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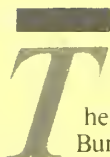
# State Weights and Measures Laboratories

## Program Handbook



U.S. Department of Commerce  
National Bureau of Standards  
Gaithersburg, MD 20899

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No. 143  
1985



The National Bureau of Standards<sup>1</sup> was established by an act of Congress on March 3, 1901. The Bureau's overall goal is to strengthen and advance the nation's science and technology and facilitate their effective application for public benefit. To this end, the Bureau conducts research and provides: (1) a basis for the nation's physical measurement system, (2) scientific and technological services for industry and government, (3) a technical basis for equity in trade, and (4) technical services to promote public safety. The Bureau's technical work is performed by the National Measurement Laboratory, the National Engineering Laboratory, the Institute for Computer Sciences and Technology, and the Center for Materials Science.

### *The National Measurement Laboratory*

Provides the national system of physical and chemical measurement; coordinates the system with measurement systems of other nations and furnishes essential services leading to accurate and uniform physical and chemical measurement throughout the Nation's scientific community, industry, and commerce; provides advisory and research services to other Government agencies; conducts physical and chemical research; develops, produces, and distributes Standard Reference Materials; and provides calibration services. The Laboratory consists of the following centers:

- Basic Standards<sup>2</sup>
- Radiation Research
- Chemical Physics
- Analytical Chemistry

### *The National Engineering Laboratory*

Provides technology and technical services to the public and private sectors to address national needs and to solve national problems; conducts research in engineering and applied science in support of these efforts; builds and maintains competence in the necessary disciplines required to carry out this research and technical service; develops engineering data and measurement capabilities; provides engineering measurement traceability services; develops test methods and proposes engineering standards and code changes; develops and proposes new engineering practices; and develops and improves mechanisms to transfer results of its research to the ultimate user. The Laboratory consists of the following centers:

- Applied Mathematics
- Electronics and Electrical Engineering<sup>2</sup>
- Manufacturing Engineering
- Building Technology
- Fire Research
- Chemical Engineering<sup>2</sup>

### *The Institute for Computer Sciences and Technology*

Conducts research and provides scientific and technical services to aid Federal agencies in the selection, acquisition, application, and use of computer technology to improve effectiveness and economy in Government operations in accordance with Public Law 89-306 (40 U.S.C. 759), relevant Executive Orders, and other directives; carries out this mission by managing the Federal Information Processing Standards Program, developing Federal ADP standards guidelines, and managing Federal participation in ADP voluntary standardization activities; provides scientific and technological advisory services and assistance to Federal agencies; and provides the technical foundation for computer-related policies of the Federal Government. The Institute consists of the following centers:

- Programming Science and Technology
- Computer Systems Engineering

### *The Center for Materials Science*

Conducts research and provides measurements, data, standards, reference materials, quantitative understanding and other technical information fundamental to the processing, structure, properties and performance of materials; addresses the scientific basis for new advanced materials technologies; plans research around cross-country scientific themes such as nondestructive evaluation and phase diagram development; oversees Bureau-wide technical programs in nuclear reactor radiation research and nondestructive evaluation; and broadly disseminates generic technical information resulting from its programs. The Center consists of the following Divisions:

- Inorganic Materials
- Fracture and Deformation<sup>3</sup>
- Polymers
- Metallurgy
- Reactor Radiation

<sup>1</sup>Headquarters and Laboratories at Gaithersburg, MD, unless otherwise noted; mailing address Gaithersburg, MD 20899.

<sup>2</sup>Some divisions within the center are located at Boulder, CO 80303.

<sup>3</sup>Located at Boulder, CO, with some elements at Gaithersburg, MD.

# State Weights and Measures Laboratories

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Program Handbook

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*NBS Handbook*

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## SUMMARY

State weights and measures laboratories are custodians of measurement standards at the State level that serve as the basis for assuring equity in the marketplace and as reference standards for calibration services for indigenous industry. As part of its program to encourage a high degree of technical and professional competence in such activities, the National Bureau of Standards (NBS) has developed performance standards and formalized procedures for the following two purposes:

1. certification of competence for the production of reliable metrological measurements (principally mass, volume, and length), and
2. authorization to conduct initial evaluation of weighing and measuring devices/systems before their use in commerce.

### CERTIFICATION OF COMPETENCE (PART I)

Part I of this Handbook describes the procedures followed by NBS in certifying State weights and measures laboratories for competence. A certified laboratory must satisfy general and specific requirements for each competence area in which certification is desired (see Appendix A).

The general requirements address good management practices and the general facilities necessary for good metrological services.

The specific requirements include the availability of suitable test equipment, calibrated standards, and defined test procedures. The staff must demonstrate a comprehensive understanding of the procedures and the ability to perform valid measurements. The laboratories must have adequate space and environmental controls to facilitate accurate measurements.

Under this plan, applying laboratories appraise their compliance with the requirements, using appropriate checklists which are reviewed and evaluated by NBS.

Following review and evaluation (which may include a site visit), NBS issues a certificate indicating recognized competence areas. Certification may be for a period up to three years, but on an annual basis each certified laboratory must review its status and submit a statement that no adverse changes have taken place in order for the certification to remain in effect.

Types of assistance available from the National Bureau of Standards are listed in Appendix B.

## AUTHORIZATION FOR TYPE EVALUATION (PART II)

Part II of this Handbook describes the procedures followed in authorizing certified State weights and measures laboratories to conduct evaluation of weighing and measuring devices and systems under the National Type Evaluation Program (NTEP).

Only a certified laboratory (Part I) may request authorization. In addition, a certified laboratory must meet specific criteria for each device area for which authorization is sought. The specific requirements address staff training, equipment and facility needs, tutorial procedures, quality assurance, and record keeping.

Under this plan, applying laboratories appraise their compliance with the requirements, using appropriate checklists which will be reviewed and evaluated by NBS.

Following review and evaluation (which may include a site visit), NBS issues a certificate indicating recognized competence areas. Authorization will be for a period up to three years. Each authorized laboratory must request review of its status annually (before the anniversary date of authorization) by submitting a statement that no adverse changes have taken place.

### GENERAL

Each State weights and measures laboratory is encouraged to study this Handbook carefully and to apply for certification and authorization in all areas in which it provides measurement services or desires authorization. NBS reserves the right to deny or withdraw certification or authorization. In such cases, NBS will notify the State in writing of deficiencies, and provide recommendations for remedial action. In the case of withdrawal, NBS will attempt to reach agreement with the State on the timing of the remedial action in order to keep the certification/authorization in force provisionally. Both of these programs are managed by the Office of Weights and Measures of the National Bureau of Standards.



## GLOSSARY

The following section contains the definitions of a number of terms in the sense in which they are used throughout this Handbook.

**Audit** - A formal or official inspection to verify or clarify matters related to certification.

**Authorization for Type Evaluation** - The process used by NBS to evaluate the capability and thence to authorize a certified State Weights and Measures Laboratory to conduct evaluations of weighing and measuring devices and systems under the National Type Evaluation Program (NTEP).

**Calibration** - Comparison of a standard or instrument with another standard or instrument to report or eliminate by adjustment any variation (deviation) in the accuracy of the item being compared.

**Certification** - The recognition that a laboratory appears to have the capability to perform reliable measurements in specific measurement areas and meets the general and specific requirements as described in this Handbook.

**Certification Process** - A formal process by which a laboratory is evaluated, with respect to established criteria, for its competence to perform a specified kind(s) of measurement.

**Criteria for Certification** - Objective minimum requirements that must be satisfied in order that a laboratory may be certified.

**Good Laboratory Practice (GLP)** - An acceptable way to perform some basic operation or activity in a laboratory, that is known or believed to influence the quality of its outputs. GLP's ordinarily are essentially independent of the measurement techniques used.

**Good Measurement Practice (GMP)** - An acceptable way to perform some operation associated with a specific measurement technique, and which is known or believed to influence the quality of the measurement.

**Length Laboratory** - A specific area, within a metrology laboratory, that is used solely for calibration or tolerance testing of length standards.

**Mass Laboratory** - A specific area, within a metrology laboratory, that is used solely for calibration or tolerance testing of mass standards.

**National Type Evaluation Program (NTEP)** - A program in which new weighing and measuring devices are evaluated for compliance with requirements adopted by weights and measures officials.

**Performance Testing** - An exercise in which a laboratory measures an artifact or other test object in order to evaluate the laboratory's ability to perform a specific test.

- Permanence Testing** - Actual or simulated use tests, often of an accelerated nature, to determine the ability of a device or system to maintain specified performance characteristics over a period of time.
- Post Audit** - An audit conducted subsequent to a certification evaluation to verify or clarify details of laboratory operations. Such an audit may be conducted as an adjunct to a routine technical visit to a certified laboratory by NBS personnel, or occasioned by some question(s) that could adversely affect an existing certification.
- Primary Standard** - A substance, object, or scale, the value of which has been established by a reliable source, and which can be accepted (within specified limits) without question when used to establish the value of the same or related property of another similar object or scale. Note that the primary standard for one user may be secondary standard for another.
- Quality** - An estimation of acceptability or suitability for a given purpose of an object, item, tangible, or intangible thing.
- Quality Assessment** - The overall system of activities whose purpose is to provide assurance that the quality control activities are being done effectively. It involves a continuing evaluation of performance of the production system and the quality of the products produced.
- Quality Assurance** - A system of activities whose purpose is to provide to the producer or user of a product or a service the assurance that it meets defined standards of quality with a stated level of confidence. It consists of two separate but related activities, quality control and quality assessment (defined).
- Quality Control** - The overall system of activities whose purpose is to control the quality of a product or service so that it meets the needs of users. The aim is to provide quality that is satisfactory, adequate, dependable, and economic.
- Random** - Little or no guidance by a governing mind, eye, objective, or the like.
- Random Sample** - A sample selected from a population, using a randomization process.
- Secondary Standard** - A standard whose value is based upon comparison with some primary standard. Note that a secondary standard, once its value is established, can become a primary standard for some other user.
- Standard Operating Procedure (SOP)** - A procedure adopted for repetitive use when performing a specific measurement or sampling operation. It may be a standard method or one developed by the user.

**Tolerance Testing** - A measurement operation performed to determine whether the actual value of a standard, artifact, or instrument is within a permitted tolerance of its nominal value.

**Volume Laboratory** - A specific area, within a metrology laboratory, that is used solely for calibration or tolerance testing of volumetric standards.

**Working Standard** - A secondary standard used for routine or field evaluation of other standards or for the measurement of specific properties of materials.



PART I  
PLAN FOR CERTIFICATION OF CAPABILITY  
OF  
STATE WEIGHTS AND MEASURES LABORATORIES

1. INTRODUCTION

1.1 Objectives

The objectives of the certification program for State weights and measures laboratories are to: (1) promulgate uniform performance standards that, in the judgment of professional metrologists, are deemed to be prerequisites for the production of reliable metrological measurements and; (2) evaluate the proficiency of the use of these standards in State laboratories.

NBS will issue a certificate of capability to each State that qualifies, listing on the face of the certificate those areas of competence for which the State qualifies.

The certification of any laboratory indicates only that the capability to perform reliable measurements appears to exist, but does not imply that its measurements are certified by NBS. Each laboratory, whether certified or not, must stand behind its own measurements and has sole responsibility for the reliability of data and reports issued.

Although certification is voluntary, the integrity of measurement services provided for regulatory and industrial purposes needs to be supported. This certification process serves the best interests of the States, their clientele, and the national measurement system. Laboratories are encouraged to seek certification and NBS will provide advice and assistance to laboratories for that purpose.

1.2 Policy

1.2.1 State weights and measures laboratories differ mainly in the kind of metrological measurements they provide. In recognition of this and the diversity of measurement skills, equipment, and facilities, certification will be issued for specific measurement competence areas.

1.2.2 To be certified, laboratories must meet both the general and specific requirements for each measurement competence area in which certification is sought. Certification will be based largely on information provided in a self-appraisal process in which each laboratory appraises its degree of compliance with the requirements.

1.2.3 NBS will issue a certificate only to the primary metrology laboratory of a State; the certificate is valid only for the laboratory certified. The certificate does not cover subsidiary or satellite laboratories that may report to the State laboratory. State laboratories may use the NBS requirements as a basis for their own certification of subsidiary or satellite laboratories but this does not constitute NBS certification of such laboratories.

## 2. CERTIFICATION PROCEDURE

The certification and self-appraisal procedures are shown, diagrammatically, in Figures 1 and 2, respectively. Certification will be based primarily on self appraisal for substantial compliance with the general and specific requirements as described in Sections 3 and 4, respectively. All information provided will be subject to postaudit by NBS.

