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APPROPRIATE CALIBRATION INTERVALS OF LABORATORY TEST EQUIPMENT IN ACCORDANCE WITH THE INTERNATIONAL IECEE REGULATIONS AND ITE PREDOM DIVISION ACTIVITY

Joanna Walczak-Złotkowska, Marek Starczewski, Jan M. Łysko

Institute of Electron Technology, PREDOM Division, 53, Krakowiaków Str., 02-255 Warsaw, Poland, jmlysko@ite.waw.pl

Abstract. Requirements for traceability of calibrations and calibration intervals contained in the document IECEE OD-5011 for the testing laboratories IECEE members are presented. Among the others, the issues related to selection of a calibration laboratory, calibration intervals for particular group of test equipment, requirements for traceability of calibrations as well as the matters of test equipment on the status of "Initial Calibration Only" were overviewed. Information about the IECEE OD-5011 application in the laboratory practice of ITE PREDOM Division is presented as well.

Keywords: metrology, calibration, accredited laboratory

PROBLEM WŁAŚCIWYCH PRZEDZIAŁÓW CZASOWYCH DLA WZORCOWANIA PRZYRZĄDÓW LABORATORYJNYCH W AKTUALNYCH UREGULOWANIACH MIĘDZYNARODOWYCH IECEE I PRAKTYCE ITE ODDZIAŁ PREDOM

Streszczenie. W artykule przedstawiono wymagania zawarte w dokumencie IECEE OD-5011 dotyczące spójności pomiarowej i wzorcowania wyposażenia badawczego w laboratoriach zrzeszonych w IECEE. Omówiono m.in. sprawy wyboru laboratorium wzorcującego, okresów między kolejnymi wzorcowaniami dla poszczególnych grup sprzętu pomiarowego, wymagań dotyczących spójności pomiarowej. Omówiono zagadnienia wyposażenia badawczego podlegającego jedynie wzorcowaniu wstępnemu. Przedstawiono również informację o stosowaniu IECEE OD-5011 w bieżącej praktyce laboratoryjnej ITE Oddział PREDOM.

Słowa kluczowe: metrologia, wzorcowanie, laboratorium akredytowane

Introduction

Appropriate calibrations of the test equipment is particularly essential for the cases when on the basis of the laboratory test results the consistent decisions are taken, for example the decisions on compliance by the tested product with detailed certification or conformity assessment requirements. For that reason the international organization IECEE (*ang. IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components*) attaches great importance to ensure that the testing laboratories - IECEE members (336 Testing Laboratories CBTL (*ang. CB Testing Laboratory*) from 52 countries) use the uniform rules related to the test equipment and uniform requirements for traceability of calibrations and calibration intervals to ensure consistent and repeatable test results.

1. Document IECEE CD 5011 – general information

In 2014 CTL (*ang. Committee of Testing Laboratories*) decided to convert the CTL Operational Procedure (OP) into the IECEE Operational Document (OD) structure, [1].

The content of the former procedure has not been essentially changed; only some editorial adjustments have been made in some clauses. The scope of the document applies to testing laboratory equipment (excluding chemical testing) required to be calibrated under the requirements of the standard ISO/IEC 17025 "General requirements for the competence of testing and calibration laboratories".

Amended document IECEE OD-5011 Edition 1.0 2015-06-03 „Requirements for Traceability of Calibrations and Calibration Intervals”, Fig. 1, covers as follow:

- Purpose,
- Scope,
- Normative References,
- Definitions,
- Responsibility of the laboratory,
- General,
- Requirements.

