MARK INTEGRITY PROGRAM

UL Calibration Requirements: Equipment Used for UL/C-UL/ULC Mark Follow-Up Services

UL defines minimum requirements for calibration of inspection, measuring and test equipment (IMTE) required as part of its Follow-Up Services Procedures. These requirements also include IMTE supplied by customers and used by UL field representatives during inspection activities at the inspection location. Standards used to calibrate such inspection, measuring and testing equipment are also covered by these requirements.

This document applies to all customers of UL's product certification services for the U.S. and Canadian markets, i.e., UL/C-UL/ULC Mark certifications. Calibration is a requirement of UL certification as noted in the United States and Canadian testing and certification service terms and conditions located at www.ul.com/contracts.

Why this requirement is important

A key element in determining compliance with UL requirements is the validity and accuracy of inspection, measurement and test results. Equipment used to perform these activities must be calibrated to provide the necessary level of confidence in the results of the inspections, measurements and tests being conducted. Calibration of IMTE – as well as the standards for calibration – must be traceable to national standards and SI units of measure, whenever possible, e.g., the National Institute of Standards and Technology in the United States. It is recommended that providers of calibration services be accredited under ISO/IEC 17025. See page 3 of this document for calibration certificate requirements for calibrations performed by a non-accredited laboratory or performed in-house by the manufacturer.

REQUIREMENTS

Equipment requiring calibration

All IMTE required as part of a UL Follow-Up Services Procedure including any Appendices, Follow-Up Inspection Instructions or Standard Appendix Pages or equipment that is used by UL field representatives while conducting inspection activities at the factory or used by the manufacturer to verify compliance with UL requirements must be calibrated and traceable to SI units.

Customers are responsible for selecting inspection, measuring, and test equipment that is suitable for the measurements to be taken. Customers must ensure that the IMTE selected for each measurement meets measurement tolerances specified in UL Follow-Up Services Procedures or related documentation, i.e., customers must select and use the right tool for the job.

When inspection, measuring and test equipment with low precision capability, such as tape measures, steel rules, protractors, radius gauges, etc., are used as the final means of verifying compliance with UL requirements, customers have the following options:

Option 1

At a minimum, customers will have an appropriate accuracy statement from the manufacturer of a measuring device to certify or attest to a device's stated precision and accuracy capabilities. This information is important in demonstrating that equipment accuracy is capable of meeting required measurement tolerances. In addition, tape measures and similar low-precision inspection, measuring and test equipment shall undergo in-service checks as described in the "In-Service Checks" section of this document.

Option 2

Customers may choose to include tape measures and similar low-precision IMTE in their calibration system. This equipment will be calibrated or validated at regularly defined intervals, according to requirements defined in this document.

Equipment not requiring calibration:

Manufacturing equipment instrumentation and gauges that are an integral part of equipment used in manufacturing products are not generally subject to calibration requirements, unless specifically identified in the Follow-Up Services Procedure. Typically, these are gauges and instruments used to monitor process characteristics, e.g., speed, pressure, etc., and are not used to evaluate final product characteristics.

Weights do not need to be calibrated if verified with a calibrated scale. Unless specified in UL Follow-Up Service Procedures or related documents, timing devices such as timers, stop watches, and clocks do not require calibration.

In-Service Checks of inspection, measuring, and test equipment

During an in-service check, IMTE is validated prior to use to ensure it is capable of achieving the required measurement accuracy. Customers must specify the criteria and methods used to conduct these in-service checks, as well as the process for handling nonconformances. IMTE used to verify compliance with UL requirements shall be checked daily by the customer to ensure it is functioning properly. If this equipment is not used daily, then this functional verification should be performed prior to use.

Frequency of calibration

All IMTE described in a UL Follow-Up Services Procedure as well as Appendices, Follow-Up Inspection Instructions or Standard Appendix Pages or used by UL field representatives in activities at a manufacturing location must be calibrated at least annually for their intended function and use. If a UL Follow-Up Services Procedure specifies more frequent calibration frequency, then that frequency is to be followed.