### 2.1 Development of Requirements

NBS developed the requirements based on the more informal procedures followed in the past, augmented by requirements adopted by and tested in many laboratories in recent years. Certification by individual competency areas will thus be based on these requirements. This approach to laboratory certification has been endorsed by the 1983 National Conference on Weights and Measures.

### 2.2 Annual Solicitation

NBS will solicit requests for certification during the period October 1 to November 15 of each year. Applicants must report any changes from the previous year. In the case where the laboratory certification period will expire, the applicants shall submit Appendices C and F. All applications will be reviewed and a certification determination made before December 31, at which time full or conditional certification will be issued (when merited) for the year beginning January 1. Full certification will depend upon compliance with all of the general requirements together with the specific requirements in each competence area for which certification is sought.

Figure 1  
Certification/Authorization Procedure

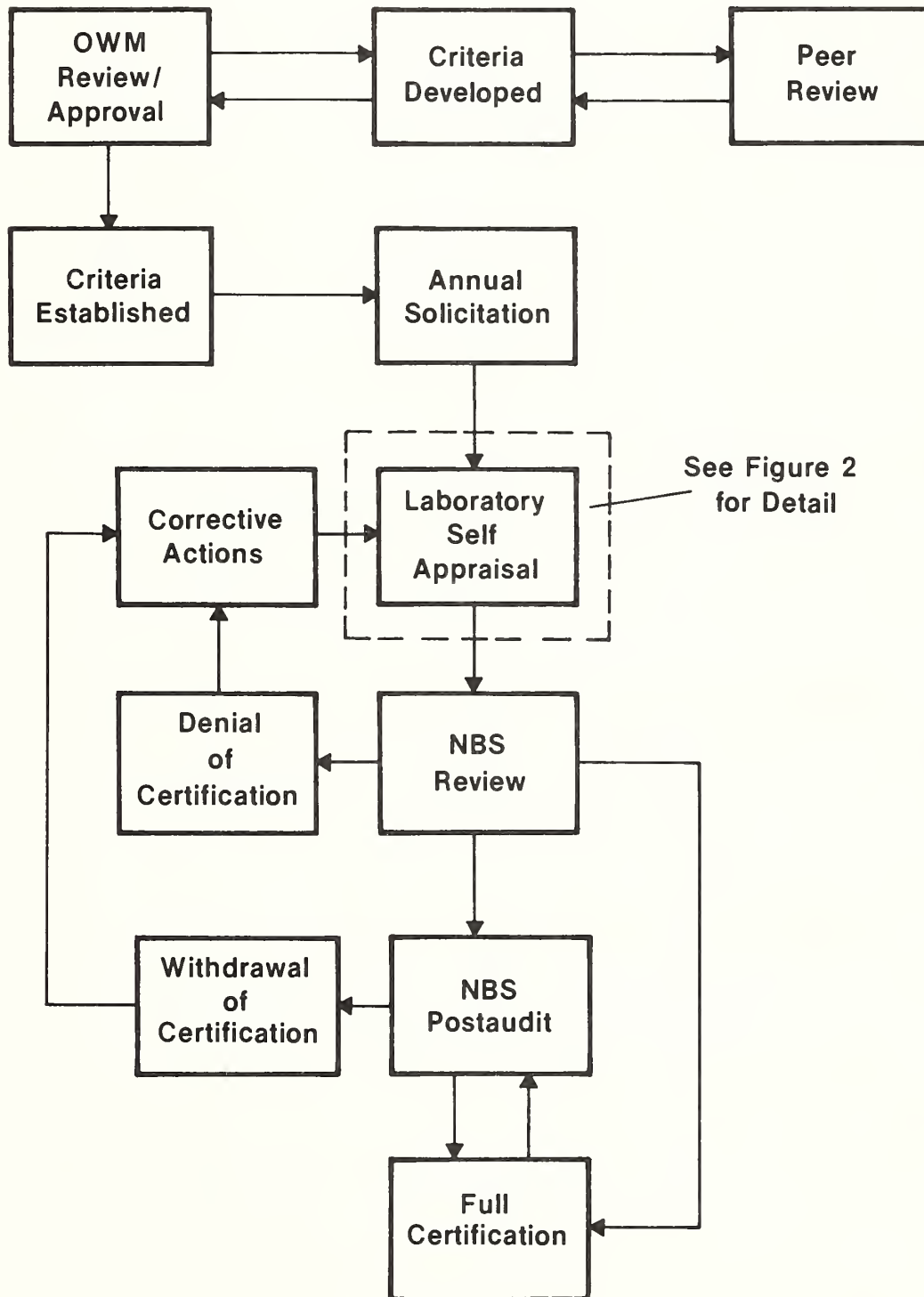
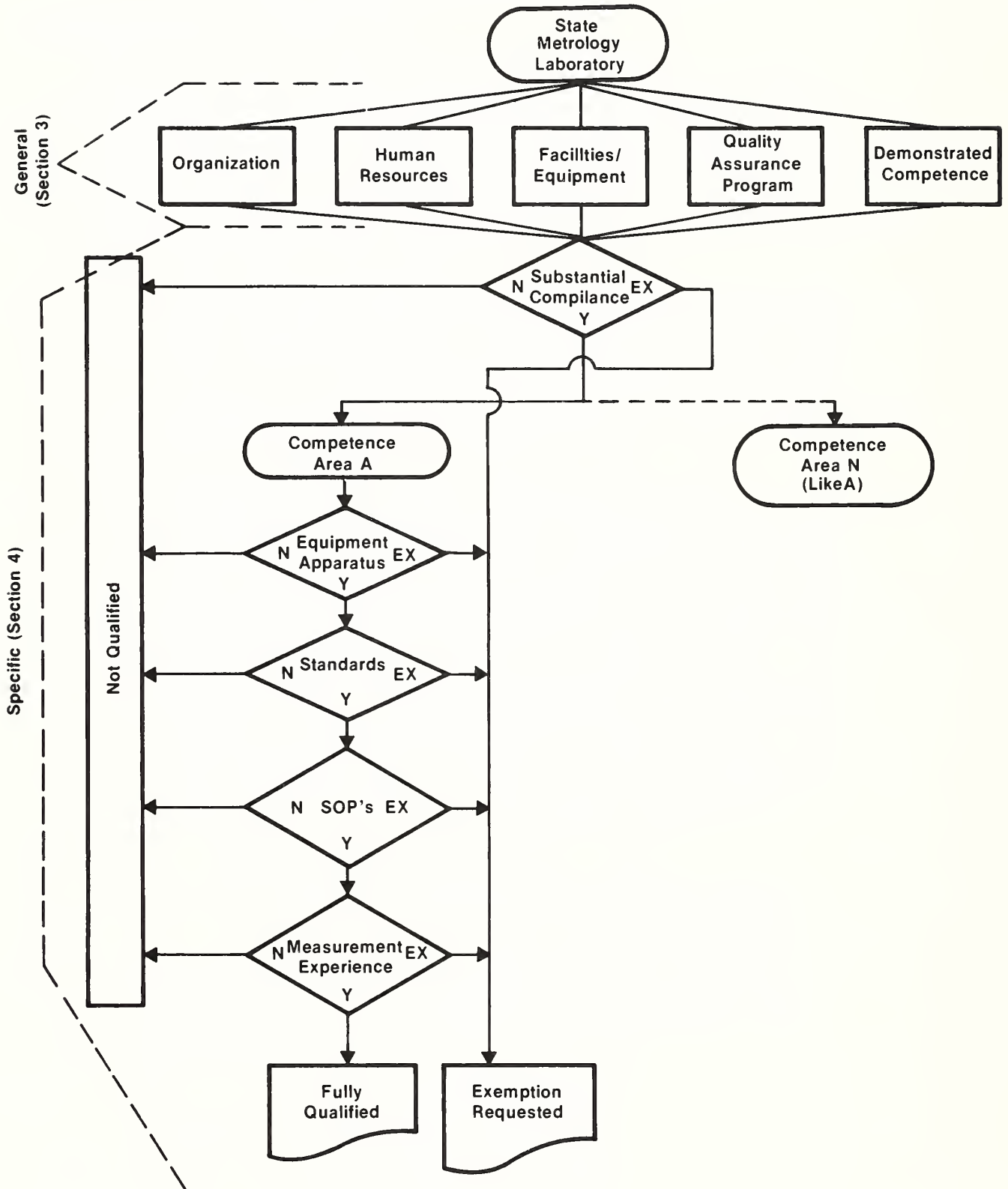


Figure 2  
State Appraisal Procedure





## 2.3 Self Appraisal

2.3.1 Each laboratory seeking certification shall use and submit a completed checklist as contained in Part 1 of Appendix C. In using the checklist, "Yes" should be checked if the requirement is met, while "Comments Attached" should be checked if the requirement is not met or only partially met. In the latter case, an explanatory statement should be included. Such information will be taken into consideration for certification.

2.3.2 Each competence area (see Appendix A) for which certification is sought must be addressed using the checklist in Part 2 of Appendix C.

2.3.3 Each laboratory completes Part 3 of Appendix C for use by NBS in updating its State Weights and Measures Laboratories Directory.

2.3.4 Certified laboratories shall annually submit a statement during the period of October 1 to November 15, updating any information previously supplied or stating that the conditions prevailing at the time of certification are essentially unchanged. NBS shall review such submissions and notify the laboratory whether or not the certification remains in effect.

A laboratory may submit a request for certification at any time other than the period described in Section 2.2. NBS will act upon such a request as expeditiously as possible.

## 2.4 Review and Decision

NBS reviews State submissions to determine the specific certification to be issued. The certification issued will be published in the State Weights and Measures Laboratories Directory (see Appendix F for identification of required general information).

2.4.1 NBS issues certification in those areas for which the laboratory complies with all requirements. In accepting the self appraisal of a laboratory, NBS reserves the right to review any or all information upon which the appraisal was based, either at the time of application for certification or during a postaudit for verification purposes, and to take appropriate actions.

2.4.2 NBS issues certification for up to a 3-year period which will remain valid throughout that period unless changing conditions require withdrawal at an earlier date. A certificate (Figure 3) will be issued identifying:

- the State to which the certificate is issued,
- the period of time covered, and
- the areas of competence recognized by NBS.

2.4.3 NBS shall provide an explanation in the case of denial of certification so that the nature of the corrective action(s) necessary for certification can be understood.

## 2.5. NBS Postaudit

2.5.1 NBS conducts a postaudit when it deems such to be necessary to verify any or all claims or to clarify any matters relevant to judging the merits of certification.

2.5.2 A postaudit may consist of a site visit, a request for documentation, or other means. Such postaudits also may be conducted in the course of routine visits by NBS staff.

### 2.5.3 Withdrawal of Certificate

A certified laboratory must report to NBS when significant changes have occurred that would substantially affect any claims made on its application for certification. Examples would include, but not be limited to, such matters as: loss of key personnel; irreparable damage and/or loss of equipment or calibration standards. NBS will investigate each case on an individual basis and decide whether to waive action, withdraw certification, or reissue certification on a conditional basis. NBS reserves the right to take appropriate action with respect to any certificate that has been issued.

## 2.6. Other Actions

### 2.6.1 Renewal of Expired Certificate

After a certificate has expired, NBS processes a request for renewal by following the same procedure as for an original application.

### 2.6.2 Resubmission

Any laboratory denied certification may resubmit its application at any time after the indicated corrective actions have been taken. NBS will reconsider the application and take action based on the additional information provided.

### 2.6.3 Expansion of Certification

A laboratory may request certification in additional competence areas at any time by submitting the information requested in Part 2 of Appendix C.

# United States Department of Commerce National Bureau of Standards



is certified\* under the Laboratory Metrology  
Program for the years  
**1985 - 1987**

The State Standards are traceable to the National Bureau of Standards

\*CERTIFIED AREAS OF COMPETENCE

Tolerance Testing	Calibration
<b>Mass</b> Weights $\leq$ 1000 lb Weights $>$ 1000 lb  <b>Volume</b> Small, intermediate and large standards	<b>Mass</b> Weights $\leq$ 3 kg Weights $>$ 3 kg  <b>Length</b> Steel tapes, rigid rules Frequency Tuning forks
	<b>Volume</b> Small glassware Metal standards  <b>Temperature</b> Liquid in glass thermometers

Date \_\_\_\_\_ For the National Bureau of Standards

Figure 3  
Laboratory Certification Certificate Format

### 3. GENERAL REQUIREMENTS FOR CERTIFICATION

To be certified, laboratories shall demonstrate compliance with all the requirements described below. Exemptions to specific requirements may be allowed to individual laboratories based upon the overall evaluation of the laboratory. The exemptions may be granted for only a limited period to provide time to correct the deficiencies.