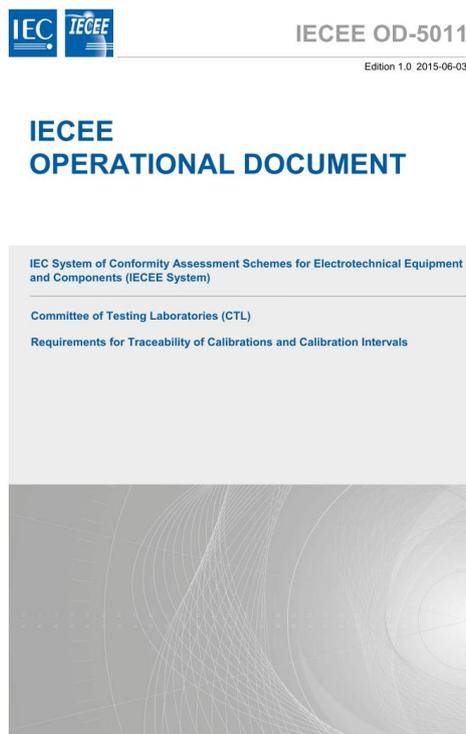


Fig. 1. Cover page of the document: IECEE OD-5011 Edition 1.0 2015-06-03 – source: www.iecee.org [1]

2. Essential requirements for calibration according to IECEE OD-5011

2.1. Traceability of calibrations

Calibrations shall be provided by an unbroken chain of comparisons to:

- a) Units of measure of The International System of Units (SI),
- b) Fundamental physical constants,
- c) Certified Reference Materials, in the case where (a) and (b) do not exist for the measurement property.

Calibrations shall be recognized as traceable if the calibrations are performed according to the requirements of ISO/IEC 17025 standard and carried out by:

- a) National Metrology Institute,
- b) calibration laboratory with ISO/IEC 17025 standard accreditation,
- c) calibration laboratory (internal or external) annually assessed by the CBTL, NCB (National Certification Body) or authorized department within the CBTL or NCB, and found to comply with the requirements of the ISO/IEC 17025 standard. The assessments shall be conducted by a qualified ISO/IEC 17025 assessor or metrologist.

Services delivered by an external calibration laboratory without accreditation is allowed only in the case when a calibration services from accredited laboratory are not available. For highly specialized test equipment case, when no accredited calibration laboratory services are available, the equipment may be calibrated by the equipment manufacturer provided that:

- the applied calibration standards are traceable to national or international units of measurement,
- the traceability chain is identified and estimation of uncertainty of measurement is included on the calibration certificate.

2.2. Calibration intervals

Every test equipment should be calibrated before its first use. Next calibration periods shall be no longer than:

- a) one year for every electrical, electronic and mechanical test equipment,
- b) three years for every mechanical test equipment made of solid materials, which not subject to any kind of deterioration,
- c) appropriate recommendations according to the manufacturer instructions.

Maximum interval time between consecutive calibrations shall be appropriate to assure, that accuracy of the equipment remains within the specifications stated by the laboratory.

These calibration intervals may be changed only after detailed analyses by the testing laboratory. In such analysis one should consider, as a minimum, results obtained during previous calibrations, possible environmental and handling impacts to which tested equipment was exposed. Certified laboratory should establish procedures regarding adjustment of calibration intervals for each device in use. Reduction of calibration intervals shall be made, if necessary (for example the test equipment is very often used) to keep equipment within the accuracy ranges indicated by the laboratory. Also if the testing laboratory has well established and documented procedures for the adjustment of calibration intervals for test devices it may establish other limits within the maximum equipment tolerance to determine whether to extend the calibration interval on prior calibration results.

According to the IEC 60730-1 clause 8.3 the calibration intervals may be extended when there are sufficient data from the previously done calibrations that assure that the instrument will maintain stated accuracies over the extended calibration interval. Time extension of the calibration intervals shouldn't exceed 50% of the primary calibration interval. Calibration data base may be used to legitimate longer calibration intervals if stability of the instrument can be demonstrated. Historical calibration data may be used to support longer calibration intervals where stability of the instrument is demonstrated.

Risks associated with the extension of calibration intervals shall be considered with regard to test results and the ability to review all work affected by nonconforming equipment. Such a factors like use duration and frequency, influence of environment and transport conditions shall be considered too.

