Filters* Al	Half-Value Layer Cu	Half-Value Layer Al	Homogeneity Coefficient (1st Al HVL/ 2nd Al HVL)	Exposure Rate Min.	Exposure Rate Max.
	kV	mm	mm	mm	mm		mR/s	mR/s
MFB	60	0	0	--	1.62	0.68	7	120
MFC	60	0	2.50	0.090	2.79	0.79	7	40
MFE	75	0	2.51	0.116	3.39	0.74	7	70
MFG	100	0	3.50	0.20	5.03	0.73	15	100
MFI	150	0.25	3.49	0.66	10.25	0.89	15	130
MFK	200	0.50	3.49	1.24	13.20	0.92	30	220
MFM	250	1.01	3.50	2.23	15.80	0.92	40	280
MFO	250	3.20	3.47	3.25	18.30	0.98	20	150

*The inherent filtration is approximately 1.5 mm Al.

¶ Calibration or Measurement Assurance Program Service

HEAVILY FILTERED X RAYS

Beam Code	Constant Potential	Added Filter*				Half-Value Layer		Effective Energy	Exposure Rate	
		Pb	Sn	Cu	Al	Cu	Al		Min.	Max.
	kV	mm	mm	mm	mm	mm	mm	keV	mR/s	mR/s
HFC	50	0.10	0	0	2.50	0.14	4.19	38	0.3	1.5
HFE	100	0.50	0	0	2.50	0.74	11.20	70	0.8	4
HFG	150	0	1.51	4.00	2.50	2.45	16.96	117	0.7	4
HFI	200	0.77	4.16	0.60	2.47	4.09	19.60	167	0.5	4
HFK	250	2.72	1.04	0.60	2.50	5.25	21.55	210	0.5	4

*The inherent filtration is approximately 1.5 mm Al.

GAMMA RAYS

Beam Code	Energy	Half-Value Layer* Cu	Exposure Rate Min.	Exposure Rate Max.**
	Mev	mm	mR/s	R/s
Cs-137	0.66	10.8	1.5	0.1
Co-60	1.25	14.9	1.5	2.5

*Calculated
**Higher exposure rates can be obtained with some loss of accuracy.

8.4 GAMMA-RAY AND BETA-PARTICLE SOURCES

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* Inquiries should be addressed to: Dosimetry Group, RAD PHYS--C210, National Bureau of Standards, Washington, DC 20234. Telephone: 301-921-2361. Shipments should be addressed to: Health Physics/Dosimetry Group, Shipping and Receiving, National Bureau of Standards, Rt. 270 and Quince Orchard Road, Gaithersburg, MD 20877. *
****

At Cost	8.4A	Special measurement services
$ 440	8.4E¶	0.5 to 250 mg Ra, or Co-60, Cs-137, or Ir-192, having exposure rates 0.1 to 100 $(\mu R/s)m^2$ (microroentgens per second at one meter)
195	8.4F	Each additional gamma-ray source of the same radionuclide
495	8.4K¶	Beta-particle applicators calibrated for surface dose rate

8.5 DOSIMETRY OF HIGH-ENERGY ELECTRON BEAMS

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* See 8.3 *
****

At Cost	8.5A	Special measurement services
$ 255	8.5B¶	Three ferrous-ferric dosimeters (two for irradiation, one control)
79	8.5C¶	Each additional dosimeter

¶ Calibration or Measurement Assurance Program Service

8.6 DOSIMETRY FOR HIGH-DOSE APPLICATIONS

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* Inquiries should be addressed to: X-Ray Physics Group, RAD PHY--C216, National Bureau of *
* Standards, Washington, DC 20234. Telephone: 301-921-2201. *
****

At Cost $		
	8.6A	Special measurement services
79	8.6B	Irradiation with ^{60}Co gamma rays of customer-supplied dosimeters or samples (up to five at each dose) to a specified absorbed dose in the range 10 to 10^6 grays (10^3 to 10^8 rads)
97	8.6C	Provide dose interpretation of NBS-packaged dosimeters irradiated by service customer (each dose point)
10	8.6D	Spectrophotometric reading of dosimeters, optical density at one to five wavelengths (each dosimeter)
41	8.6E	Spectrophotometric reading of dosimeters, ultra-violet and visible spectrum scan (each dosimeter)

¶ Calibration or Measurement Assurance Program Service

9.0 OTHER NBS SERVICES

9.1 STANDARD REFERENCE MATERIALS

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* For general information about the NBS program in Standard Reference Materials, direct inquiries to: Office of Standard Reference Materials, CHEM--B311, National Bureau of Standards, Washington, DC 20234. Telephone: 301-921-2045. *
****

NBS Special Publication 260, "Standard Reference Materials," lists and describes the Standard Reference Materials (SRM's), Research Materials (RM's), and General Materials (GM's) currently distributed by the National Bureau of Standards, as well as many of the materials currently in preparation. SRM's are used to calibrate measurement systems and to provide a central basis for uniformity and accuracy of measurement. The unit and quantity, the type, and the certified characterization are listed for each SRM, as well as directions for ordering. The RM's are issued to meet the needs of scientists engaged in materials research and are issued with a "Report of Investigation." The GM's are standardized by some agency other than NBS. NBS acts only as a distribution point and does not participate in the standardization of these materials. Announcements of new products are made by mail to those who have requested such information from the address above.