#### 3.1 Laboratory Organization

The laboratory must be organized to insure the discharge of its metrological responsibilities in an efficient and expeditious manner. While details will depend upon the individual case, the following general requirements must be met.

3.1.1 The organizational responsibilities must be defined and identified on an organization chart or similar device. The chart must depict the relation of the laboratory to its parent organization and to other units that report to the same parent. Position descriptions shall be available for each staff member and each shall know his/her responsibilities within the organization.

3.1.2 All supervisory responsibilities must be clearly defined. Technicians must be under the supervision of senior personnel with demonstrated competence in the measurement area. An accredited (Section 3.2.4) metrologist must have overall supervisory responsibility and attest to the validity of all measurements made by the laboratory.

3.1.3 The laboratory shall maintain a list of the kinds of services it is capable of providing. No service will be listed unless the laboratory has acquired the necessary equipment and standards, has on file a written copy of the appropriate test procedures, and has staff available with demonstrated competence in their use.

#### 3.2 Human Resources

3.2.1 High-quality technical work depends on the availability of technically competent staff. The size of the staff will depend on the work load but should be adequate to insure that the work can be done without undue stress, yet expeditiously and efficiently. In general, the staff will include management, technical, and supporting personnel. (It is recognized that multi-functions may exist in small laboratories).

3.2.2 The laboratory shall ensure staff competence by such means as on-the-job training and supporting attendance at training courses, seminars, and conferences.

### 3.2.3 Laboratory Manager

The laboratory manager must be skilled in the management of a technical organization and have a comprehensive knowledge of the metrology laws and regulations of the State served by the laboratory. The laboratory manager has the full responsibility for development, implementation, and enforcement of the quality assurance program of the laboratory.

### 3.2.4 Technical Staff

The technical staff must be fully competent by virtue of training and/or experience to perform the measurements required. The staff must include at least one metrologist who has been accredited through the successful completion of the basic training course provided by NBS. The metrologist must have the capability to perform work carefully, demonstrate good judgment, and have the aptitude for critical analysis. A college degree (or the equivalent) in a technical field such as engineering, physics, chemistry or mathematics is required. A working knowledge of algebra and statistics is also required. previous laboratory experience and a knowledge of computer programming is desirable. Completion of the intermediate and advanced courses offered by NBS are desirable and provide additional basis for certification.

All other technical personnel must at least receive on-the-job training before they are permitted to make definitive metrological measurements.

### 3.2.5 Supporting Staff

The supporting staff, including technicians, clerical staff, and similar personnel, must be qualified to assist the technical staff and to facilitate the administrative functions of the laboratory. All such staff must be trained (at least on-the-job) to carry out their functions, subject to review and/or supervision of the technical and managerial staff.

## 3.3 Facilities and Equipment

Facilities and equipment must meet the minimum requirements described below. The laboratory must be arranged to facilitate the program of work, and good housekeeping practices must be followed to maintain it in a clean and orderly condition.

### 3.3.1 Facilities

Office space and equipment, including provision for maintenance and storage of records, must be adequate for the work load of the laboratory.

All facilities must be maintained in a manner to provide a safe, clean environment conducive to high quality work.

#### 3.3.1.1 General

Location - The laboratory must be in a suitable location with respect to accessibility and freedom from excessive external sources of vibration, or suitably protected from interference by such.

Temperature and Relative Humidity - Facilities must be provided for controlling temperature to within  $\pm 1$  °C and maintaining relative humidity within the range of 35% to 55%.

Illumination - At least 70 footcandles at bench level must be provided. The Lighting Handbook of the Illuminating Engineering Society recommends 100 footcandles at bench level for precise laboratory measurements.

#### 3.3.1.2 Mass Laboratory

Either the basement or ground level of a building is the preferred location for balances.

Locations exposed to the effect of sunlight or to other temperature fluctuations should be avoided.

The balances should not be located in buildings subject to high-amplitude (low-frequency) vibration such as from jackhammers, jaw crushers, forges, and shakers.

If possible, locations adjoining streets with heavy bus or truck traffic should be avoided. In case of high-amplitude vibration areas, independent piers, with separate footings not in contact with the floor or other structural footings, should be used. Insulation between piers and the floor must be soft and remain soft and should not be inserted until after the pier has set.

Air Currents - Air currents that could affect results must be avoided. Doors and windows must be able to be tightly closed. Heat and cooling ducts must be positioned so that air currents are not directed toward the balances.

Isolation - A mass laboratory should be located away from external walls and should be isolated from any main pedestrian traffic flow.

Size - A small-mass laboratory must be at least 108 square feet in area, with a minimum width of 8 feet. A large-mass laboratory must be at least 150 square feet in area, with a minimum width of 10 feet. These two laboratories should not be combined in a single space.

Weight Handling Equipment - A laboratory offering test services for large weights must have suitable equipment for handling them. To be suitable, equipment must provide adequate safeguards for the measurement apparatus and protect both the weights undergoing test and the calibration standards from damage of any kind during the handling operations.

#### 3.3.1.3 Length Laboratory

Size - A length laboratory must be at least 150 square feet in area, with a minimum width of 6 feet; a clear straight wall of not less than 20 feet in length must also be provided. At least two feet of space should be allowed on each end of the length bench to facilitate working with the steel tapes to be tested.

#### 3.3.1.4 Volume Laboratory

Water Supply - A volume laboratory must have hot and cold running water at a counter-top sink, and a source for distilled or deionized water must be available.

Size - A volume laboratory must be at least 80 square feet in area, with a minimum width of 8 feet.

#### 3.3.1.5 Other Competence Areas

Requests for certification in other competence areas will be considered as the needs develop. The development of criteria will address the specific requirements of each competence area. The certification process will follow the steps described in Section 2 and as illustrated in Figure 1.

### 3.3.2 Equipment

The laboratory must have all apparatus and equipment necessary to carry out its metrological responsibilities as defined in prescribed test procedures and applicable NBS handbooks. All equipment required for the performance of any test procedure must be of the type specified for that purpose or generally considered as adequate for the end use. It must be properly installed and maintained in a first class condition. Any equipment requiring calibration must be periodically calibrated and must have a currently valid calibration at the time of its use. Records of calibration must be maintained so that the status of calibration may be ascertained for any item of equipment at any time.

### 3.3.3 Calibration Standards

High-quality calibration standards must be available for every test procedure offered by the laboratory. All such standards must have calibration certificates that are traceable to NBS. All standards must be stored and used under conditions that will protect them from loss and damage and that would obviate questions as to their integrity.

Primary standards must be kept in a locked storage compartment that provides security and protection from dust and laboratory fumes. They may be removed from such storage areas only during the time of use, and with the approval of a designated responsible authority.

Secondary and working standards must be stored in a manner similar to that for primary standards, consistent with the fact that they may be extensively used.

Primary standards should be used only for primary standardization or for calibrations requiring standards of the highest quality. Secondary and working standards, traceable to the primary standards, should be used for all routine measurements to preserve the integrity of the laboratory's primary standards.

Certificates of calibration must be on file and the latest calibration (or correction) factors must be valid and applied to all standards at the time of their use.

## 3.4 Quality Assurance

The laboratory must have in operation a quality assurance program that meets the following minimum requirements.



3.4.1 A written statement describing the quality assurance program of the laboratory must be on file. (See Appendix D for an example of such a document.) This document will formally declare management's commitment to all aspects of quality assurance and its support and enforcement of good laboratory practices within the laboratory.

3.4.2 The document will describe the good laboratory practices and a quality assurance plan to be followed.

3.4.3 The quality assurance plan must include the maintenance of appropriate control charts together with the rationale for their use. This includes maintenance of records of any "out-of-control" incidents and the resulting corrective actions taken.

3.4.4 The quality assurance plan must include a process for review of all Test Reports for adequacy and freedom from detectable errors before their release from the laboratory.

3.4.5 The quality assurance plan must include mechanisms by which the quality of measurements may be assessed. Examples of such mechanisms include participation in Regional Measurement Management Programs (RMMPs) and exchange of test specimens with other laboratories.

3.4.6 The quality assurance plan should address matters of safety and safe laboratory practices.

3.4.7 All records pertinent to the laboratory operations and/or measurements must be maintained in a suitable manner and include: items for test; laboratory data; test reports; manual of methods; instruction manuals. It is recommended that an appropriate system of serial numbers or other means of identification be adopted and used, as well as a system to log and index these identifications for ease of retrieval.

### 3.5 Demonstration of Competence

The laboratory staff must demonstrate metrological competence from among the following accomplishments.

3.5.1 Successful completion of the current set of laboratory exercise/problems prepared and distributed by NBS.

3.5.2 Successful participation in a recognized Measurement Assurance Program or a Regional Measurement Management Program.

3.5.3 Receipt of honors/recognitions for excellence in some phase(s) of metrology by a member(s) of the staff.

3.5.4 Active participation in meetings of the National Conference on Weights and Measures.

3.5.5 Active contributions to the National Conference of Standards Laboratories.

3.5.6 Other evidence of professional competence by the technical staff such as the successful completion of advanced short courses given by a recognized professional organization or institution of higher education, or of a specialized seminar such as an NBS Precision Measurement Seminar.

#### 4. SPECIFIC REQUIREMENTS FOR CERTIFICATION

Certification, as merited, will be restricted to specific areas of competence as defined in Appendix A. The following requirements must be met for each specific competence area for which certification is requested.

##### 4.1 Competence

The staff must have a comprehensive understanding of the basic concepts and the specific metrological/testing procedures involved and experience in applying them to measurements/tests.

##### 4.2 Equipment and Apparatus

The equipment/apparatus specified in the test procedures (4.4) as well as all other items generally recognized as necessary to perform the measurements/tests in the competence area must be available and maintained in a satisfactory working condition.

##### 4.3 Standards

The standards specified and generally recognized as necessary to perform the measurements/tests must be available, with currently valid calibrations traceable to national measurement standards.

##### 4.4 SOP's

The laboratory must have on file well defined, written test procedures (Standard Operating Procedure, see Appendix E).

PART II  
PLAN FOR AUTHORIZATION  
OF MEASUREMENT LABORATORIES  
FOR TYPE EVALUATION

1. INTRODUCTION

1.1 Objectives

The objectives of the authorization plan of the National Type Evaluation Program are to: (1) promulgate uniform criteria and procedures for the selection of testing laboratories, (2) authorize those qualifying laboratories to participate as testing laboratories in the Program, (3) assure the uniform application of NTEP device evaluation criteria following uniform procedures, and (4) provide the basis for acceptance by the States in general of the evaluations conducted in the authorized State laboratories. The concepts of the authorization plan have been endorsed by the 1983 National Conference on Weights and Measures.

Although application for authorization is voluntary, use of the program will (1) result in uniform evaluations, (2) eliminate redundant evaluation of devices and the resultant costs to industry and States, (3) establish capabilities within the States to provide services to industry locally, (4) increase the number of skilled laboratory personnel nationally, (5) spread the understanding of NTEP criteria as a basis for attainment of increased uniformity in field enforcement practices.

NBS will issue a Certificate of Authorization (Figure 4) to each qualifying laboratory listing on the face of the certificate the device areas for which the authorization is valid. No authorization will be issued to a jurisdiction that performs only the permanence testing portion of an evaluation.

The authorization of any laboratory does not imply that its evaluation results are assured by the NBS, but only that the capability to perform the evaluations appears to exist. The NBS will review the results of each evaluation completed by an authorized laboratory before making a decision regarding their validity.

1.2 Policy

1.2.1 NBS conducts the NTEP authorization plan as an extension of the NBS Certification Plan (Part I). The certification of a State laboratory for its metrology program is a basic (but only partial) requirement for authorization under NTEP. The authorization plan is a separate one, and a separate Certificate will be issued to each qualifying NTEP laboratory.

# United States Department of Commerce National Bureau of Standards



is authorized under the National Type Evaluation  
Program for the years  
**1985 - 1987**

To conduct evaluations of the following equipment:

#### Scales and Weighing

Counter, portable, self-contained  
Vehicle, axle-load, livestock  
Automatic bulk weighing systems  
Belt conveyor scales  
Indicating and recording elements  
Electronic cash registers

#### Volumetric Measuring

Retail motor fuel dispensers  
Indicating and computing elements  
Vehical tank and wholesale meters  
Service station consoles

#### Linear Measuring

Taximeters  
Fabric measuring devices

Date \_\_\_\_\_

For the National Bureau of Standards

Figure 4  
Laboratory Authorization Certificate Format

1.2.2 The capability of a State weights and measures laboratory to function as an evaluation laboratory under NTEP depends on (1) the areas of competence for which it is certified under the Certification Plan (Part I), and (2) the degree to which it meets the incremental skill, facility, and equipment requirements under the Authorization Plan (Part II).