According to the Annex A, IEC 60730-1 document, proper flow chart of the calibration intervals adjustment should be consistent with the diagram on Fig. 2.

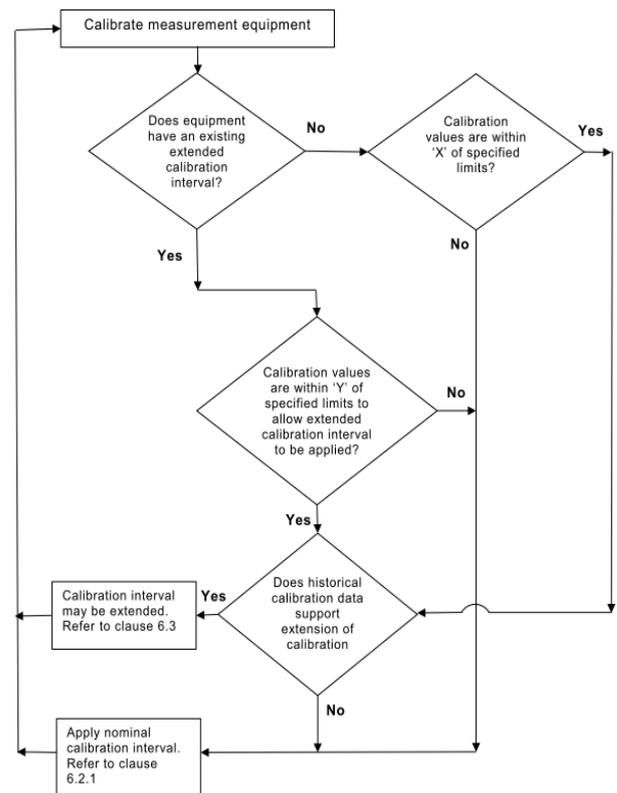


Fig. 2. Diagram of the calibration interval extension (example), [1]

Calibration data obtained from the nominal calibration intervals of equipment, that was applied by the testing laboratory, provides an indication that all calibrated parameters remain within 'X' tolerance limits. The laboratory is allowed to extend calibration intervals when calibrations carried out at the end of the extended calibration interval continue to be within 'Y' tolerance limits, Fig. 3.

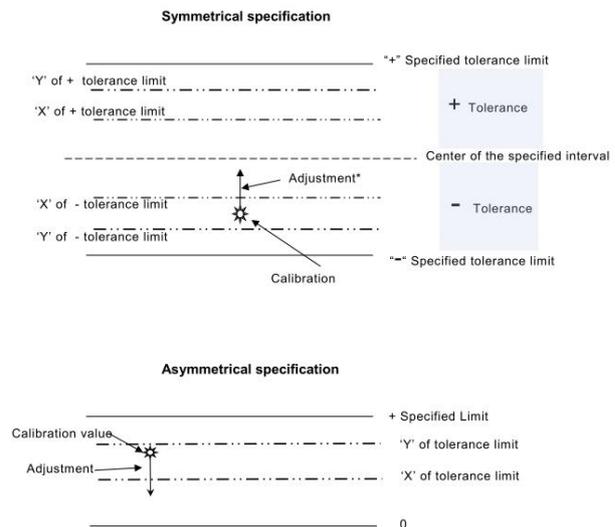


Fig. 3. Illustration of the 'X' and 'Y' tolerance limits in two possible cases: symmetrical and asymmetrical specifications, [1]

2.3. Initial Calibration Only (ICO)

Test equipment in that failure is evident to a user (with laboratory procedures requiring the user to check the equipment before use) may be put on the status of "Initial Calibration Only" (ICO). The laboratory shall carry out periodic inspections of the test equipment to determine that it is still in sufficiently condition. Examples of the ICO equipment are steel rules, tape measures, weights 4,5 kg or more, calibrated to +/-1% tolerance, single piece steel probes, greater than or equal to 3 mm

in diameter with blunt ends, graduate cylinder, thermometers, steel impact balls, steel or plastic probes with no moving parts and sufficient structural integrity so as to not deform.