Measurement standards

Measurement standards used in the calibration of IMTE must be calibrated and traceable to national standards and SI units whenever possible and are to be used for calibration purposes only.

Weights and dimensional gauge block standards must be calibrated by a competent body – preferably by an ISO/IEC 17025 accredited calibration service provider – every **three years** or whenever the measurement standard has been subject to some form of abuse that may affect the measurement standard's fitness for use. Other measurement standards, e.g., voltmeters, master gauges used to calibrate other gauges, etc., shall be calibrated by a competent body – preferably by an ISO/IEC 17025 accredited calibration service provider – either **annually** or in accordance with the equipment manufacturer's specifications, or whenever the standard has been subject to some form of abuse that may affect the fitness of a standard.

Standards, including any related software, shall be protected from damage or deterioration and must be maintained according to the original equipment manufacturer's recommendations.

Calibration identification and status

All IMTE being calibrated – as well as measurement standards used for calibrations – shall include evidence of calibration status, e.g., a label or other marking indicating the next calibration due date. If size limitations or usage environment prevents the use of a calibration label, alternate identification methods are acceptable, providing that the identification and calibration status can be readily determined. Each piece of calibrated IMTE must have a unique, unambiguous identifier such as manufacturer name and model number, serial number, identification number, asset number, etc.

Calibration Acceptance Criteria

Customers are responsible for determining the tolerances, i.e., the calibration acceptance criteria, required for IMTE. Customers should consider the tolerances required for the measurement when selecting IMTE for measurements. Customers may accept the precision and accuracy tolerances provided by the IMTE manufacturer for use in calibration, provided the UL measurement accuracy requirements are still satisfied.

Calibration certificates: ISO/IEC 17025 accredited calibration service providers

UL recommends using calibration service providers that are accredited to ISO/IEC 17025 through authorized signatories of an international accreditation body. See page 5 for more information on accreditation endorsements. Using an accredited calibration service provider expedites review of calibration records during a UL inspection visit: the calibration information that UL field representatives are required to verify is limited due to calibrations being performed in accordance with a calibration service provider's accreditation requirements.

During UL inspection visits, UL field representatives will evaluate calibration records. Each calibration certificate from an accredited calibration service provider shall include at least the following information:

- Unambiguous identification of the calibrated item. Some examples are manufacturer name and model number, serial number, identification number, etc.
- Date(s) calibration was performed to determine that the IMTE has been calibrated within required frequency
- A valid accreditation body endorsement for the calibration performed. Please refer to page 5 for a sample list of accreditation endorsements

During UL inspection visits, UL field representatives will confirm that the inspection, measuring and testing equipment is within the defined calibration period. Additionally, UL field representatives will review calibration certificates and data to verify that inspection, measuring and test equipment has been calibrated for the measurements for which it will be used.

If the above information is unavailable or cannot be verified, UL representatives will evaluate compliance with the requirements specified for non-ISO/IEC 17025 accredited calibration service providers or calibrations performed in-house.

Calibration certificates: non-ISO/IEC 17025 accredited calibration service providers or calibrations performed in-house

Certificates for calibrations performed by non-ISO/IEC 17025 accredited calibration service providers must include the following information:

1. Title, e.g., Calibration Certificate, Calibration Report, etc., or equivalent
2. Name and address of the calibration service provider
3. Location where the calibration was conducted, if different from the service provider address
4. Unambiguous identification of the specific piece of IMTE calibrated such as manufacturer name and model number, serial number, identification number, etc.
5. Unique identifier of the calibration record such as a serial number and the capability to match it to a specific piece of calibrated IMTE
6. Description of the condition of the item calibrated, i.e., the as-received condition, e.g., out of tolerance, in tolerance, damaged, etc.
7. Date(s) calibration was performed
8. Quantitative measured value(s) of the calibration results when out of calibration conditions are identified, i.e., when stated calibration tolerances have been exceeded
9. For IMTE capable of measuring multiple parameters, calibration records must include an attestation or statement confirming that the equipment's as found conditions and calibration results encompass all parameters for which it is being used. Examples of this type of equipment include digital multi-meters measuring voltage, amperage and resistance as well as 6" calipers measuring ID, OD and depth attributes
10. The name(s), functions(s) and signature(s) or equivalent identification of person(s) authorizing the calibration certificate. Note: Electronic signature/authorization is acceptable