1.2.3 Evaluations may be conducted in authorized State laboratories, manufacturers' laboratories, or at field sites. Other than permanence tests (i.e., actual or simulated use tests to determine the ability of a device to maintain its performance characteristics over time), the evaluations must be conducted by qualified staff of authorized State or Federal laboratories. Permanence tests may be performed by personnel from an authorized laboratory or by a weights and measures official under the supervision of an official from an authorized laboratory. It is recommended that evaluation of small devices (including permanence tests when required) be conducted in an authorized State laboratory or in the manufacturer's facility. A company, requesting the evaluation of a large device that must be tested at a field site, is responsible for arranging for adequate physical standards to conduct the evaluation.

## 2. AUTHORIZATION PROCEDURE

The authorization process and self appraisal are shown, diagrammatically, in Figures 1 and 2 respectively. Authorization will be based upon both the self appraisal of the staff and facilities and an NBS audit.

To be authorized, applying laboratories must meet the requirements by device category of interest. Additionally, an on-site appraisal of a laboratory's facilities will be made by an NBS staff member before an authorization decision is made.

### 2.1 Development of Requirements

The requirements and test procedures for type evaluation were developed by the Task Force on National Type Evaluation (Technical Working Groups that subsequently were reassigned as Technical Subcommittees of the NCWM Committee on Specifications and Tolerances). These requirements and test procedures are designed to be compatible with NBS Handbook 44 (HB44), and are constantly being expanded to cover revised and additional HB44 codes.

If additional tests are required (as a result of action by the NCWM), the authorization requirements will be expanded and the States will be afforded the opportunity to request authorization to conduct these new tests as soon as the specific requirements are established.

## 2.2 Application

### 2.2.1 Forms to Use

To request authorization to conduct type evaluations, complete the application form in Appendix G and the self-appraisal checklist in Appendix H. An application may be submitted at any time. The application will list the personnel who will perform the examinations and identify the types of devices that each will examine. Describe the qualifications and familiarity of each individual with particular devices or features of devices to aid NBS in assessing the background of the applicants.

### 2.2.2 Justification

Authorization will be issued only to evaluate those device categories for which the laboratory applies, qualifies, and can project a sufficient work load to justify the cost of training and administration.

## 2.3 Self Appraisal

Each laboratory seeking authorization must submit a completed checklist (Appendix H). In using the checklist, "Yes" should be checked if the requirement is met, and "Comments Attached" should be checked if the requirement is not met or only partially met. In the latter case, an explanatory statement should be included. Such information will be taken into consideration for authorization.

## 2.4. Review and Decision

2.4.1 NBS will make an authorization decision based on the information provided by the applying laboratory in the self-appraisal checklist plus an optional audit of the laboratory and staff. In reviewing the self appraisal of a laboratory, the NBS reserves the right to accept or reject any of the information on which the appraisal is based.

2.4.2 NBS will issue a Certificate to qualifying laboratories listing the types of devices the laboratory is authorized to evaluate (Figure 4). The authorization will normally be valid for a three-year period. A listing of all authorized laboratories and the types of devices they are authorized to evaluate will be published in the "State Weights and Measures Laboratories Directory".

2.4.3 NBS will explain a rejection of a request for authorization so that necessary corrective action(s) can be understood.

## 2.5 Laboratory Audit

2.5.1 NBS will conduct an audit visit to the laboratory to evaluate the laboratory facilities and the standards available for type examinations. If the type examination training is provided at the laboratory site, the audit evaluation may be conducted at that time.

### 2.5.2 Withdrawal of Authorization

NBS reserves the right to modify or withdraw the authorization if certain requirements are no longer met (e.g., the only qualified staff member is no longer in the program), or if NBS review of the type evaluations conducted by the laboratory uncovers faulty or otherwise incorrect conclusions.

An authorized laboratory shall report to NBS when significant changes have occurred that would invalidate or substantially modify any claims made on its application for authorization. Examples would include, but are not limited to, such matters as loss of key personnel and irreparable damage to or loss of equipment. NBS will investigate each case on an individual basis and decide whether to waive action or withdraw certification.

## 2.6 Other Actions

### 2.6.1 Renewal of Expired Certificate

After a certificate has expired, NBS will process a request for renewal by following the same procedure as for an original application.

### 2.6.2 Resubmission

Any laboratory denied authorization may resubmit its application at any time after the indicated corrective actions are completed. NBS will reconsider the application and take action based on the additional information provided.

### 2.6.3 Expansion of Authorization

A laboratory may request authorization in additional testing areas at any time by submitting the information called for in Appendix H.

### 2.6.4 Withdrawal from Program

A laboratory may withdraw from the authorization process at any time or withdraw itself from an authorized status.

## 3. REQUIREMENTS FOR AUTHORIZATION

To be authorized, laboratories shall demonstrate with all the requirements described below. Only States with

certified weights and measures laboratories will be eligible for authorization. The requirements for authorization are in addition to those for laboratory certification. The States must also have adopted the "Uniform State Regulation for National Type Evaluation". Exemptions from specific requirements may be allowed to individual laboratories based upon the overall evaluation of the laboratory. Exemptions may be granted for only a limited time period to provide time to correct the deficiencies.

### 3.1 Laboratory Organization

The laboratory must be organized to insure the discharge of its NTEP responsibilities. The requirements for laboratory organization are analogous to those given in Part I, Paragraph 3.1.

### 3.2 Human Resources and Training

3.2.1 The laboratory manager may be one of the people performing type evaluation examinations (see responsibilities under Part I, Paragraph 3.2.3.). The staff must be familiar with the types of devices currently in use, their applications, and the enforcement requirements for the devices for which the laboratory is requesting authorization. The staff must also be familiar with the mechanics and theory of operation for the devices to be evaluated. An understanding of computer programming is also necessary for devices or systems utilizing microprocessors.

3.2.2 The technical staff must be trained by NBS to use the NTEP criteria and test procedures effectively. Explanations of the requirements and their rationale will be provided. Joint examinations may be conducted on devices to assure uniform application of the requirements and procedures. These examinations will be used to evaluate the judgment of each applicant to determine whether his or her decisions are likely to be consistent with those of NBS and to identify any differences in requirements that are not immediately obvious.

### 3.3 Facilities and Equipment

Facilities and equipment must meet the minimum requirements described in Appendix H and be maintained in good condition. The laboratory must be arranged to facilitate NTEP work and good housekeeping practices must be followed to keep it in a clean and orderly condition.

Office space and equipment, including provision for maintenance and storage of records, must be adequate for the work load of the NTEP in addition to the normal work load of the laboratory (see Section 3.3 of Part I).



### 3.4 Quality Assurance

3.4.1 The quality assurance plan must include a procedure for review of all Test Reports for accuracy and freedom from detectable error before their submission to NBS.

3.4.2 All records pertinent to the NTEP must be maintained in a suitable manner and include retention of all test data, description of the devices/systems tested, all correspondence, and memos for the record of important conversations and decisions.

### 3.5 Demonstration of Competence

Individuals conducting type evaluations shall demonstrate competence by conducting examinations while an NBS representative is observing the process. Additionally, NBS may conduct examinations separately on the same equipment and compare the results with those obtained by the applicant.

NBS will continue to monitor the competence of individuals conducting type evaluations by reviewing the data submitted to NBS in the Reports of Test. NBS shall review performance data to verify the adequacy of the testing and suitability of test results. NBS shall also review the type evaluation checklist to determine whether sufficient notes were made to describe new or unusual features. Authorized laboratories shall maintain regular communication with NBS to discuss new or unusual features. The identification of new or unusual features and the analysis made for determining their appropriateness are major components of demonstrating competence.

## 4. PERMANENCE TESTING

Whenever possible, permanence testing will be performed in the laboratory. If permanence testing must be done in the field, it may be performed by weights and measures officials in whose jurisdiction the device is installed provided they have participated in the initial examination and are familiar with the tests to be performed. The representative from the authorized laboratory is responsible for the examination and must review the data and assure that the tests were conducted properly.



## A P P E N D I X A

### COMPETENCE AREAS FOR CERTIFICATION

(Apply for certification by submitting information requested in Appendix C for each competence area desired).

#### I. Mass Measurement

- A. Tolerance testing to Class F, ASTM Classes 4, 5, or 6
  - 1. Weights less than or equal to 1000 lb
  - 2. Weights greater than 1000 lb
- B. Calibration and tolerance testing to ASTM classes 1, 2, or 3
  - 1. Weights less than or equal to 3 kg
  - 2. Weights greater than 3 kg

#### II. Volume Measurements

- C. Tolerance testing to NBS Handbook 105-2 and 105-3
  - 1. Glass flasks and small volume metal standards (25 gal)
  - 2. Intermediate-volume provers (25 to 500 gal)
  - 3. Large-volume provers (over 500 gal)
- D. Calibration
  - 1. Small Glassware
  - 2. Metal Volume Standards

#### III. Length Measurements

- E. Tolerance testing and calibration of metal tapes
- F. Tolerance testing and calibration of rigid rules

#### IV. Temperature Measurements

- G. Liquid-in-glass thermometer
  - 1. Tolerance testing
  - 2. Calibration
- H. Other Temperature Measurement Devices

#### V. Frequency Measurements - Tuning-fork Calibration

- I. Calibration services provided



## A P P E N D I X B

### ASSISTANCE AVAILABLE FROM NBS

It is the objective of NBS to encourage all State laboratories to seek full certification. Assistance to attain such status includes:

1. **Basic metrology training** in mass, length, and volume, (two-week seminar).
2. **Intermediate metrology training** in mass, length, and volume (one-week seminar). Prerequisite - completion of basic course or equivalent.
3. **NBS Precision Measurement Seminars.** Seminars on special measurement techniques (two- to five-day duration).
4. **Recommended test procedures for:**
  - a. mass tolerance testing
  - b. mass calibration weighing designs
  - c. volume calibration
    - volume transfer
    - gravimetric
  - d. length calibration
    - length bench
    - tape-to-tape
    - rigid rules
  - e. temperature - NBS Monograph 150
5. **Time and frequency information** - NBS Special Publication 432
6. **Measurement assurance information** - NBSIR 77-1240
7. **NBS Evaluation of Laboratory Auditing Problems**
8. **NBS Evaluation of laboratory facilities** by on-site visit.
9. **Measurement control programs** in selected measurement areas.

For further details on any of the above, general information, or assistance in areas not listed above, or in the case of special measurement problems, contact:

**Office of Weights and Measures, OPSP  
National Bureau of Standards  
Gaithersburg, MD 20899  
Attention: Manager, State Laboratory Program  
301-921-2401**

# APPENDIX C

## SELF-APPRAISAL CHECKLIST

### PART 1. GENERAL REQUIREMENTS

**INSTRUCTIONS:** Certified laboratories must comply with all of the following general requirements, described more fully in Section 2 of the Certification Plan. Please read the requirements and appraise your compliance by addressing the corresponding questions. Then make an overall self appraisal as requested.

Numbers in parentheses throughout the checklist refer to the corresponding paragraphs of Section 3 in the Certification Plan where the requirements are discussed. "Yes" should be checked if the requirement is met. "Comments Attached" should be checked if the requirement is not met or only partially met; in this case, submit an explanatory statement.

#### I. Laboratory Organization (3.1)

	<u>Yes</u>	<u>Comments Attached</u>
1. Laboratory organized to insure the efficient performance of its responsibilities. (3.1)	___	___
2. Organizational responsibilities defined on an organizational chart. (3.1.1.)	___	___
3. Position descriptions for each staff member on file. (3.1.1)	___	___
4. Supervisory responsibilities clearly defined.	___	___
5. An accredited metrologist has overall supervisory responsibility. (3.1.2)	___	___
6. A list of the laboratory services provided is maintained. (3.1.3)	___	___
7. Overall Appraisal: Laboratory Organization Requirements are met.	___	___

## II. Human Resources (3.2)

	<u>Yes</u>	<u>Comments Attached</u>
8. Mechanism established for continuing training of the staff. (3.2.2)	—	—
9. Laboratory manager skilled in the management of a technical organization. (3.2.3)	—	—
10. Laboratory manager has a comprehensive knowledge of metrology laws and regulations. (3.2.3)	—	—
11. Staff includes at least one metrologist who has completed NBS basic training course. (3.2.4)	—	—
12. Remainder of staff has received at least on-the-job training. (3.2.4)	—	—
13. Overall Appraisal: Human resources requirements met.	—	—

## III. Facilities and Equipment (3.3)

### A. Office Space

14. Office space and equipment are adequate (3.3.1)	—	—
---	---	---

### B. Laboratory Facilities (General) (3.3.1.1)

Check below the condition most closely describing the laboratory.

