Proficiency Testing and Interlaboratory Comparisons in Laboratory for Dimensional Measurement

Article · November 2012

CITATIONS
3

READS
17,069

3 authors, including:

Softić Almira
University of Sarajevo
18 PUBLICATIONS **21** CITATIONS
SEE PROFILE

Hazim Bašić
University of Sarajevo
51 PUBLICATIONS **136** CITATIONS
SEE PROFILE

Journal of Trends in the Development of Machinery and Associated Technology
Vol. 16, No. 1, 2012, ISSN 2303-4009 (online), p.p. 115-118

PROFICIENCY TESTING AND INTERLABORATORY COMPARISONS IN LABORATORY FOR DIMENSIONAL MEASUREMENT

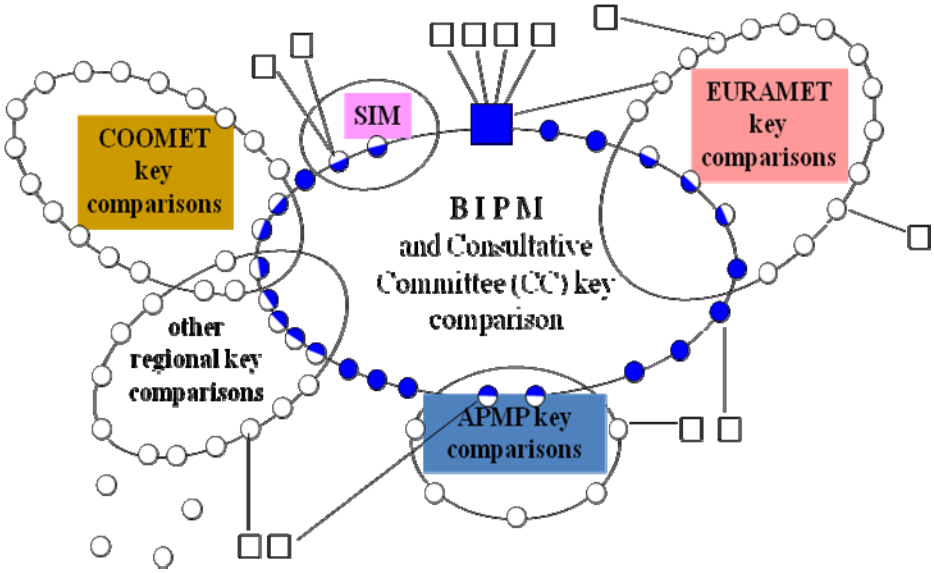
Almira Softić, Nermina Zaimović-Uzunović, Hazim Basić
University of Sarajevo, Mechanical Engineering Faculty Sarajevo
Sarajevo, Bosnia and Herzegovina

ABSTRACT
The testing/calibration laboratories shall demonstrate their performance through their participation in appropriate proficiency testing (PT) schemes by means of interlaboratory comparisons. Proficiency testing is the determination of laboratory testing performance by means of interlaboratory test comparisons. Interlaboratory comparison is the organization, performance and evaluation of tests on the same or similar test items by two or more laboratories in accordance with predetermined conditions. Participation in proficiency testing scheme provides independent verification of laboratory competence. It demonstrate to the publics, customers, accreditation bodies, regulators and management that procedures are under control and gives technical confidence in the service which laboratory provide.
Keywords: proficiency testing, laboratory, interlaboratory comparisons

1. INTRODUCTION
Proficiency testing is a method of checking laboratory testing performance by means of an inter-laboratory test. It is an important way of meeting the requirements of ISO/IEC 17025 in the area of quality assurance of laboratory results. Participation in PT schemes provides laboratories with an objective of assessing and demonstrating the reliability of data they are producing. It is also mandated by accreditation bodies that laboratories participate in proficiency testing programs for all types of measurements undertaken in that laboratory, when suitable programs exist. Proficiency testing involves a group of laboratories performing the same measurements on the same samples and comparing results. The key requirements of such comparisons are that the samples are same or similar, and also that the set of samples measured are appropriate to test and display similarities and differences in results. Interlaboratory comparisons are widely used for a number of purposes and are being increasingly used internationally.

