

NISTIR 7082

**Proficiency Test Policy and Plan
(for State Weights & Measures
Laboratories)**

Jeff C. Gust
Quametec Corporation
(under NIST contract)

Georgia L. Harris
Laboratory Metrology Group
Weights and Measures Division
National Institute of Standards and Technology
Technology Administration
U.S. Department of Commerce

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Donald L. Evans, Secretary
TECHNOLOGY ADMINISTRATION
Phillip J. Bond, Under Secretary of Commerce for Technology
**NATIONAL INSTITUTE OF STANDARDS AND
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Arden L. Bement, Jr., Director

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Preface

This document has been prepared by Jeff C. Gust (Quametec Corp., under contract) in collaboration with NIST Weights and Measures Division staff as a first step in the process of enabling State weights and measures laboratories to comply with criteria for proficiency testing as noted in NIST Handbook 143 and as needed for accreditation programs. This project is intended to align NIST policies to international mutual recognition arrangement requirements, and to ensure that proficiency tests developed within this program meet all international requirements for design, development, execution, analysis and reporting of proficiency tests.

The following individuals participated in the development and/or review of this document:

Jeff C. Gust, Quametec Corp.
 Georgia L. Harris, NIST/WMD
 G. Diane Lee, NIST/WMD
 Val Miller, NIST/WMD
 Doug Faison, NIST/NVLAP
 Ross Andersen, NY
 Richard Cote, NH
 Mike Dynia, CT
 L.F. Eason, NC
 Ken Fraley, OK
 Kelley Larson, AZ
 Steve Sumner, NM

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Introduction

This proficiency testing policy and plan is designed to assist the States and Regional Measurement Assurance Program (RMAP) groups in identifying the minimum level of proficiency testing needed on an ongoing basis to comply with international expectations as described in the PT Requirements section of this document. In realizing compliance to this policy, some of the Proficiency Tests (PTs) and Interlaboratory Comparisons (ILCs) will be conducted through the RMAP groups and some, by necessity, will have to be coordinated on a national basis. This plan addresses these different coordination needs.

While the NIST Weights and Measures Division (WMD) does not operate as a formal Accreditation Body, WMD is responsible for the Measurement Assurance Recognition program. This program is documented in NIST Handbook 143 (2003). WMD issues Certificates of Measurement Traceability to support commerce and measurements made for legal metrology. This policy and plan is consistent with international guidelines set forth by the International Laboratory Accreditation Cooperation (ILAC). It also supplements PT/ILC requirements of the General Technical Requirements for Calibration Labs in NIST Handbook 143, which are based on ISO/IEC 17025, section 5.9.

As part of the State Laboratory Program (SLP) described in NIST Handbook 143, the WMD is responsible for Regional Measurement Assurance Programs (RMAPs) where Metrologists from State legal metrology laboratories in six regions are required to attend annual training and participate in proficiency testing in planned measurement areas for which they will seek WMD recognition. State metrology laboratories may also seek accreditation from recognized accreditation bodies. The results of the proficiency testing from the RMAPs may be used to meet accreditation requirements for proficiency testing in addition to meeting WMD requirements.

The six regions are as follows:

1. Northeastern Measurement Assurance Program (NEMAP)
2. Southeastern Measurement Assurance Program (SEMAP)
3. Southwestern Assurance Program (SWAP)
4. Mid-America Measurement Assurance Program (MidMAP)
5. Western Regional Assurance Program (WRAP)
6. Caribbean Measurement Assurance Program (CaMAP)

Most PTs/ILCs are coordinated through and by members of these regional groups. Some PTs/ILCs are coordinated on a national basis.

Previous WMD activities related to developing PT “plans” have included a draft schedule of proficiency testing in the form of interlaboratory comparisons and round robins. This document is intended to align WMD policies and procedures with the most recent ILAC

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documents and to make planning a more formal part of an ongoing program for PTs/ILCs within the Weights and Measures Division, Laboratory Metrology Group.

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PT Requirements

In order for an accreditation body to sign a Mutual Recognition Arrangement (MRA) with the International Laboratory Accreditation Cooperation (ILAC) or a regional accreditation cooperation such as the Asia Pacific Laboratory Co-operation (APLAC), the accreditation body must develop a quality system that meets the criteria for recognition. ILAC provides the procedure ILAC P1:2003 “ILAC Mutual Recognition Arrangement Requirements for Evaluation of Accreditation Bodies by ILAC Recognized Regional Co-operations” that sets forth the requirements for entry into an the ILAC MRA.