- ( ) No vibration sources in immediate vicinity.
- ( ) Highway near building but light traffic that is primarily passenger cars and light trucks.
- ( ) Heavily traveled highway(s) are in vicinity of the building. Traffic is primarily passenger cars and light trucks.



Yes      Comments  
Attached

- ( ) Heavily traveled highway(s) are near the laboratory. Mixture of light and heavy vehicles. Railroad track near building but only infrequently used.
- ( ) Vibrations interfere with precision measurements

15. Overall Appraisal. Laboratory Facilities (General)  
Laboratory is free from excessive vibration; i.e., no railroad tracks, heavily traveled highway, or other vibration sources in immediate vicinity.      \_\_\_\_\_

**C. Laboratories Facilities (Movement)**

Check below the conditions most closely describing the laboratory.

- ( ) Overhead crane with movement front-to-back and side-to-side
- ( ) Monorail track
- ( ) Portable crane or hoist
- ( ) Equipment is inconvenient to use
- ( ) No equipment, or balances show signs of damage

16. Laboratory design facilitates movement of weights or provers into test area.      \_\_\_\_\_

17. Overall Appraisal. Means for moving large weights in and out of building and moving weights around the balance without subjecting the balance or weights to damage.      \_\_\_\_\_

**D. Laboratory Facilities (Painting)**

Check below the condition most closely describing the evaluation.

- ( ) Paint booth with blower/filters to catch overspray
- ( ) Paint area
- ( ) No painting facilities

	<u>Yes</u>	<u>Comments Attached</u>
18. Overall Appraisal. Facilities for painting weights and other equipment is adequate.	_____	_____
19. Work area for tools, vise, etc., adequate and located away from balances.	_____	_____

**D. Temperature Control (3.3.1.1)**

**NOTE: Window air conditioners do not usually provide adequate temperature and/or humidity control for high precision calibrations**

Temperature controls most closely match the description checked below (Check one):

- ( ) Temperature in entire laboratory is maintained within +1 °C.
- ( ) Temperature in mass, length, and volume laboratory maintained within +1 °C. Remainder of laboratory is controlled by normal building heating and cooling system.
- ( ) Temperature in small-mass laboratory is maintained within +1 °C. Length and volume laboratories have normal building temperature control; temperature variations are slow. Large-mass laboratory has auxiliary heaters and is subject to temperature variations in excess of +2 °C in eight hours.
- ( ) Small-mass, length, and volume laboratories are on normal building temperature controls temperature variations are slow (+2 °C/day). Large-mass laboratory has auxiliary heaters and is subject to temperature variations in excess of +2 °C in eight hours.
- ( ) Laboratory lacks adequate insulation from outer areas. Temperature in some laboratory areas subject to large variations. Temperature varies more than +2 °C during the day in small mass laboratory.

20. Overall Appraisal. Temperature controls are believed to meet the minimum requirements.	_____	_____
--	-------	-------

**E. Relative Humidity Control (3.3.1.1)**

Humidity controls most closely match the description checked below (check one):

- ( )    Controlled between 35-55 percent
- ( )    Varies between 20-70 percent
- ( )    No humidity control; varies beyond 20-70 percent levels
- ( )    No humidity control, no means to measure humidity

21. Overall Appraisal. Humidity controls meet minimum requirements.

\_\_\_\_\_

**F. Other General Considerations (3.3.1.1)**

- 22. Laboratory lighting adequate in all areas
- 23. Laboratory free of water dripping from water pipes or air conditioning units
- 24. If hazardous chemicals are used, the laboratory has a hood to exhaust chemical vapors
- 25. The laboratory has a barometer to measure air pressure.
- 26. Laboratory is clean and constructed so the entrance of dirt through doors, vents, and other openings is minimal.
- 27. Equipment and supplies stored in a manner that prevents interference with laboratory operations and promotes cleanliness.
- 28. Access to the laboratory limited to prevent possible damage to the standards. Keys to the laboratory issued only to those immediately responsible for the laboratory, e.g., metrologist(s), laboratory or division director, and security officer.
- 29. The laboratory is cleaned only when the metrologist is available to supervise the cleaning operation; standards protected from possible damage.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

	<u>Yes</u>	<u>Comments Attached</u>
30. The entrances to the small mass, length, and volume laboratories are from rooms not subject to a wide variation in temperature.	—	—

**G. Mass Laboratory (3.3.1.2)**

31. The laboratory is located in the basement or ground level floor of a building.	—	—
--	---	---

32. Small-mass laboratory has an area of at least 108 ft <sup>2</sup> with a minimum width of eight feet.	—	—
---	---	---

Give dimensions: Length \_\_\_\_\_ Width \_\_\_\_\_

Check below the conditions describing the laboratory balance installation.

- ( ) Smaller balances and the base for the Russell balance are installed on independent piers with separate footings not in contact with the floor.
- ( ) Balances are installed on the normal concrete-tile flooring of the building.
- ( ) Balances are installed on a wood floor. Movement about laboratory affects balances.
- ( ) Air currents and drafts held to a minimum. Doors and windows close and seal tightly.
- ( ) Balances located away from heating or cooling vents; air currents not directed toward the balances (large and small mass laboratories).
- ( ) The small-mass, length, and volume laboratories are located away from external walls.
- ( ) Facility and/or equipment not adversely affected by exposure to sunlight or external environment.
- ( ) Laboratory isolated from any main pedestrian traffic flow.
- ( ) Garage doors do not open directly into the laboratory (except for the large-mass laboratory).

Check the condition describing the laboratory arrangement.

- ( ) Small-mass laboratory is in a separate room with adequate space for standards and test weights.
- ( ) Separate room meeting minimum requirements
- ( ) The mass laboratory and length bench laboratory are in the same room but adequate space is available.
- ( ) Small mass laboratory is cramped for space.
- ( ) Small mass laboratory is in the same room as all the rest of the standards.

33. Overall Appraisal. The mass laboratory is believed to meet minimum requirements based on the information provided below:

\_\_\_\_\_

**H. Length Laboratory (3.3.1.3)**

34. The laboratory has an area of at least 120 ft<sup>2</sup> with a minimum width of six feet. A clear straight wall of not less than 20 feet in length is available with at least two feet of space allowed on each end of the length bench.

\_\_\_\_\_

Give Dimensions: Length \_\_\_\_\_ Width \_\_\_\_\_

35. The length bench is free of all material except the apparatus needed for performing length measurements.

36. Length bench supplied by NBS maintained in good working order.

\_\_\_\_\_  
\_\_\_\_\_

37. Overall Appraisal. The length laboratory is believed to meet the minimum requirements.

\_\_\_\_\_

**I. Small-Volume Laboratory (3.3.1.)**

38. The laboratory has hot and cold running water at a counter-top sink.

\_\_\_\_\_

Check the condition best describing the source of distilled or deionized water.

- ( ) Water source is in the laboratory.
- ( ) Water source is not in laboratory but conveniently located.
- ( ) Water source is not conveniently available.

If a distilled or deionized water source is not conveniently available, indicate the number of times per year the glass volume standards are used. \_\_\_\_\_

- |  |       |       |
|--|-------|-------|
| 39. The glassware is located in a room or area free from pedestrian traffic or protected from damage by being enclosed in a cabinet. | _____ | _____ |
| 40. The glassware is covered to prevent it from getting dirty.   | _____ | _____ |
| 41. Teflon hoses are used to conduct water to the volume standards. The hoses are not worn, cracked, or flaking.                     | _____ | _____ |
| 42. The laboratory has an area of at least 80 ft <sup>2</sup> with a minimum width of 8 feet.  | _____ | _____ |
| <b>43. Overall Appraisal. The small-volume laboratory is believed to meet the minimum requirements</b>                               | _____ | _____ |

### J. Large-Volume Laboratory (3.3.1.4)

Check the condition describing the laboratory.

- ( ) An elevated area available for the installation and use of large volume standards.
- ( ) Elevated area has water supply.
- ( ) Standard must be installed outside or on the test vehicle or prover each time the standard is used.

	<u>Yes</u>	<u>Comments Attached</u>
44. Overall Appraisal. The large-volume laboratory is believed to meet the minimum requirements.	—	—
<b>K. Equipment (General) (3.3.2)</b>		
45. Laboratory has all general equipment necessary to provide the services it offers.	—	—
46. General equipment is maintained in a serviceable condition.	—	—
47. Apparatus/equipment requiring calibration is calibrated on a scheduled basis.	—	—
48. Calibration certificates are filed in a specified location.	—	—
<b>L. Calibration Standards (3.3.)</b>		
Describe on the Comment Sheet the monitoring procedure used.		
49. All State standards have valid calibration certificates.	—	—
50. State standards are properly stored and secure.	—	—
51. Primary standards are used only for high precision work.	—	—
52. Secondary (working) standards are used for all routine measurements; e.g., tolerance testing of 500- and 1000-lb weights, 50-lb weights, and field weight kits.	—	—
53. Overall Appraisal: Calibration Standards Met	—	—
<b>IV. <u>Quality Assurance Program (3.4)</u></b>		
54. The laboratory has a quality assurance policy statement on file that formally declares management's commitment to quality assurance and good laboratory practices (3.4.1) (Submit copy)	—	—

	<u>Yes</u>	<u>Comments Attached</u>
55. A document describing the good laboratory practices to be followed is on file (3.4.2)	—	—
56. Control charts are maintained and used to monitor laboratory performance (3.4.3)	—	—
List on Comment Sheet all control charts maintained and date each was initiated.		
57. Procedures established to regularly review reports before release (3.4.4)	—	—
58. Laboratory regularly participates in quality assessment procedures.	—	—
Indicate participation below (3.4.5):		
MAP _____; RMAP _____;		
Cooperation with _____		
Other _____		
59. Laboratory plan addresses safety (3.4.6)	—	—
60. Plan addresses record management (2.4.7):	—	—
Check items covered:		
Test items ( ); Laboratory data ( ); Test reports ( );		
Calibration certificates ( ); Control charts ( );		
Instruction manuals ( ); Other (use Comment Sheet)		
61. Overall Appraisal: Quality Assurance Program Requirements met.	—	—

#### V. Demonstration of Competence (3.5)

(The following is offered as evidence of professional competence of staff)

Indicate on Comment Sheet training that staff metrologists have received or the activities in which they participated. Use the categories listed below and provide names and dates for each individual.

- a. Two-week basic seminar
- b. Completed the ten basic LAP problems



- c. Completion of assigned LAP problems annually
- d. Intermediate seminar
- e. Completed the practice problems based upon the intermediate seminar (effective 1980)
- f. Participation in the NCWM metrologist's workshop
- g. Participation in regional measurement assurance programs (RAMPs)
- h. Attendance of advanced seminars conducted by the NBS calibration laboratories in specialized measurement areas
- i. Participation in the National Conference of Standards Laboratories
- j. Participation in ASTM or other standards organizations
- k. Home study courses
- l. Other (describe)



## PART 2

### COMPETENCE AREA REQUIREMENTS

#### INSTRUCTIONS

Fill in the following checklist for each area in which certification is sought; follow the instructions given in Section 2, "Certification Procedure". Identify equipment by manufacturer.

Certification is restricted to each area of competence (see Appendix A) in which the laboratory has adequate equipment, calibration standards, written test procedures, and demonstrated experience.

The equipment listed under each measurement area is considered the minimum needed to perform the measurements. Some laboratories may have equipment that is used instead of the specific equipment listed. In this case the listed equipment should be crossed out and the substitute equipment listed in its place. Additional equipment and standards should be listed in the space following the listed equipment. The additional standards will be considered when evaluating the relative capabilities of the laboratories.

If a laboratory is deficient in some of the listed equipment or standards but believes the measurement service can be provided despite the apparent deficiency, describe the equipment, standards, and procedures used to overcome the apparent deficiency.

#### I. Mass Measurement

##### A. Tolerance testing to Class F. ASTM Classes 4, 5, or 6

##### A.1. Weights less than 1000 lb

Check equipment used (in good operational condition)

- 100-g or 160-g capacity balance
- 1-kg capacity balance
- 3-kg capacity balance
- 30-kg capacity balance
- Russell balance
- Other (describe on Comment Sheet)

Yes      Comments  
Attached

62. Three standard deviations of each balance is less than or equal to one-fourth the tolerance applied to the smallest weight tested on the balance.                        

List standards used for about purpose on Comment Sheet

Check other equipment and standards available.

- ( ) Micro balance
- ( ) Electronic 30-kg capacity mass comparator
- ( ) 30-kg capacity equal-arm balance
- ( ) Other (list on Comment Sheet)

Check methods used with written procedures on file.