9.2 PROFICIENCY SAMPLE PROGRAMS

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* Direct inquiries to persons shown below at the National Bureau of Standards, Washington, DC 20234. Telephone: 301-921-3481. *
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Proficiency Sample Programs for Hydraulic Cements and Portland Cement Concrete	J. W. Haverfield
Proficiency Sample Programs for Soils, Aggregates, and Bituminous Materials	O. W. McIntosh
Inspection of Cement and Concrete Testing Laboratories	J. W. Haverfield
Inspection of Soils and Bituminous Testing Laboratories	O. W. McIntosh

9.3 ACCREDITATION OF TESTING LABORATORIES

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* For general information about the National Voluntary Laboratory Accreditation Program (NVLAP) or application packages, direct inquiries to: John W. Locke, Manager, Laboratory Accreditation, TECH--B06, National Bureau of Standards, Washington, DC 20234. Telephone: 301-921-3431. For specific testing areas, direct inquiries to persons shown below at the telephone number given above. *
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NVLAP-01	Program for Thermal Insulation Materials	Diana Kirkpatrick
NVLAP-02	Program for Freshly Mixed Field Concrete	Robert Gladhill
NVLAP-03	Program for Carpet	Diana Kirkpatrick
NVLAP-04	Program for Solid Fuel Room Heaters	Diana Kirkpatrick
NVLAP-05	Program for Personnel Dosimeters Processors	Robert Gladhill
NVLAP-06	Program for Electromagnetic Calibration Services	Robert Gladhill
NVLAP-07	Program for Window and Door Products	Wiley Hall
NVLAP-08	Acoustical Testing Services	Douglas Thomas

Each NVLAP program includes proficiency testing data comparisons for some of the test methods for which accreditation is offered.

9.4 NATIONAL CENTER FOR STANDARDS AND CERTIFICATION INFORMATION

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* Inquiries or requests for additional information should be directed to: National Center for Standards and Certification Information, TECH B166, National Bureau of Standards, Washington, DC 20234. Telephone: 301-921-2587. *
****

This office (NBS-NCSCI) maintains a reference collection of some 240,000 engineering and related standards issued by U.S. technical societies, professional organizations, and trade associa-

tions; State purchasing offices; U.S. Federal Government agencies; and major foreign national and international standardizing bodies. The collection, which is located at the National Bureau of Standards facility in Gaithersburg, MD (about 20 miles (32 kilometers) northwest of Washington, DC), is open to the public Monday through Friday from 8:30 a.m. to 5:00 p.m.

NBS-NCSCI publishes general and special indexes of standards. Information services which are free consist of searching Key-Word-In-Context (KWIC) Indexes to determine whether there are any published standards, specifications, codes, test methods, or recommended practices for a given item or product. Inquirers are referred to the appropriate source to obtain copies of standards.

9.5 NATIONAL STANDARD REFERENCE DATA SYSTEM

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* General inquiries on the Standard Reference Data Program should be addressed to: Office *
* of Standard Reference Data, PHYS--A323, National Bureau of Standards, Washington, DC *
* 20234. Telephone: 301-921-2104. *
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The National Standard Reference Data System (NSRDS) is a nationwide program established to compile and critically evaluate quantitative physical science data and assure its availability to the technical community. The program publishes compilations of critically evaluated data, critical reviews of experimental techniques, and bibliographies. A complete listing of the publications of the NSRDS is available from the Office of Standard Reference Data (OSRD). The OSRD responds in a limited way to queries within the scope of the program by providing references, referrals, documentation, or data, as available. The program's newsletter, REFERENCE DATA REPORT, is available on request.