11. Evidence that the measurements are traceable to national or international standards and SI units. Note:
    - There should be **no** alteration to the calibration data/results without evidence of appropriate authorization, e.g., names, titles, dates, nature of alteration, etc.
    - When the certificate or report contains results of calibrations performed by subcontractors, these results shall be clearly identified

For calibrations performed in-house by customers, calibration results may be reported in a simplified manner. However, any information outlined in this section that is not included on the calibration certificate or report shall be readily available for review at the time of the UL inspection.

Out of calibration conditions

When IMTE (before any adjustments are made) is found to be outside of required calibration tolerances, i.e., OEM accuracy specification, customers shall perform an analysis to determine if the out of calibration condition could have adversely affected inspection results. Similarly, this same analysis must be performed if equipment is determined to be non-operational, if it is discovered to be defective or if other conditions exist that would raise questions about the validity of previous measurements/test results.

The equipment in question must be removed from service by segregating or prominently labeling it. The customers shall:

- Evaluate **and** document the effects of the equipment on previous inspections or tests
- Evaluate if the condition of the equipment could have significantly affected previous inspections or test results and take corrective action, as appropriate. Customers **must** take action to correct product that does not comply with UL requirements

Corrective actions taken by customers should include a robust root cause analysis, containment actions, and long-term corrective actions to ensure that any nonconformance is not likely to recur.

Traceability

All calibrated IMTE is to be calibrated using measurement standards traceable to a national metrological institute, e.g., National Institute of Standards and Technology in the United States or an officially recognized national metrology institute participating in Bureau International des Poids et Measures (BIPM), either directly or through a regional group.

Note: Citation of a NIST test number, certification of the calibration lab to ISO 9001, or a simple statement of traceability to NIST or other international body by the calibration service provider are **not** acceptable as evidence of traceability. The calibration certificate and related records must provide evidence that a calibration service provider utilized calibration standards that are traceable to national standards.

Measurement uncertainty

UL recommends that calibration certificates or reports include the uncertainty of measurement values associated with the calibration data. Uncertainty calculations are recommended for all calibrations. These calculations may be performed in accordance with ISO 5725-2, Guide to the Expression of Uncertainty in Measurement Accuracy of Measurement Methods and Results – Part 2, also known as GUM (trueness and precision), or in accordance with ANSI/NCSL Z540-2, General Requirements for Calibration Laboratories and Test Equipment.

RECORDS

Certificates and other records

Customers must maintain records of calibration for at least one year. For equipment calibrated less frequently, e.g., every three years, records shall be maintained at least for the current calibration cycle.

The content of the records must comply with the requirements defined in this document.

Records of analysis of out-of-calibration conditions shall also be maintained. The duration of records retention should be defined and documented by customers. UL also recommends that customers maintain records of in-service checks for low-precision equipment.

Accreditation endorsements

The following information is provided to assist customers; it is not intended to be all-inclusive.

Since calibration certificates from accredited laboratories that conduct work within their scope of accreditation can bear an endorsement of accreditation, attention to verifying a suitable endorsement with the unique identifier is necessary. This satisfies the need to substantiate that a certificate was provided by an accredited calibration laboratory.