- ( ) Modified substitution
- ( ) Direct reading; built-in weights calibrated
- ( ) Direct reading; errors of built-in weights are believed to be negligible compared to the tolerances applied to the weights under test.
- ( ) Other (describe on Comment Sheet)

Indicate experience in this competence area

Staff years (estimated) \_\_\_\_\_

Number of tests performed annually (estimated) \_\_\_\_\_

63. Overall appraisal. Tolerance-Testing less than 1000 lb requirements met.



	<u>Yes</u>	<u>Comments Attached</u>
65. Overall Appraisal. Tolerance-Testing greater than 5000 lb requirements met.	_____	_____

B. Calibration and/or tolerance testing to ASTM Classes 1, 2, or 3

B.1. Weights less than or equal to 100 g

Check equipment used (in good operational condition).

- Micro balance
- 100-g or 160-g capacity balance
- Other (describe on Comment Sheet)

Check standards used for above purpose

- Complete set of NBS calibrated State standards is available.
- Other (describe on Comment Sheet)

Check methods used with written procedures on file

- Double Substitution
- 3-1 weighing design
- Mass measurement control program (LAP Nos. 26 and 27) is used; control charts are maintained.
- Corrections and uncertainties are reported for calibrations

List experience in this competence area.

Staff years (estimated) \_\_\_\_\_

Number of tests performed annually (estimated) \_\_\_\_\_

66. Overall Appraisal: Calibration and Testing less than or equal to 100 g.	_____	_____
---	-------	-------

B.2. Weights 100 g to 3 kg.

Check equipment used (in good operational condition).

- ( ) 1-kg capacity balance  
    Manufacturer \_\_\_\_\_
- ( ) 3-kg capacity balance  
    Manufacturer \_\_\_\_\_
- ( ) Other (describe on Comment Sheet)

Check standards used for above purpose

- ( ) Complete set of NBS calibrated standards is available.
- ( ) Standard deviations are current.
- ( ) Other (describe on Comment Sheet)

Check methods used with written procedures on file.

- ( ) Double Substitution
- ( ) 3-1 weighing design
- ( ) Other (describe on Comment Sheet)
- ( ) Corrections and uncertainties are reported for calibrations.
- ( ) Measurement control program  
    (desirable but not required at this time)

List experience in this competence area.

Staff years (estimated) \_\_\_\_\_

Number of tests performed annually (estimated) \_\_\_\_\_

67. Overall Appraisal: Calibration and Testing 100 g to 3 kg requirements met.                      \_\_\_\_\_

B.3. Weights 3 kg to 30 kg.

Check equipment used (in good operational condition)

- ( ) 30-kg balance single-pan  
    Manufacturer \_\_\_\_\_.
- ( ) 30-kg balance equal arm  
    Manufacturer \_\_\_\_\_
- ( ) Other (describe on Comment Sheet)

Check standards used for above purpose.

- ( ) Complete set of NBS calibrated standards is available
- ( ) Standard deviations are current
- ( ) Other (describe on Comment Sheet)

Check methods used with written procedures on file.

- ( ) Double Substitution
- ( ) Transportation
- ( ) 3-1 weighing design
- ( ) Other (describe on Comment Sheet)
- ( ) Corrections and uncertainties are reported for calibrations.
- ( ) Measurement control program  
    (desirable but not required at this time)

List experience in this competence area

Staff years (estimated) \_\_\_\_\_

Number of tests performed annually (estimated) \_\_\_\_\_

68. Overall Appraisal. Calibration and Testing 3 kg  
to 30 kg requirements met.                      \_\_\_\_\_



B.4. Weights 30 kg to 1000 lb.

Check equipment used (in good operational condition).

- Russell balance
- Mass comparator (describe on Comment Sheet)
- Other (describe on Comment Sheet)

Check standards used for this purpose.

- NBS calibrated standards
- Other (describe on Comment Sheet)

Check methods used with written procedures on file.

- Double Substitution
- Transportation
- 3-1 weighing design
- Other (describe on Comment Sheet)
- Standard deviations are current.
- Corrections and uncertainties are reported for calibrations.
- Measurement control program  
(desirable but not required at this time)

List experience in this competence area.

Staff years (estimated) \_\_\_\_\_

Number of tests performed annually (estimated) \_\_\_\_\_

69. Overall Appraisal. Calibration and Testing 30 kg to 1000 lb requirements met.      \_\_\_\_\_

B.5. Weights over 1000 lb.

Describe equipment used (in good operational condition) on Comment Sheet.

Check standards used for above purpose

- NBS or State calibrated standards
- Other (describe on Comment Sheet)

Check methods used with written procedures on file.

- Double substitution
- Transportation
- 3-1 weighing design
- Other (describe on Comment Sheet)
- Standard deviations are current.
- Corrections and uncertainties are reported for calibrations
- Measurement control program (desirable but not required at this time)

Largest weight that can be tested \_\_\_\_\_ lb

List experience in this competence area

Staff years (estimated) \_\_\_\_\_

Number of tests performed annually (estimated) \_\_\_\_\_

70. Overall Appraisal. Calibration and Testing over 1000 lb Requirements met. \_\_\_\_\_

II. Volume Measurement

C. Tolerance testing to NBS Handbooks 105-2 and 105-3

Yes

Comments  
Attached

C.1. Glass flasks.

Check equipment used (in good operational condition).

- ( ) Source of distilled/deionized water
- ( ) Calibrated thermometers
- ( ) Other (describe on Comment Sheet)

Check standards used for above purpose.

- ( ) Calibrated volume standards are available
- ( ) Other (describe on Comment Sheet)

Check methods used with written procedures on file.

- ( ) Volume transfer procedure is used.
- ( ) Other (describe on Comment Sheet)

List experience in this competence area

Staff years (estimated) \_\_\_\_\_

Number of tests performed annually (estimated) \_\_\_\_\_

71. Overall Appraisal. Glass Flask Requirements met. \_\_\_\_\_

C.2. Five-gallon test measures

Check equipment used (in good operational condition).

- ( ) Source of pure water
- ( ) Calibrated thermometer
- ( ) Other (describe on Comment Sheet)

Check standards used for above purpose.

- ( ) 5-gallon slicker plate standard
- ( ) Other (Describe on Comment Sheet)

Methods used with written procedures on file.

- ( ) Volume transfer procedure
- ( ) Other (describe on Comment Sheet)

List experience in this competence area.

Staff years (estimated) \_\_\_\_\_

Number of tests performed annually (estimated) \_\_\_\_\_

72. Overall Appraisal. Test Measures 5-gallon requirements met.      \_\_\_\_\_

C.3. Large Metal Provers.

Check equipment used (in good operational condition)

- ( ) Source of pure water
- ( ) Thermometer is available to determine water temperatures.
- ( ) Other (describe on Comment Sheet)

Check standards available for above purpose.

- ( ) Calibrated volume standards are available such that not more than 15 deliveries are needed to test a field prover.
- ( ) Other (describe on Comment Sheet)

Capacity of largest standard \_\_\_\_\_

Check methods used with written procedures on file

- ( ) Volume transfer procedure is used (NBSIR 73-287)
- ( ) Other (describe on Comment Sheet)

List experience in this competence area.

( ) Staff years (estimated) \_\_\_\_\_

( ) Number of tests performed annually (estimated) \_\_\_\_\_

73. Overall Appraisal. Large Metal Provers, requirements met. \_\_\_\_\_

D. Calibration

D.1. Small Glassware, pipets and burets.

Check equipment used (in good operational condition).

( ) Balance (describe on Comment Sheet)

( ) Thermometer, calibrated to \_\_\_\_\_ °C

Barometric pressure obtained by.

( ) Barometer

( ) Other (describe on Comment Sheet)

74. Transfer vessels are available. \_\_\_\_\_

Check standards available for above purpose.

( ) Distilled water

( ) Deionized water

Methods used with written procedures on file.

( ) Gravimetric procedure is used

( ) Other (describe on Comment Sheet)

List experience in this competence area.

Staff years (estimated) \_\_\_\_\_

Number of tests performed annually (estimated) \_\_\_\_\_

74. Overall Appraisal. Small Glassware, Requirements met.

\_\_\_\_\_

D.2. Metal Volume Standards.

List balances used on Comment Sheet if gravimetric calibration is done.

Check equipment used (in good operational condition).

Source of distilled/deionized water

Thermometer calibrated to \_\_\_\_\_°C

Check standards available for above purpose.

Calibrated volume standards are available such that not more than 15 deliveries are needed to calibrate a prover if volumetric method is used

Other (describe on Comment Sheet)

Check methods used with written procedures on file.

Gravimetric procedure

Volume transfer procedure

Other (describe on Comment Sheet)

List experience in this competence area.

Staff years (estimated) \_\_\_\_\_

Number of tests performed annually (estimated) \_\_\_\_\_

75. Overall Appraisal. Metal Volume Standards, requirements met.

\_\_\_\_\_

III. Length Measurements

E. Tolerance testing and calibration of metal tapes

Yes      Comments  
Attached

Check equipment used (in good operational condition).

- ( ) Length bench
- ( ) Microscope with graduated reticle to 0.002 inch for length bench
- ( ) Thermometer
- ( ) Other (describe on Comment Sheet)

Check standards available for the above purpose.

- ( ) 25 ft/7m State standard steel tape
- ( ) 100 ft/30m State standard steel tape
- ( ) Length bench is calibrated.
- ( ) Other (describe on Comment Sheet)

Check methods used with written procedures on file.

- ( ) Tape-to-tape calibration procedure is used
- ( ) Other (describe on Comment Sheet)

List experience in this competence area.

Staff years (estimated) \_\_\_\_\_

Number of tests performed annually (estimated) \_\_\_\_\_

76. Overall Appraisal. Requirements, Metal Tapes met.      \_\_\_\_\_

## F. Rigid rule calibration and tolerance testing

Yes      Comments Attached

Check equipment used (in good operational condition).

- ( ) Length bench
- ( ) Microscope with graduated reticle to 0.002 inch
- ( ) Thermometer
- ( ) Other (describe on Comment Sheet)

Standards available for above purpose.

- ( ) 18-inch State standard steel rule
- ( ) Other (describe on Comment Sheet)

Check methods used; written procedure on file

- ( ) Rigid rule calibration procedure
- ( ) Other (describe on Comment Sheet)

List experience in this competence area.

Staff years (estimated) \_\_\_\_\_

Number of tests performed annually (estimated) \_\_\_\_\_

77. Overall appraisal. Rigid Rules, Requirements met. \_\_\_\_\_

### IV. Temperature Measurement

(Thermometer tolerance testing and calibration)

Equipment used (in good operational condition); describe on Comment Sheet.

Standards available for above purpose. (Describe on Comment Sheet; include tolerances).

Methods used with written procedures on file. Describe test procedures on Comment Sheet (should be consistent with NBS Monograph 150, Liquid-in-Glass Thermometry)



List experience in this competence area.

Staff years (estimated) \_\_\_\_\_

Number of tests performed annually (estimated) \_\_\_\_\_

78. Overall appraisal. ~~Temperature Measurements~~  
requirements met.    \_\_\_\_\_

V. Frequency Measurements

(Tuning fork calibration)

Check equipment used (in good operational condition).

( ) Frequency counter

( ) Microphone

( ) Other (describe on Comment Sheet)

Check standards available for above purpose.

( ) Connection to WWV for NBS frequency  
standard

( ) Other (describe on Comment Sheet)

Check methods used with written procedures on file.

( ) Test procedure developed by David  
Allen and Frank Bryzoticky

( ) Other (describe on Comment Sheet)

List experience in this competence area.

Staff years (estimated) \_\_\_\_\_

Number of tests performed annually (estimated) \_\_\_\_\_

79. Overall Appraisal. Frequency Measurements,  
requirements met.    \_\_\_\_\_

## VI. Other Calibration Services

On Comment Sheet,

list other calibration services provided for which certification is desired. List each separately and provide pertinent information as follows:

Equipment used (in good operational condition).

Standards available.

Methods used; written procedures on file

Experience in this competence area

Staff years (estimated) \_\_\_\_\_

Number of tests performed annually (estimated) \_\_\_\_\_

Part 3

GENERAL INFORMATION

Provide the following additional information for use by NBS in updating its State Measurement Laboratories Directory.

(List State standards that have been damaged and have not been replaced by NBS calibrated standards on Comments Sheet.)