Weights do not need to be calibrated if are verified by the laboratory with a calibrated scale before each use. The verification must be documented.

In the case of infrequently used test equipment – it can be assigned the status of "calibrate before use". For such equipment the periodic calibration is not necessary.

3. Accuracy and tolerances of measurement instruments

The matters related to accuracy and tolerances of measurement instruments are very important for testing quality.

Up to now the matters are included in the CTL DSH 251 E decision as a guidance document only.

During the last 53rd CTL meeting (March 2016, Prague, Czech Republic, the members propose to extended document IEC EE OD-5011 to the matters concerned accuracy and tolerances of measurement instruments.

Because the accuracy and tolerances of measurement instruments matters have directly affect the quality of test results CTL proposed to give them greater importance and to merge into the IEC EE OD-5011 as an Annex B.

The Annex B defines the instrument accuracy limits for measurement parameters and measuring ranges. Among the other the Annex covered such parameters as voltage, current, leakage (touch) current, power, frequency, resistance, temperature, linear dimensions, mass, force, mechanical energy, torque, angles, relative humidity, barometric air pressure, gas & fluid pressure. Excerpt of the proposal is shown on Fig.4.

Instrument Accuracy Limits

Measurement values stated in a CB Test Report shall be made with instruments with accuracies within the limits stated below. These values apply unless more stringent requirements are given in the reference standard.

Parameter	Range	Instrument accuracy of Measuring Range
Voltage		
- Up to 1000 V	up to 1 kHz	± 1,5%
	1kHz up to 5 kHz	± 2%
	5 kHz up to 20 kHz	± 3%
	20 kHz and above	± 5%
- 1000 V and above	dc up to 20 kHz	± 3%
	20 kHz and above	± 5%
Current		
- Up to 5 A	dc up to 60 Hz	± 1,5%
	above 60 Hz up to 5 kHz	± 2,5%
	5 kHz up to 20 kHz	± 3,5%
	20 kHz and above	± 5%
- Above 5 A	dc up to 5 kHz	± 2,5%
	5 kHz up to 20 kHz	± 3,5%
	20 kHz and above	± 5%
Leakage (Touch) current¹		
	50 Hz up to 60 Hz	± 3,5%
	greater 60 Hz up to 5 kHz	± 5%
	greater 5 kHz up to 100 kHz	± 10%
	greater 100 kHz up to 1 MHz	under consideration
Power (50/60 Hz)		
	up to 3 kW	± 3%
	above 3 kW	± 5%
Power Factor (50/60 Hz)		
		± 0,05

Fig. 4 Excerpt of the CTL proposal related to accuracy and tolerances of measurement instruments in the Annex B of IEC EE OD-5011

The CTL proposal has been sent to the IEC EE working group for discussion and approval.

4. IEC EE OD-5011 in laboratory practice of ITE PREDOM Division

ITE PREDOM Division is accredited by Polish Centre of Accreditation for:

- testing laboratory (certificate AB 003)
- calibration laboratory (certificate AP 153)
- body for product certification (certificate AC 044)
- body for quality system certification (certificate AC 134)

ITE PREDOM Division is a member of IEC EE CB Scheme as the testing laboratory CBTL and the National Certification Body. Also it is a member of European organization ETICS (*ang. European Testing, Inspection and Certification System*)

ITE PREDOM Division has several laboratories with appropriate equipment and experienced staff dealing with calibration and testing of electrical, electronic devices as well as household gas equipment.

Selected testing items are shown on Fig. 5(a-d).