ILAC P1:2003, Section 5, *Criteria for Evaluation*, specifies requirements of proficiency testing activities that the accreditation body must require of laboratories that they accredit. Section 5.3 recommends that at a minimum, laboratories successfully participate in at least one proficiency test prior to gaining accreditation and one proficiency test relating to each “Major Discipline” [metrology area], and “Major sub-area” [branch and/or service], of a laboratory’s scope of accreditation during a four-year period.

Regional organizations such as APLAC have adopted the P1:2003 recommendation in APLAC MR0001 “Procedures for Establishing and Maintaining Mutual Recognition Agreements Between Accreditation Bodies.” Section 3.3 of this document requires accreditation bodies to specify that accredited laboratories participate in a minimum of one proficiency test prior to accreditation and one proficiency test for each “Major Discipline” [metrology area], and “Major sub-area” [branch and/or service], of a laboratory’s scope of accreditation at least every four years.

Some accreditation bodies such as the American Association for Laboratory Accreditation (A2LA) have added to the ILAC recommendation by requiring laboratories to participate in a minimum of two proficiency tests per year and to cover their laboratory technical scope every four years (Document - A2LA Proficiency Testing Requirements).

The NIST WMD is not a formal accreditation body following ISO Guide 58 and does not enter into national or international agreements for acceptance and reciprocity as noted earlier. However, one goal of the NIST WMD is to encourage/ensure the adoption of uniform measurement practices in the State Weights and Measures laboratories that are used internationally in calibration and metrology laboratories. NIST Handbook 143, Program Handbook (2003) contains the requirements for participation in a measurement assurance program that are based on ISO/IEC 17025. The objective of the plan described in this document is to assist State laboratories to comply with ISO/IEC 17025 and the ILAC P1 criteria for demonstrating proficiency.

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Summary of PT Requirements from Accreditation Cooperation's and Accreditation Bodies

Organization	Reference Document	PT Requirement
ILAC	P1:2003, 5.3	Accreditation Body must specify minimum PT requirements Recommendation (not requirement): 1 PT prior to obtaining accreditation 1 PT for each major sub-area during a four year period
APLAC	MR-001, 3.3	1 PT prior to obtaining accreditation 1 PT for each major sub-area during a four year period
NVLAP	Handbook 150 (2001 Edition) 3.3	No documented minimum participation requirements
NVLAP	Handbook 150-2C (technical guide for time and frequency measurements), 1.7.2	1 PT per year per field
NVLAP	Handbook 150-2E (technical guide for optical radiation measurements), 1.7.2	1 PT per year per field
NVLAP	Handbook 150-2 (additional technical guides for measurement parameters are being developed)	1 PT per year per field
A2LA	A2LA Proficiency Testing Requirements (1/2001), III (Calibration)	1 PT before accreditation is granted 2 tests per year, scope of calibration covered in four year period

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1. Policy

1.1 Proficiency Testing (PT) And Interlaboratory Comparisons (ILC)

Proficiency tests (PTs) and interlaboratory comparisons (ILCs) are effective tools for a laboratory to objectively validate their measurement capability. NIST Handbook 143 (2003) recommends the use of proficiency testing and interlaboratory comparisons in Section 5.9 as one of the required methods for assuring the quality of test and calibration results and also in Section 5.4.5.2 as a means of verifying test and calibration methods.

1.2 PT/ILC Requirements For Laboratories Seeking Recognition To NIST Handbook 143 (2003)

Before a laboratory is granted recognition to NIST Handbook 143, the laboratory must participate in at least one PT/ILC that has been coordinated by a RMAP or by NIST WMD, or by a NIST WMD approved PT/ILC provider for each major measurement area for which recognition is sought.

1.3 PT/ILC Requirements For Laboratories To Maintain Recognition To NIST Handbook 143

In order to maintain recognition status to NIST Handbook 143, laboratories must participate in PTs/ILCs coordinated by a RMAP, NIST WMD, or by a NIST WMD approved PT/ILC provider as required by the NIST Handbook 143 (2003), PT/ILC schedule.