2. WHAT IS PROFICIENCY TESTING?
The typical format of proficiency testing programs issues a set of samples to each participant together with a set of instructions and any necessary background information. The participants then carry out the requested measurements in their normal manner and submit their results. The results are then statistically handled to generate a report. Each participant is confidentially provided with a report to allow them to compare their performance with the other participants. The performance of individual laboratories will only be known by that particular laboratory and a limited number of management personnel. The handling of results is generally performed in a manner that compares each individual result with the consensus of the entire group, [1]. Regular participation in a proficiency testing scheme

provides independent verification of measurement capability of a laboratory and shows a commitment to a maintenance and improvement of performance. It demonstrates to the public, customers, accreditation bodies, regulators, and management that procedures are under control and gives laboratory's staff confidence that the service which they provide will withstand scrutiny.



BIPM - Bureau International des Poides et Measures
COOMET-Euro-Asian Cooperation of National Metrological Institutions
EURAMET- European Association of National Metrology Institutes
SIM - Inter-American Metrology System
APMP -Asia Pacific Metrology Programme
CC - Consultative Committe

■ BIPM
● NMI participating in BIPM/CC key comparisons
○ NMI participating in BIPM/CC key comparisons and in regional key comparisons
○ NMI participating in regional key comparisons
NMI participating in neither BIPM/CC nor key comparisons and in regional key comparisons but making bilateral comparisons

Figure 1. Scheme of equivalence of national measurement standards through key comparisons

3. TYPES OF PT SCHEMES

Proficiency testing schemes vary according to the needs of the sector in which they are used, the nature of the proficiency test items, the methods in use and the number of participants,[2].Various types of PT schemes are available, each based on at least one element of each of the following four categories, [4]:

1. a) qualitative: the results of qualitative tests are descriptive and reported on a nominal or ordinal scale;
   b) quantitative: the results of quantitative measurements are numeric and are reported on an interval or a ratio scale;
   c) interpretive: no measurement is involved. The PT item is a measurement result, a set of data or other set of information concerning an interpretative feature of the participant's competence;
2. a) single: PT items are provided on a single occasion;
   b) continuous: PT items are provided on a regular basis.
3. a) sequential: PT item to be measured is circulated successively from one participant to the next. In this case the PT item may be returned to the PT provider before being passed on to the next participant in order to determine whether any changes have taken place to the PT item. It is also possible for the participants to converge in a common location to measure the same PT item;

b) simultaneous: in the most common PTs, randomly selected sub-samples from a homogeneous bulk material is distributed simultaneously to participants for concurrent measurement after reception

of the results the PT provider will evaluate, on the basis of statistical techniques, the performance of each individual participant and of the group as a whole.

4. a) pre-measurement: in this type of PT scheme, the "PT item" can be an item (e.g. a toy), on which the participant has to decide which measurements should be conducted or a set of data or other information (e.g. a case study);
   b) measurement: the focus is specifically on the measurement process;
   c) post-measurement: in this type of PT scheme, the "PT item" can be a set of data on which the participant is requested to give an opinion or interpretation.

One special application of PT, often called "blind" PT, is where the PT item is indistinguishable from normal customer items or samples received by the participant. All of the types of PT schemes mentioned above could be organized as a blind PT, [2].

4. RECOMMENDATIONS FOR LABORATORIES

According to ISO/IEC 17025:2005 a laboratory shall have quality control procedures for monitoring the validity of test and calibration undertaken. This monitoring may include the participation in interlaboratory comparisons or proficiency testing programmes but also other means e.g. calibrations using the same or different methods. By this means a laboratory can provide evidence of its competence to its clients and the accreditation body. The very important fact which shall have to be recognized is that such activities have economic impact on laboratories. The recommended minimum amount of appropriate proficiency testing activities per laboratory is:

- one activity prior to gaining accreditation,
- one activity relating to each major sub discipline of a laboratory scope of accreditation within the period between two subsequent assessments (e.g. four years).