9.6 OFFICE OF WEIGHTS AND MEASURES

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* For information on programs of NBS and the States, contact: Office of Weights and *
* Measures, National Bureau of Standards, Washington, DC 20234. Telephone: 301-921-2401. *
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Prototype Examination of Commercial Weighing and Measuring Devices

The NBS Office of Weights and Measures (OWM) operates a Prototype Examination Program which provides for an evaluation of (1) prototype weighing and measuring devices to determine compliance with the requirements of NBS Handbook 44, "Specifications, Tolerances, and Other Technical Requirements for Commercial Weighing and Measuring Devices," (2) standards to determine compliance with the requirements of NBS Handbook 105-1, 105-2, 105-3, "Specifications and Tolerances for Reference Standard and Field Standard Weights and Measures." This program may be used by manufacturers and weights and measures officials in determining the acceptability of devices for commercial use or the suitability of reference and field standards.

Equipment will be examined at any stage of development on request. The examination may be made in the laboratories of the National Bureau of Standards, at the factory, or in the field.

To obtain a prototype examination: Address a letter giving a reasonably complete description of the equipment, its operating characteristics and instructions, and its intended application, model number, capacity, size, and shipping weight, to the address above, requesting an examination.

9.7 STRUCTURAL ENGINEERING--HIGH CAPACITY TESTING MACHINE

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* Direct inquiries to: Structural Engineering Program, BR--B168, National Bureau of *
* Standards, Washington, DC 20234. Telephone: 301-921-3471. *
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The research and testing facilities for structural engineering include a 53-MN (12 million-lbf) capacity universal testing machine believed to be the largest in the world. A significant addition to the nation's facilities for research and testing in the field of large structures, this unique machine is available to do work for the entire technological community upon consideration of requests on a case-by-case basis. This hydraulically operated machine is a vertical, four screw type with the main fixed platen flush with the floor. It is capable of applying 53 MN (12×10^6 lbf) in compression to test speciments up to 17 m (58 ft) in height and 27 MN (6×10^6 lbf) in tension to speciments up to 16 m (53 ft) in length. To extend the versatility of the machines, the reinforced concrete foundation incorporates a floor tie-down system which can accommodate test specimens for transverse loading up to 27 m (90 ft) in length. Calibration of all load ranges indicates that they exhibit error generally no greater than 0.5 percent of the applied load. A more detailed description of this facility is presented in NBS Special Publications 355.

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(continued from front)

Each seminar lasts from one to five days and its meeting are devoted to lectures, group discussions, and laboratory demonstrations. A course may be cancelled if registration is insufficient. However, in the past, requests for enrollment have nearly always exceeded the numbers that could be accommodated. Laboratory directors who wish to have members of their staff attend any of these courses are therefore urged to send, as soon as possible, a letter of application to the individual named in the course descriptions below. Applications should also be accompanied by a check, billing authorization, or purchase order for the stated fee.

Acceptance of qualified applicants, on the basis of first come first served, other things being equal, will be made by letter not later than 4 weeks prior to the scheduled date of the course. Detailed information on schedules and housing will be available at that time. Those accepted will be expected to study the assigned reading material before coming to the course and should be prepared to discuss their own experiences with related problems.

Refreshments (e.g., coffee) will be served as appropriate, except for the seminar on Calibration and Use of Piston Gages, and will be paid for out of the fee.

NBS SOLICITS INTEREST IN MAP TRAINING SEMINAR (W)

Description: The National Bureau of Standards has received many requests for a training seminar dealing with the use of NBS Measurement Assurance Program Services (MAP's). In response, NBS is considering holding a MAP training seminar, if there is sufficient interest. The specific agenda for the seminar is still being considered, but the general format is:

Part I: Two and one-half days, discussion of the general aspects of the MAP approach, including the advantages and disadvantages, costs and benefits, the use of check standards and control charts, the statistical tools used, etc.

Part II: Two and one-half days, detailed discussion of the MAP approach applied to dc voltage, although brief mention may be made of other electrical measurements such as resistance, capacitance, and microwave power for which MAP techniques can be used.

Note: Participants would be able to attend either Part I or Part II or both parts.

Location: Los Angeles area. *Fee*: To be announced. *Dates*: January 24-28, 1983. *Apply to*: Dr. Brian C. Belanger, Chief, Office of Measurement Services, NBS, Washington, DC 20234. *Telephone*: 301-921-2805.

MEASUREMENT OF THERMAL RESISTANCE OF INSULATING MATERIALS (W)

Description: This seminar is held to assist users of SRM 1450 and calibrated transfer standards to attain the highest possible accuracy in thermal resistance measurements on the guarded-hot-plate and heat-flow-meter apparatus. It will be directed at engineers and senior technicians and will include discussions of present NBS services, guarded-hot-plate and heat-flow-meter apparatus, and calibration error analysis. The seminar will consist of lectures and hands-on measurement in the laboratory.

Arrangements: Attendance will be limited to 10. *Fee*: To be announced. *Dates*: November 4-5, 1982. *Apply to*: Rita Allen or Chock Siu, Physical Environment Division, NBS, Washington, DC 20234. *Telephone*: 301-921-2144 or 3536.