Additionally, laboratories must participate in at least one PT/ILC for each service area included in the laboratory's scope of recognition during a four-year period.

Only the metrologist who has performed a particular test has demonstrated proficiency. The laboratory manager shall strive to ensure that all staff authorized to perform a particular type of measurement participates in proficiency tests when offered. In conducting proficiency tests, it is recognized that the participant is evaluated in conjunction with the laboratory facility, equipment, standards, and operations as the metrologist cannot be evaluated independent from the resources used to perform the PT/ILC.

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Major Metrology Areas, Branches and Services

The BIPM Key Comparison Database (KCDB) uses the Metrology Area/Branch/Service taxonomy for delineating measurement areas and types of calibration services. Other taxonomy is in use such as major discipline and major sub-area. The table listed below considers the BIPM nomenclature and the Recognition parameters listed in NIST Handbook 143, 2003.

Proficiency Testing Frequency Requirements

Metrology Area/Branch (Discipline, Parameter)	Service (Major Sub-Area, Scope/Range/Application)
Mass	
	<i>Echelon I</i>
	<i>Echelon II</i>
	<i>Echelon III</i>
Mass, Fluid Flow (Volume)	<i>Echelon I Gravimetric</i>
	Large Volume (provers)
	Small Volume (glassware)
	<i>Echelon II Volumetric</i>
	Large Volume Transfer
	Small Volume Transfer
Length, Dimensional, Linear	
	Length Rulers
	Length Tape (Bench or Tape to Tape)
Temperature	E.g.: Liquid-In-Glass Thermometers, RTD's, SPRT's, Thermistors, Thermocouples
	<i>Echelon I</i>
	<i>Echelon II</i>
	<i>Echelon III</i>
	<i>Echelon IV</i>
	<i>Echelon V</i>
Hydrometers	
Tuning Forks	
Time Interval	Stop Watches, Timing Devices
Hygrometer/Relative Humidity	
Grain Moisture	

NOTE: A successful completion of a PT/ILC in one service area does not imply proficiency in another, even within the same metrology area/branch and/or range.

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2. Proficiency Test (PT)/ Interlaboratory Comparison (ILC) Plan

2.1 PT/ILC Plan

The information presented below provides guidance for planning PT/ILC activities in order to meet the policy requirements of this document. The level of organization and frequency of PTs/ILCs suggested is based on:

- 2.1.1 The number of laboratories with the measurement capabilities for the specific metrology area. (i.e., For common measurements, several RMAPs may have to organize PTs/ILCs in the same metrology area in order to allow all, or have enough, laboratories to participate. For less common measurements, NIST (or individual participants) may need to coordinate a PT/ILC on a national basis in order to have enough participants.
- 2.1.2 The number measurements made within a specific metrology area will be considered. Since nearly 90 % of the State Laboratory Program workload is mass calibration, more PTs/ILCs are required in mass than in a discipline such as length, which accounts for less than 1 % of the laboratory workload. This means that a greater frequency may be required for some parameters than two years.
- 2.1.3 The historic stability of the standards used and tested within a specific metrology area will be considered. Length standards have been shown to be much more stable than mass standards. Therefore, fewer length PTs/ILCs are required for length calibration than for mass calibration in order to provide adequate demonstration of a laboratory's measurement proficiency over time and the full four-year period will be used.
- 2.1.4 The cost and logistics of the PT/ILC will be considered. For example, large volume PTs/ILCs that require the movement of a large trailer mounted prover through regions need to be coordinated by NIST. The frequency of this type of PT/ILC is also limited by cost of the standard (it is impractical to purchase multiple standards) and the time it takes to circulate the standard to all laboratories within each region.
- 2.1.5 While the minimum requirements only dictate that the laboratories participate in one PT/ILC per major sub-area of their scope of recognition every four years, it is desirable to participate in PT/ILC activities for each specific metrology area and test method that the laboratory employs. The long range plan of participant laboratories, RMAPs and WMD should include plans to eventually develop

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PT/ILCs for each specific metrology area and test method as it is economically and logistically feasible.