	<u>Yes</u>	<u>Comments Attached</u>
80. Services provided to industry.	_____	_____
81. Fees charged for laboratory services to industry.	_____	_____
82. The laboratory accepts measurement results from other certified State laboratories.	_____	_____
83. State requires registration of scale and meter service agencies.	_____	_____

Describe on the Comment Sheet the intervals at which service agency standards must be tested in your laboratory

Form completed by: Name \_\_\_\_\_  
Title \_\_\_\_\_  
Laboratory \_\_\_\_\_  
Date \_\_\_\_\_



## A P P E N D I X D

### QUALITY ASSURANCE PROGRAM FOR STATE WEIGHTS AND MEASURES LABORATORIES (EXAMPLE)

#### 1. Policy

This laboratory shall conduct all measurements under conditions and by using techniques that are conducive to a high degree of reliability. This laboratory shall follow generally recognized good laboratory practices

#### 2. Responsibility

##### 2.1 Management

The management of the laboratory shall implement and enforce the good laboratory practices described herein. It shall provide resources, adjust work loads, and provide training opportunities to facilitate their realization. Management shall specify and/or approve all methodology used.

##### 2.2 Supervisory Staff

Supervisory staff shall implement good laboratory practices by providing instruction and training as needed, developing work plans and procedures, and requiring that these be followed in all day-to-day operations. No personnel will be assigned to conduct any measurement until full competence to do so has been demonstrated and/or verified.

##### 2.3 Supporting Staff

Each staff member shall follow the principles described in this document in all day-to-day operations.

#### 3. Maintenance

##### 3.1 Facilities

Laboratory facilities must be maintained in a first-class condition. Good housekeeping practices are followed. Air conditioning, lighting, heating, and ventilation are maintained so that the laboratory environment does not adversely affect the required precision and accuracy of the measurements. Sufficient space is provided around test equipment to minimize the risk of damage or danger to personnel, and to provide for convenient and accurate operations. Adequate space is provided to store supplies and equipment not in use, and laboratories must be maintained in an uncluttered condition.

## 3.2 Apparatus/Equipment

All laboratory apparatus and equipment are maintained in a reasonable and proper state of repair. This includes protection from dirt, dust, corrosion, and other causes of deterioration. Instruction for proper maintenance procedures must be available and followed. Any item of equipment that has been subject to adverse use (e.g., overloading, mishandling) or that gives suspect results, or has been shown by calibration or otherwise to be defective, must be placed out-of-service until it has been examined and/or repaired and, in the case of measuring equipment, shown by calibration to be satisfactory. No equipment is to be operated until it is ascertained that it is in a safe and reliable condition and then only by personnel who have been thoroughly trained and duly qualified as operators.

## 3.3 Standards

All primary standards must be safely stored, and removed only for use by authorized personnel. Any maintenance operations, such as inspection, adjusting, cleaning, and coating, as needed or as required, must be done in a generally acceptable manner.

All secondary and working standards must be maintained in a manner similar to that for primary standards, consistent with the precision and accuracy requirements of their end-use.

## 4. General Operations

### 4.1 Calibrations

Each item of measuring equipment requiring calibration must be calibrated according to an established program, consistent with appropriate regulations or with generally accepted practices. The program of calibration must be such that all measurements made are traceable to national standards of measurement. Primary reference standards must be used for primary calibrations, and for no other purpose, and these calibrations must be traceable to national measurement standards. Standard operating procedures are available and used for such purposes.

### 4.2 Methodology

Appropriate methodology must be identified, approved, and used for each measurement performed by this laboratory. Only methods that have been fully validated must be candidates for approval. In each case, a standard operating procedure (SOP) must be adopted or developed and used. Any deviations or departures from the SOP's that are necessary or desirable for any reason must first receive the approval of laboratory management. Measurements that may be requested, but for

which approved methodology is not available, may not be undertaken until the methodology proposed has been demonstrated to be valid and its use has been approved.

#### 4.3 Standard Operating Procedures

Standard operating procedures (SOP's) are written giving specific directions for carrying out a measurement sequence or series of sequences based on sound and accepted metrological practices. SOP's must be available or developed and placed in the record before use in the test program of the laboratory. Standard methods are ordinarily the methods of choice since their SOP's have been developed and approved by the consensus of experts in the field. (An example of an SOP is given in Appendix E.)

### 5. Quality Assurance

#### 5.1 General Policy

A recognized quality assurance program must be followed to provide a basis for evaluating the quality of work, to estimate limits of uncertainty in all measurements, and, at the same time, to minimize the amount of effort required to provide quality data and tests. This consists of a quality control and a quality assessment program.

#### 5.2 Quality Control Program

The basic elements of the quality control program are as follows:

- (a) Use of qualified personnel/operators
- (b) Use of approved methodology
- (c) Use of SOP's
- (d) Strict adherence to the good laboratory practices described in this document.
- (e) Use of appropriate calibrations and standards
- (f) Close supervision of all operations by management/senior personnel.

#### 5.3 Quality Assessment Program

Because the identification of bias must necessarily depend on external evidence, the laboratory engages in as many activities as possible for this purpose, including participation in measurement assurance programs (MAP's and RMMP's) if they exist. The laboratory also engages in an interchange of test specimens with specify laboratory with which it will cooperate.

Any discrepant results are investigated, including the use of a third party to assist in the identification of any problem that may arise.

### Control Charts

The laboratory develops and maintains a control chart for each of the major measurement practices within its purview. These include: (List specific charts to be maintained and date initiated.)

- (a) \_\_\_\_\_
- (b) \_\_\_\_\_
- (c) \_\_\_\_\_
- (d) \_\_\_\_\_
- (e) \_\_\_\_\_
- (f) \_\_\_\_\_
- (g) \_\_\_\_\_
- (h) \_\_\_\_\_
- (i) \_\_\_\_\_
- (j) \_\_\_\_\_
- (k) \_\_\_\_\_
- (l) \_\_\_\_\_
- (m) \_\_\_\_\_
- (n) \_\_\_\_\_

The control charts are used as a basis for judgment that the measurement process is in a state of statistical control. The laboratory shall not release any data or test reports unless the measurement process concerned has been demonstrated to be in a state of statistical control at the time the respective measurements are made.

## 6. Data Handling

### 6.1 Data Review

The laboratory supervisor shall review all laboratory data for adequacy and absence of technical errors. Any inconsistencies in data that may be evident must be investigated and reconciled before a final test report is issued.

### 6.2 Test Reports

Test reports must be reviewed and signed by an accredited metrologist or higher official of the laboratory. Such signing certifies that a careful review has been made and that the signer takes full responsibility for the validity of the results and the content of the report. (See also section 7.2)

## 7. Laboratory Records

### 7.1 General Policy

Records must be maintained for all aspects of laboratory operations. They must be in sufficient detail so that unequivocal



statements can be made at any time about the laboratory's measurements.

## 7.2 Measurement Data

Measurement data must be recorded in permanent form in bound notebooks or equivalent format. Information must include reference to methodology, equipment, calibrations, and the operator's name. Any deviations from SOP's must be approved and recorded. The actual data must be recorded in ink or other permanent marking directly into the notebook or approved data sheets (no transcriptions are allowed) and no erasures are permitted. Any corrections must be documented.

## 7.3 Laboratory Reports

Laboratory reports are considered as a disclosure of data with suitable interpretations. Reports are issued in a standard format and contain sufficient information to inform the recipient of the nature of the test/measurements contained therein. Each report must contain reference to the original laboratory records. Reports are given an appropriate serial number and indexed for future reference. All reports must be approved, signed, and dated by an appropriate official before release. Only written reports are issued; no oral reports are permitted.

## 7.4 Maintenance Records

Records must be kept of the maintenance of all laboratory equipment and apparatus. These must include dates, by whom performed, and what was done. Repairs that affect the operating characteristics must be duly noted and appropriate changes must be made in the instruction manuals. When repairs, adjustments, or other maintenance operations necessitate a recalibration, this must be done and recorded.

## 7.5 Instruction Manuals

Instruction manuals must be secured and filed for each item of equipment (copies may be located adjacent to the actual equipment but a central file of all instruction manuals should be established as well). Any changes in instructions, resulting from repairs, maintenance, etc. must be recorded in the file copies as well as in any copies located elsewhere.

## 7.6 Identification of Test Items

The full identification, status, and condition of every item received for test or calibration must be recorded and maintained in an easily retrievable manner. Each test item should be identified with a test number, which is suitably attached and serves as its identification while in the laboratory and undergoing test.

All test items must be stored in a safe manner to protect them from loss or damage while in the custody of the laboratory. Any chain of custody measures required by the client must be followed. Tests must be scheduled to insure their completion in an expeditious manner. Special consideration is given to tests when delay could endanger the integrity of the test item.

## 8. Training of personnel

Adequately trained personnel are a key factor in good measurement. All personnel must receive training that provides a comprehensive understanding of the measurement principles involved and of the procedures (SOP) to be followed before being assigned to a measurement program. Supervisors have the responsibility to ascertain that the personnel assigned are properly trained and qualified to make the required measurements.

## 9. Safety

Safe working conditions are prerequisite to good laboratory practices. All laboratory personnel are fully instructed in safe working practices and management/supervisors make sure that these are followed. Management provides safe working conditions and complies with all regulations in this respect.

Adopted:

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Title

\_\_\_\_\_  
Date

A P P E N D I X E  
MODEL FORMAT FOR  
STANDARD OPERATING PROCEDURE  
FOR

---

**1. Introduction**

1.1 Purpose of measurement/test

A brief description of why the measurement/test is needed and typical end-use(s) of the results/test report

1.2 Prerequisites

1.2.1 Verification of calibrations

A brief statement of the calibrations of equipment and standards to be made previous to, or at the time of the measurement, and the checks required to verify that they have indeed been made and are valid at the time of use. This could include a checklist on the data sheet.

1.2.2 Verification of equipment

A statement of the checks, including trial measurements that must be made before a measurement sequence, to verify that the equipment is operating properly.

1.2.3 Verification of ability to test

A statement of the qualifying experience required before technical staff is permitted to make definitive measurements, or apply the procedure to a specific test. The supervision that is required should also be specified.

NOTE: The data sheet may include a checklist to indicate that the various verifications have been made.

**2. Methodology**

2.1 Standard Method

Reference to a standard method or to an NBS-recommended method as available. A copy should be appended.

## 2.2 Laboratory Method

When a standard method is not available, the method developed in the laboratory and previously tested for reliability should be included. This should follow the format of a standard method (such as ASTM format, for example). The following layout is considered to be minimal.

**Title**

**Scope, Precision, Accuracy**

**Summary**

**Special Terminology**

**Calibration/Standardization**

**Procedure (with explanatory notes as needed)**

**Calculations (include sample)**

**Report**

**Reference**

## A P P E N D I X F

### SUMMARY OF SERVICES PROVIDED (For inclusion in Directory) Laboratory \_\_\_\_\_

Please insert the appropriate symbol in the boxes as follows:

I Internal, Only      F To Public for Fee      N To Public, No Fee  
X Not Provided

#### I. Mass Measurement

##### A. Tolerance testing to Class F, ASTM Classes 4, 5, or 6.

- A.1. \_\_\_\_\_ Weights less than 1000 lb  
A.2. \_\_\_\_\_ Weights equal to or greater than 1000 lb  
Largest weight tested: \_\_\_\_\_ lb

##### B. Calibration and tolerance testing to ASTM Classes 1, 2, or 3

- B.1. \_\_\_\_\_ Weights less than 3 kg  
B.2. \_\_\_\_\_ Weights equal to or greater than 3 kg  
Largest weight calibrated \_\_\_\_\_ lb

#### II. Volume Measurements

##### C. Tolerance testing to NBS Handbook 105-2 and 105-3

- C.1. \_\_\_\_\_ Glass flasks and small-volume metal standards (25 gal)  
C.2. \_\_\_\_\_ Intermediate-volume provers (25 to 500 gal)  
C.3. \_\_\_\_\_ Large-volume provers (over 500 gal)

##### D. Calibration

- D.1. \_\_\_\_\_ Small Glassware  
D.2. \_\_\_\_\_ Metal Volume Standards

#### III. Length Measurements

- F.1. \_\_\_\_\_ Tolerance testing and calibration of metal tapes  
F.2. \_\_\_\_\_ Tolerance testing and calibration of rigid rules

IV. Temperature Measurements

G. Liquid-in-glass thermometer

G.1. \_\_\_\_\_ Tolerance testing

G.2. \_\_\_\_\_ Calibration

H. \_\_\_\_\_ Other temperature measurement devices (list on Comment Sheet)

V. Tuning-fork Calibration

I. \_\_\_\_\_ Calibration services provided

VI. Other metrology services (not included in above)

J. List on Comment Sheet

APPENDIX G  
NTEP Laboratory Authorization  
Application Form

State \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_

Telephone \_\_\_\_\_

Laboratory Manager \_\_\_\_\_

Date \_\_\_\_\_

A. LABORATORY CERTIFICATION/BASIS FOR AUTHORIZATION

The prerequisite for consideration as an NTEP Laboratory is certification of the State Laboratory under Part I of this Handbook. (See Appendix H, Question A-7)

B. PLANNED STAFF ASSIGNMENTS

Enter the name(s) of the staff members who will evaluate each type of device listed, together with an estimate of the number of evaluations expected to be requested each year.