CALIBRATION AND USE OF PISTON GAGES (W)

Description: These seminars are held to help industrial and other users attain the highest possible accuracy in pressure measurements with piston gages. The seminar is directed at engineers and senior technicians. The two-day seminar presents information on the theory of piston gages, elastic distortion, design and types, calibration of controlled clearance piston gages, calibration by cross-float, error analysis, computer programs, demonstration of cross-float, hydrostatic weighing and transducer calibrations. The seminar closes with a tour of the laboratory, for those who are interested and a discussion of research and development work in the field of pressure measurements.

Arrangements: Attendance will be limited to 10-15. *Fee*: To be announced. *Dates*: November 18-19, 1982. *Apply to*: Bernard E. Welch, or Nancye E. McBryde, Temperature and Pressure Measurements and Standards Division, NBS, Washington, DC 20234. *Telephone*: 301-921-2121, or 3316.

LINEWIDTH MEASUREMENTS ON INTEGRATED CIRCUIT PHOTOMASKS AND WAFERS (W)

Description: This five-day seminar will present information on the accurate and precise measurements of linewidths on integrated-circuit (IC) photomasks and patterned wafers. The seminar will consist of lectures, equipment demonstrations, and group discussions. It is directed at engineers and senior technicians and will be devoted to the following areas of linewidth measurements: theory of the optical microscope, proper microscope operating conditions for accurate measurements, data analysis, linewidth calibration, measurement artifacts, and transfer of measurements from NBS to the IC

industry. Use of optical linewidth-measurements, systems on both photomasks in transmitted light and on wafers coated with thin oxide films in bright-field reflected light will be demonstrated.

Location: Rickeys Hyatt Hotel, Paulo Alto, CA. *Arrangements*: Attendance will be limited to 75. *Fee*: To be announced. *Dates*: March 7-11, 1983. *Apply to*: Elaine C. Cohen, Semiconductor Materials and Processes Division, NBS, Washington, DC 20234. *Telephone*: 301-921-3786.

QUALITY ASSURANCE OF CHEMICAL MEASUREMENTS (W)

Description: This two-day seminar is concerned with techniques to improve the precision and accuracy of analytical measurements such as those needed in the compositional analysis of materials, process control, and regulatory enforcement. It is designed for supervisors of analytical laboratories, experienced analytical chemists, and those responsible for the development and/or supervision of laboratory quality control programs. Topics discussed will include: general aspects of quality assurance; the role of Standard Reference Materials in quality assurance; statistical considerations used in the evaluation of data quality; good laboratory practices for precise and accurate chemical measurements. In addition, each participant may elect to attend three two-hour clinics on good measurement practices, selected from the following areas; atomic absorption spectrometry; gas analysis, gas chromatography; gas chromatography-mass spectrometry; general analytical chemistry, ICP spectroscopy; ion chromatography; isotope dilution mass spectrometry; liquid chromatography; polarography-voltammetry; neutron activation analysis; spectrophotometry; statistical concepts; UV-IR organic spectroscopy; standard reference materials; quality assurance program development.

Note: Applicants should indicate the three clinics of their choice when applying.

Arrangements: Attendance will be limited to 30. *Fee*: To be announced. *Dates*: To be announced. *Apply to*: Dr. John K. Taylor, Center for Analytical Chemistry, A309 Chemistry Building, NBS, Washington, DC 20234. *Telephone*: 301-921-3497.

PRECISION THERMOMETRY SEMINAR (W)

Description: The seminar will consist of integrated instruction in Platinum Resistance Thermometry, Liquid-in-Glass Thermometry, Thermocouple Thermometry, and Thermistor Thermometry to be given over a five-day period. Attendance will be limited to 25 people in order to provide adequate laboratory instruction to accompany the lectures in each area. Material to be covered includes the International Practical Temperature Scale of 1968; its use in the laboratory; thermometers and instrumentation, including automatic data acquisition; the treatment of calibration data; and innovations in thermometry. Time will be split between lecture sessions and hands-on measurements in the laboratory. The seminar is especially intended for calibration laboratory personnel and others who wish to undertake precision temperature measurements. Applicants should possess undergraduate training in physics or engineering and should have some laboratory experience in metrology.

Arrangements: Attendance will be limited to 25. *Fee*: To be announced. *Dates*: March 14-18, 1983 and September 12-16, 1983. *Apply to*: Nancye E. McBryde or Robert J. Soulen, Temperature and Pressure Measurements and Standards Division, NBS, Washington, DC 20234. *Telephone*: 301-921-3315 or 3316.

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