- 2.1.6 The scopes of recognition (ranges) selected within each metrology area and service needs to be considered and should vary from test to test. For example, the range of 20 kg to 2 kg may be selected one year and the range 1 kg to 1 mg may be selected in another. Single weights and/or sets may be considered.
- 2.1.7 Proficiency test Schedules shall be developed by each RMAP and updated annually for PTs to be organized on a regional level. NIST WMD will participate in planning discussions and will evaluate the plans for compliance to this policy. NIST WMD will develop and update an annual PT plan for programs that require national coordination.
- 2.1.8 The ILC Plans should be annually reviewed by each region to determine if the “frequency” is appropriate. A maximum number of PT/ILCs will be coordinated each year based on a balance between the full parameters/scopes of the laboratories and a reasonable workload due to PTs/ILCs. Coordination among regions is also acceptable to allow a new metrologist to participate in an ILC of another region without having to wait a number of years for the ILC to be conducted in their region.
- 2.1.9 This Plan does not preclude additional PT/ILC activities as desired/needed. Some examples of special activities include: calibration of masses with unique densities or surface finishes, tests of density for mass standards, tests of magnetism of mass standards, tests of environmental equipment used in buoyancy corrections (temperature, pressure, relative humidity), key comparisons, tests for new designs of field standards used in weights and measures, tests for evaluation of environmental effects on calibration values and uncertainties, tests for comparison of procedures, tests for evaluation and verification of measurement traceability.
- 2.1.10 Tools and forms are available as a part of the NIST/WMD quality system for PT/ILC planning and reporting. The tools also include laboratory checklists for analysis, corrective action, and laboratory follow-up which may help the laboratory document successful PT/ILC completion and/or corrective actions where appropriate.

See example schedule for more information.

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Sample Proficiency Test Plan

Metrology Area	Branch/Service	Level of Coordination	Frequency
Mass	At least one "Mass" PT/ILC each year.		
	<i>Echelon I</i>	NIST or RMAP	2 yr
	<i>Echelon II</i>	RMAP	2 yr (Alternated with Echelon I PT)
	<i>Echelon III</i>	RMAP	1 yr: < 10 kg; 2 yr: 10 kg > x < 200 kg; 4 yr: > 200 kg (Avoirdupois equivalents to metric values will be considered based on need and workloads.)
Volume	<i>Echelon I Gravimetric</i>		
	Large Volume (provers, e.g., 5 gal or larger)	NIST	4 yr
	Small Volume (glassware, e.g., < 1 gal)	RMAP	4 yr
	<i>Echelon II Volumetric</i>		
	Large Volume Transfer	NIST or RMAP	2 yr: 5 gal 5 yr: 15 gal, 100 gal
	Small Volume Transfer	RMAP	4 yr
Dimensional			
	Length Rulers	RMAP or NIST	4 yr
	Length Tape (Bench or Tape to Tape)	RMAP or NIST	4 yr
Temperature	E.g.: Liquid-In-Glass Thermometers, RTD's, SPRT's, Thermistors, Thermocouples		
	<i>Echelon I</i>	NIST	4 yr
	<i>Echelon II</i>	NIST	4 yr
	<i>Echelon III</i>	NIST	4 yr
	<i>Echelon IV</i>	NIST	4 yr
	<i>Echelon V</i>	NIST	4 yr
Hydrometers		NIST	4 yr
Tuning Forks		NIST	4 yr
Time Interval	Stop Watches, Timing Devices	NIST	4 yr
Hygrometers		NIST	4 yr
Grain Moisture		NIST or GIPSA	4 yr or more often if required by GIPSA

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Example Schedule for Each RMAP (or National group)

NOTE: Some PTs/ILCs will be conducted nationally by NIST/WMD or individuals within a region.

2004	2005	2006	2007	2008	2009
	Mass, Echelon I		Mass, Echelon I		Mass, Echelon I
Mass, Echelon II		Mass, Echelon II		Mass, Echelon II	
Mass Echelon III	Mass Echelon III	Mass Echelon III	Mass Echelon III	Mass Echelon III	Mass Echelon III
	Volume, Echelon I, Gravimetric				Volume, Echelon I, Gravimetric
Echelon II, Large Volume Transfer (> 5 gal)		Echelon II, Large Volume Transfer (5 gal)	Echelon II, Small Volume Transfer (glassware)	Echelon II, Large Volume Transfer (5 gal)	Echelon II, Large Volume Transfer (> 5 gal)
Temperature (may also be broken down by Echelon)	Dimensional	Time	Tuning Forks		
	Grain Moisture	Hygrometers	Hydrometers		