For calibrations, if the laboratory, based on the measurement capabilities of its scope, must participate in an interlaboratory comparison of a calibration "type" which covers a large range of instruments/ quantities, then it should plan its participations, so that every four years it participates in a scheme with a different calibration object, i.e. a dimensional measurements laboratory is accredited for calibrating vernier calipers, micrometers and measuring tapes. According to the classification provided with the "types" of calibrations, in conjunction with the information with the classifications of dimensional measurements, the particular instruments fall into the category "linear dimensions and hand instruments". The laboratory fulfills its obligation for participating in an interlaboratory scheme for the corresponding measuring capability, by selecting a scheme for calibrating vernier calipers in the 1st fourth-year period, micrometres in the 2nd and measuring tapes in the 3rd (order arbitrary). Therefore, participating every four years in schemes with exclusively the same calibration object, e.g. vernier caliper, is unacceptable, [6].

In order to determine whether or not a participating laboratory is proficient for a particular measurement discipline, an evaluation of the laboratory's performance must be conducted. While many methods of evaluation exist, the most commonly used method for determining the performance of an individual calibration laboratory is the normalized error (En) formula. Commonly used statistics for quantitative results are listed below, in order of increasing degree of participants' results is found in ISO/IEC 17043:2010, [3.4].

The difference, D, is calculated using equation (1):

$$D = (x - X) \quad \text{....(1)}$$

The z scores are calculated using equation (2):

$$z = \frac{x - X}{\sigma} \quad \text{....(2)}$$

$$En = \frac{x - X}{\sqrt{U_{lab}^2 + U_{ref}^2}} \quad \text{.....(3)}$$

where:
x - participant's measurement result
X - assigned value of the artifact
σ - standard deviation for proficiency testing
En - normalized error
U_{lab} - uncertainty of the participant's measurement results
U_{ref} - uncertainty of the reference laboratory's assigned value.
When $|E_n| \leq 1$ the result is "satisfactory".
When $|E_n| > 1$ the result receives an action signal, or "unsatisfactory" performance [3], [4].

A Proficiency Testing (PT) scheme is a system for objectively evaluating laboratory results by external means, and includes regular comparison of a laboratory's results at intervals with those of other laboratories [5,7, 8].The main objective of a PT scheme is to help the participating laboratory to assess the accuracy of its test results.

5. CONCLUSION

Proficiency testing is gaining increasing importance as a quality assurance tool for laboratories. It is important for laboratories to have comprehensive information on the scope and availability of proficiency testing schemes in the areas in which they work. This will enable them to make appropriate decisions about in which scheme they should participate. All above mentioned show how valuable information can be obtained by interlaboratory comparisons. It is important that laboratories give to its customers the right information regarding the accuracy of the results of their calibration standards and instruments. Intercomparison of measurements results are one of the main ways of proving realistic estimates of measurement uncertainty. The basic principle of the laboratory work must be – Compare our measuring results and find out where we are in the world of metrology. The experience of each laboratory, which confers intercomparisons, it can not replace modern equipment and other assumptions. Therefore, collaboration between the laboratories is necessary for solving common issues and dilemmas that challenge the results of intercomparison.

6. REFERENCES

[1] EA-2/10 EA Policy for Participation in National and International Proficiency Testing Activities, European Co-operation for Accreditation, 2001.
[2] ILAC-G22 ILAC Use of Proficiency Testing as a tool for Accreditation in Testing, ILAC, 2004.
[3] Statistical methods for use in proficiency testing by interlaboratory comparisons (ISO 13528), International Organization for Standardization (ISO), Geneva, 2005.
[4] Standard BAS ISO/IEC 17043:2010 Conformity assessment-General requirements for proficiency testing First edition, 2010.
[5] Basic H., Softic A.,: The importance of interlaboratory comparison in length measurement as a pre-requisite for raising the accuracy of measurement and development of measurement traceability, 14th International Research/Expert Conference 'Trends in the Development of Machinery and Associated Technology', TMT 2010, Mediterranean Cruise, 11-18 September, 2010.
[6] Gust Jeff C.,: A discussion on issues of stability and homogeneity in proficiency testing for calibration laboratories, Simposio de Metrologia, 25-27, October, 2006.
[7] Hellenic Accreditation System S.A. PT policy: ESYD Policy relevant to proficiency testing schemes and interlaboratory comparisons, ESYD PDI/02/01/02-09-2011.
[8] Pajkic B.,: Medulaboratorijska saradnja-Primjeri interkomparacije rezultata mjerenja etalona duzine, Kongres metrologa 2011, Kladovo, Oktobar, 2011.