The following are acceptable accreditor endorsements:

- International Laboratory Accreditation Cooperation MRA signatories – a full listing of ILAC MRA signatories can be found at **www.ilac.org/membersbycategory.html**. The category "Full Members" includes a listing of the signatories to the ILAC MRA
- Asian Pacific Laboratory Accreditation Council MRA signatories – a full listing of APLAC MRA signatories can be found at **www.aplac.org/membership_by_category.html**
- European Accreditation Cooperation MRA signatories – a full listing of EAC MRA signatories can be found at **www.european-accreditation.org/content/mla/scopes.htm**

Sample calibration certificate

The calibration certificate/record shown on the following page is a representative example that contains the required elements defined previously in this document. These required elements include the following:

1. Title, e.g., Calibration Certificate, Calibration Report, etc., or equivalent
2. Name and address of the calibration service provider
3. Location where the calibration was conducted, if different from the service provider address
4. Unambiguous identification of the specific piece of IMTE calibrated such as manufacturer name and model number, serial number, identification number, etc.
5. Unique identifier of the calibration record such as a serial number and the capability to match it to a specific piece of calibrated IMTE
6. Description of the condition of the item calibrated, i.e., the "as received" condition, e.g., out of tolerance, in tolerance, damaged, etc.
7. Date(s) calibration was performed
8. Quantitative measured value(s) of the calibration results when out of calibration conditions are identified, i.e., when stated calibration tolerances have been exceeded
9. For IMTE capable of measuring multiple parameters, calibration records must include an attestation or statement confirming that the equipment's as-found conditions and calibration results encompass all parameters for which it is being used. Examples of this type of equipment include digital multi-meters measuring voltage, amperage and resistance as well as 6" calipers measuring ID, OD and depth attributes
10. The name(s), functions(s) and signature(s) or equivalent identification of person(s) authorizing the calibration certificate. Note: Electronic signature / authorization is acceptable
11. Evidence that the measurements are traceable (to national or international standards)

Important notes

- UL does not endorse any vendors or products referenced herein.
- For more information, please contact your local UL Field Representative.

Calibration Certificate

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Certificate Number ABC-123

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"Calibration Service Name"
3223 Clark Street
Chicago IL, 60601

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Accreditation
Endorsement Logo
Certificate No. XYZ-789

"Equipment Owner Name"
801 E Street
Asbury Park, NJ 07712
Attn: The Boss

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Manufacturer	FLUKE	Calibration Date	2/18/2012
Model	8062A	Recommended Due	2/18/2013
Description	Digital Multi-meter	Calibration Location	ONSITE
Size / Range	all checked	As Received	OUT OF TOLERANCE
Serial Number	3990313	As Returned	IN TOLERANCE
Asset Number	MM0027	Procedure	SOP-CAL-DMM-04
ID #	MM0027	Environment	22 DEG C 33% RH
Accessories	None received	P.O. Release	007-777777

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This instrument has been processed and calibrated in accordance with "Calibration Service Name" Quality Assurance Manual and is traceable to the National Institute of Standards and Technology (NIST). The "Calibration Service Name" quality system is registered to ISO 9001:2008, A2LA - accredited to ISO / IEC 17025 – 2005 & ANSI /NCSL Z540-1-1994, and compliant with ISO 10012-1, 10 CFR 50 App. B, 10 CFR 21, NQA-1 and MIL-STD-45662A. This report may not be reproduced, except in full, without the written approval of "Calibration Service Name". Unless stated otherwise, the expanded measurement uncertainty of the measurement process does not exceed 15% of the tolerance allowed for the individual characteristics measured, the measurement uncertainties for this calibration are based upon 95% (2 sigma) confidence limits. No sampling plan or other process was used for this calibration. **The results reported herein apply only to the calibration of the item described above and no limitations of use apply to the calibrated unit.** Although the item calibrated meets the specifications and performance at the time of calibration, due to any number of factors the recommended due date of the item calibrated does not imply continuing conformance to specifications during the recommended interval.