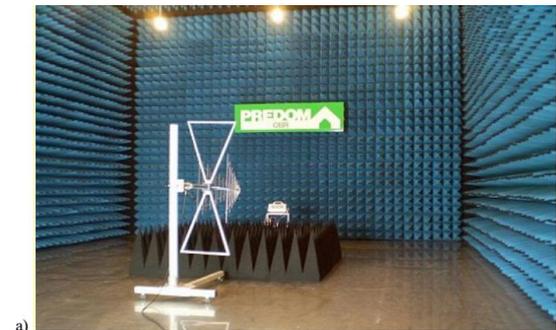


Fig. 5 Selected items in the ITE PREDOM Div. accredited laboratories: a) anechoic chamber with set of antennas applied in EMC tests, b) goniometer for light distribution testing c) spectroradiometer system for tests of photobiological safety of lamps and lamp systems (measuring range 900 – 2200 nm) d) reference multimeter for calibration of electrical test equipment

System described in the document IECEE OD-5011 is applied in the testing laboratory practice.

The requirements of the CTL DSH 251 E decision related to accuracy and tolerances of measurement instruments are fully executed too.

There are well established and documented procedures for monitoring the testing equipment. ITE PREDOM Division observes the calibration periods without extensions.

All testing equipment is regularly calibrated by the accredited laboratories among the others by the accredited Calibration Laboratory ITE PREDOM Division.

Also the ITE PREDOM Division participates in Proficiency Testing Programs. It gives possibility to ensure the used testing procedures, including procedures of uncertainty of measurement as well as testing equipment and testing personnel are in the high level. The high level is confirmed by the results of assessments carried out by IECEE and ETICS assessors.

Testing carried out by ITE PREDOM Division is used, among the other, for certification according to the following international and national schemes:



as well as for the conformity assessment, according to the following directives:

- 2014/30/EU (EMC electromagnetic compatibility, former the directive 2004/108/EC),
- 2014/53/EU (RED - radio equipment),
- 1999/5/EC (radio and telecommunication devices),
- 2009/142/EC (gas ovens and cookers),
- 92/42/EEC (boiler efficiency),
- 2006/42/EC (machinery),
- 2000/14/EC (noise emissions),
- 2014/35/EU (LVD - electrical devices, former the directive 2006/95/EC).

Bibliography

- [1] IECEE OD-5011 Edition 1.0 2015-06-03 IECEE OPERATIONAL DOCUMENT IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components (IECEE System). Committee of Testing Laboratories (CTL). Requirements for Traceability of Calibrations and Calibration Intervals International Electrotechnical Commission, www.iecee.org
- [2] IECEE-CTL/529/INF IECEE-CTL/529/INF-Info, 2016-03-09/10, documents 53rd Meeting of the IECEE Committee of Testing Laboratories, www.iecee.org

Jan M. Łysko

e-mail: jmlysko@ite.waw.pl

Since 1979 with the Institute of Electron Technology (ITE) in Warsaw, at present holding position of associate professor, head of the ITE Department of Devices, Components and Systems Research. M.Sc. in 1979 from the Warsaw University of Technology, spec. materials science, PhD. in 1990 and D.Sc. in 2006 from the ITE in electronics, B.Sc. in 1983 from the Warsaw School of Economics, spec. international trade. More than 150 publications and 15 patents. Expert EU, Polish National Centre for Research and Development (NCBR), National Science Centre (NCN) and other national agencies. Membership: SM IEEE ED Soc. (1986-2006), Polish Society for Sensor Technology (PTTS), World Federation of Scientists.



Marek Starczewski

e-mail: metrologia@predom.com.pl

Since 1984 with the ITE PREDOM in Warsaw, at present holding position of head of metrology laboratory, graduated in 1982 (Warsaw University of Technology, spec. electronics).



Joanna Walczak-Zlotkowska

e-mail: obr@predom.com.pl

Since 1973 with the ITE PREDOM in Warsaw, at present holding position of head of certification office, graduated in 1973 (Warsaw University of Technology, spec. metrology). Since 2003 IECEE Registered Assessor. Since 2003 European Electrical Products Certification Association (EPECA) Registered Assessor. Since 2015 – Member of the Board of Directors of ETICS – European Testing, Inspection and Certification System.



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