STAFF ASSIGNMENTS AND EXPECTED WORK LOADS

Device Type	Staff Names	(Devices/year)
<hr/>		
Scales		
Counter (bench)	_____	_____
Floor	_____	_____
Vehicle	_____	_____
Axle-load	_____	_____
Livestock	_____	_____
Automatic bulk-weighing	_____	_____
Belt-conveyor	_____	_____
Indicating/recording elements	_____	_____
Electronic cash registers	_____	_____

**Volumetric**

Retail motor fuel  
dispensers

\_\_\_\_\_

Indicating/computing  
elements

\_\_\_\_\_

Vehicle tank meters

\_\_\_\_\_

Wholesale meters

\_\_\_\_\_

**Linear**

Taximeters

\_\_\_\_\_

Fabric measuring  
devices

\_\_\_\_\_

**C. ADDITIONAL INFORMATION REQUIRED**

1. Attach a list of the companies most likely to use your laboratory if NTEP authorization is granted.

2. Attach a list of any differences that exist in State enforcement or type evaluation criteria from NBS Handbook 44 and NTEP criteria.



APPENDIX H  
NTEP Self-Appraisal Checklist

State \_\_\_\_\_

A. STATE ADMINISTRATIVE ITEMS

	<u>Yes</u>	<u>Comments Attached</u>
1. The State adopted the "Uniform State Regulation for National Type Evaluation".	_____	_____
2. The State accepts the NTEP Certificate of Conformance.	_____	_____
3. The State is capable of conducting all tests associated with the device types for which authorization is requested.	_____	_____
4. The State expects to complete all examinations within reasonable time periods.	_____	_____
5. The State will be able to perform field permanence tests within the specified time periods.	_____	_____
6. All standards to be used in the tests meet NBS specifications.	_____	_____
7. The metrology laboratory is certified in the appropriate areas to support the NTEP program.	_____	_____
8. The laboratory personnel identified on the "NTEP Laboratory Authorization Form" completed NBS NTEP training.	_____	_____

B. LABORATORY FACILITIES

9. The laboratory has an expected work load sufficient to support a type evaluation program.	_____	_____
10. The laboratory has adequate floor and counter space.	_____	_____

	<u>Yes</u>	<u>Comments Attached</u>
11. The laboratory is free from significant vibrations, air currents, or other disturbing influences that would significantly affect test results.	_____	_____
12. The temperature is controlled within $\pm 3$ °C.	_____	_____

### C. PROGRAM ORGANIZATION

13. The responsibilities of supervisors and staff are clearly defined.	_____	_____
14. The laboratory is organized in an efficient manner.	_____	_____
15. The fee schedule is consistent with NTEP guidelines. (Attach copy to comment sheet.)	_____	_____
16. Copies of the type evaluation checklists and test procedures on file and used for all examinations.	_____	_____
17. The recordkeeping system is adequate.	_____	_____

### D. PROGRAM MANAGER'S QUALIFICATIONS

18. The laboratory manager is familiar with the types of devices for which authorization is requested.	_____	_____
19. The laboratory manager has a comprehensive knowledge of weights and measures laws and regulations and NBS Handbook 44.	_____	_____

E. TECHNICAL STAFF QUALIFICATIONS

Indicate the level of staff familiarity with the following devices/features/capabilities.

Code

- T Thoroughly familiar
- G Generally familiar
- N Not familiar

**WEIGHING DEVICES**

Names of staff who will conduct evaluations:

- 1. \_\_\_\_\_ 2. \_\_\_\_\_
- 3. \_\_\_\_\_

Type of Device

Proficiency of Staff  
Member 1, 2, or 3 (See Code)  
#1 #2 #3

Type of Device	Proficiency of Staff Member 1, 2, or 3 (See Code) #1	#2	#3
Digital computing scales	_____	_____	_____
Automatic zero setting mechanism	_____	_____	_____
Pushbutton tare	_____	_____	_____
Keyboard tare	_____	_____	_____
Preprogrammed tare	_____	_____	_____
PLUs on computing scales	_____	_____	_____
Multiple tare registers	_____	_____	_____
Thumbwheel Tare	_____	_____	_____
Multiple sales accumulation	_____	_____	_____
Multiple weight units on scales	_____	_____	_____
Label printers	_____	_____	_____
Ticket printers	_____	_____	_____
Weigh-in/weigh-out vehicle scales	_____	_____	_____
Load cell vehicle scales	_____	_____	_____
Level system vehicle scales	_____	_____	_____
Automatic bulk weighing systems	_____	_____	_____
Wheel-load weighers	_____	_____	_____
Livestock scales	_____	_____	_____
High resolution jeweler's balances	_____	_____	_____
Grain test scales	_____	_____	_____
Motion detection	_____	_____	_____
Sampling/averaging weight signals	_____	_____	_____
Electronic cash registers	_____	_____	_____
Use of error weights	_____	_____	_____
Belt-conveyor scales	_____	_____	_____
Railroad track scales	_____	_____	_____
Multi-range scales	_____	_____	_____
Liquid crystal displays	_____	_____	_____

### LIQUID MEASURING DEVICES

Names of staff who will conduct evaluations:

1. \_\_\_\_\_ 2. \_\_\_\_\_  
 3. \_\_\_\_\_

Type of Device	Proficiency of Staff Member (See Code)		
Analog mechanical gas pumps	_____	_____	_____
Digital gas pumps	_____	_____	_____
Blend gas pumps	_____	_____	_____
Service station control consoles	_____	_____	_____
ECR/control consoles	_____	_____	_____
Credit card control systems	_____	_____	_____
Selectable unit prices; e.g., cash/credit	_____	_____	_____
Electronic indicating/computing registers	_____	_____	_____
Vehicle tank meters	_____	_____	_____
Wholesale meters	_____	_____	_____
Prepay/postpay systems	_____	_____	_____

### LINEAR MEASURING DEVICES

Names of staff who will conduct evaluations:

1. \_\_\_\_\_ 2. \_\_\_\_\_  
 3. \_\_\_\_\_

Type of Device	Proficiency of Staff Member (See Code)		
Mechanical taximeters	_____	_____	_____
Electronic taximeters	_____	_____	_____
Mechanical fabric measuring devices FMD	_____	_____	_____
Electromechanical FMD	_____	_____	_____

MISCELLANEOUS

Names of staff:

1. \_\_\_\_\_ 2. \_\_\_\_\_  
 3. \_\_\_\_\_

Subject	Proficiency of Staff Member (See Code)		
Computer programming	_____	_____	_____
Statistics	_____	_____	_____
Software switches for options	_____	_____	_____

F. GENERAL INFORMATION

		<u>Yes</u>	<u>Comments Attached</u>
20.	The staff is familiar with the applications of the devices they will examine.	_____	_____
21.	The staff is familiar with the features commonly in use on the devices to be evaluated.	_____	_____
22.	The staff understands the philosophy and rationale behind the NBS Handbook 44 requirements and the type evaluation criteria.	_____	_____
23.	The staff is familiar with the measurement problems that exist in the measurement areas where the device will be used.	_____	_____
24.	The staff has a thorough understanding of the type evaluation criteria.	_____	_____
25.	The staff demonstrates the ability to identify new features, characteristics, or operations that require consultation with NBS.	_____	_____
26.	The staff has the ability to analyze data and take the proper action based upon the analysis.	_____	_____

	<u>Yes</u>	<u>Comments Attached</u>
27. The staff demonstrates proper judgment in analyzing devices and considering impact of decisions on the commercial measurement system.	_____	_____
28. The staff has a demonstrable understanding of device technologies and computer programming.	_____	_____
29. The staff relates to industry representatives in a professional manner and justifies type evaluation decisions in a logical and constructive way.	_____	_____
30. The results of State type evaluations are consistent with the results of OWM evaluations on the same devices.	_____	_____

### G. EQUIPMENT REQUIREMENTS

Does the laboratory have the following equipment for the designated testing?

#### Laboratory Testing of Scales

Equipment	Yes	Comments Attached
31. Weights to test to the scale capacity.	_____	_____
32. Small weights to use as error weights	_____	_____
33. High precision laboratory weights for testing jewelers balances	_____	_____
34. A machine to automatically and repeatedly apply a test load of one-quarter to one-half of scale capacity for the laboratory permanence test. The machine has a counter to record the number of times the weight has been applied to the scale. The capacity of the machine is at least 50 pounds.	_____	_____
35. A means exists for varying and measuring the voltage from 100 V to 130 V for measuring performance of equipment operating on the standard AC power lines.	_____	_____

Equipment	Yes	Comments Attached
36. A variable DC voltage power supply for DC battery operated measuring equipment.	_____	_____
37. A means of placing scales out of level for portable scales that do not have level indicators.	_____	_____

Field and Permanence Testing for Platform Scales

(Except vehicle, railroad, livestock, and digital bench (counter) scales)

38. A minimum of 20,000 pounds of known field test weights.	_____	_____
39. Small weights for use as error weights and sensitivity tests.	_____	_____

Field and Permanence Testing for Vehicle and Axle Load Scales Weighing Elements

40. A minimum of 30,000 pounds (preferably 40,000 pounds) of known field test weights. (State minimum)	_____	_____
41. Small weights for use as error weights and sensitivity tests.	_____	_____

RFI/EMI Testing of Electronic Devices

42. A 27-MHz, 5-watt transceiver.	_____	_____
43. A 460-MHz, 4-watt transceiver.	_____	_____

Electrostatic Discharge Testing of Electronic Devices

(Test equipment and procedures will be specified)

Liquid Metering Devices

(Additional equipment may be specified as type evaluation test procedures are developed)

44. Volume standards	_____	_____
45. Thermometers to measure the temperature of liquids	_____	_____

Analog Mechanical Computing Registers  
for Retail Motor Fuel Dispensers

	<u>Yes</u>	<u>Comments Attached</u>
46. A motor fuel dispenser in which the computer may be installed for test purposes. ( The dispenser may be on a test bench at the manufacturer's facility or at a field site; a trailer-mounted prover is recommended as a receptacle to facilitate efficient testing with various sized test drafts)	_____	_____
47. A means to accurately read the cone gear setting and the displayed analog indication.	_____	_____

Temperature Testing

48. An environmental chamber that can vary the temperature from -10 °C to 40 °C.	_____	_____
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<b>5. AUTHOR(S)</b> H. V. Oppermann and J. K. Taylor			
<b>6. PERFORMING ORGANIZATION</b> <i>(If joint or other than NBS, see instructions)</i> NATIONAL BUREAU OF STANDARDS DEPARTMENT OF COMMERCE GAITHERSBURG, MD 20899		<b>7. Contract/Grant No.</b>	<b>8. Type of Report &amp; Period Covered</b> Final
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<b>10. SUPPLEMENTARY NOTES</b> Library of Congress Catalog Card Number: 85-600502 <input type="checkbox"/> Document describes a computer program; SF-185, FIPS Software Summary, is attached.			
<b>11. ABSTRACT</b> <i>(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)</i> State weights and measures laboratories are custodians of measurement standards at the State level that serve as the basis for assuring equity in the marketplace and as reference standards for calibration services for indigenous industry. As part of its program to encourage a high degree of technical and professional competence in such activities, the National Bureau of Standards (NBS) has developed performance standards and formalized procedures for the following two purposes: <ol style="list-style-type: none"> <li>1. certification of competence for the production of reliable metrological measurements (principally mass, volume, and length), and</li> <li>2. authorization to conduct initial evaluation of weighing and measuring devices/systems before their use in commerce.</li> </ol> <p>Part I of this Handbook describes the procedures followed by NBS in certifying State weights and measures laboratories for competence. A certified laboratory must satisfy general and specific requirements for each competence area in which certification is desired.</p> <p>Part II of this Handbook describes the procedures followed in authorizing certified State weights and measures laboratories to conduct evaluation of weighing and measuring devices and systems under the National Type Evaluation Program (NTEP).</p>			
<b>12. KEY WORDS</b> <i>(Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)</i> authorization; calibration; certification; National Type Evaluation; prototype testing; State laboratories; tolerance testing; weights and measures.			
<b>13. AVAILABILITY</b> <input checked="" type="checkbox"/> Unlimited <input type="checkbox"/> For Official Distribution. Do Not Release to NTIS <input type="checkbox"/> Order From Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. <input checked="" type="checkbox"/> Order From National Technical Information Service (NTIS), Springfield, VA. 22161		<b>14. NO. OF PRINTED PAGES</b> 82 <b>15. Price</b>	