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Calibration Accuracy	MANUFACTURER'S SPECIFICATIONS
Conditions / Analysis	DUE CALIBRATION / CALIBRATED WITH DATA ONSITE

Standards Used

ID Number	Model Number	Calibration Date	Due Date	Traceability Number
1690RC	5700A	7/27/2011	7/27/2012	1700128656
1002138	3325A	10/31/2011	10/31/2012	1700144363
5113-81	SS-32	9/4/2011	9/4/2012	1700128975

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10 Certified By Technician: C. Clemmons

Inspected By Auditor: S. Van Zandt

2 **"Calibration Service Name"**

Manufacturer	FLUKE	Certificate Number	ABC-123
Model	8062A	Calibration Date	2/18/2012
Description	Digital Multi-meter	Serial Number	3990313
Procedure	SOP-CAL-DMM-04	ID #	MM0077

4 5 7 4

Function / Range	Nominal Value	As Found	Result	As Left	Result	Min	Max
DC Voltage							
200 mV	190.00	189.99	Pass	Same	Pass	189.89	190.11
	-190.00	-190.04	Pass	Same	Pass	-190.11	-189.89
2 V	1.9000	1.9002	Pass	Same	Pass	1.8989	1.9011
20 V	19.000	19.003	Pass	Same	Pass	18.985	19.015
200 V	190.00	190.03	Pass	Same	Pass	189.85	190.15
1000 V	1000.0	1000.0	Pass	Same	Pass	999.1	1000.9
AC Voltage							
100mV @ 200 Hz	100.00	100.07	Pass	Same	Pass	99.40	100.60
20 kHz	100.00	100.12	Pass	Same	Pass	98.60	101.40
1 V @ 20 Hz	1.0000	1.0002	Pass	Same	Pass	0.9890	1.0110
200 Hz	1.0000	1.0012	Pass	Same	Pass	0.9940	1.0060
1 kHz	1.0000	1.0002	Pass	Same	Pass	0.9930	1.0070
10 kHz	1.0000	1.0033	Pass	Same	Pass	0.9930	1.0070
30 kHz	1.0000	1.0046	Pass	Same	Pass	0.9860	1.0140
0.1 V 200 Hz	0.1000	0.1000	Pass	Same	Pass	0.0985	0.1015
30 kHz	0.1000	0.1041	Pass	Same	Pass	0.0950	0.1050
10 V @ 200 Hz	10.000	10.125	Fail	Same	Pass	9.940	10.060
10 kHz	10.000	10.734	Fail	Same	Pass	9.480	10.520
30 kHz	10.000	10.787	Fail	Same	Pass	9.460	10.540
100 V @ 200 Hz	100.00	100.26	Pass	Same	Pass	99.40	100.60
10 kHz	100.00	100.46	Pass	Same	Pass	94.80	105.20
30 kHz	100.00	100.44	Pass	Same	Pass	94.60	105.40
750 V @ 400 Hz	750.0	752.60	Pass	Same	Pass	734.0	766.0
750 V @ 1000 Hz	750.0	754.5	Pass	Same	Pass	734.0	766.0
DC Current							
200 uA	190.00	190.05	Pass	Same	Pass	189.41	190.59
	-190.00	-190;06	Pass	Same	Pass	-190.59	-189.41
2 mA	1.9000	1.9007	Pass	Same	Pass	1.8941	1.9059
20 mA	19.000	19.011	Pass	Same	Pass	18.941	19.059
200 mA	190.00	190.49	Pass	Same	Pass	188.65	191.35
2000 mA	1900.0	1900.2	Pass	Same	Pass	1886.5	1913.5
	-1900.0	-1900.2	Pass	Same	Pass	-1913.5	-1886.5
AC Current @ 1kHzAC 1kHz							
20 mA	19.000	19.053	Pass	Same	Pass	18.847	19.153
Resistance in OhmsResistance Ohms							
200	100.0	10.06	Pass	Same	Pass	99.86	100.14
2 k	1.0000	0.9998	Pass	Same	Pass	0.9986	1.0012
20 k	10.000	9.997	Pass	Same	Pass	9.986	10.012
200 k	100.00	99.97	Pass	Same	Pass	99.86	100.12
2 M	1.000	0.9999	Pass	Same	Pass	0.9978	1.0022
20 M	10.00	10.00	Pass	Same	Pass	9.95	10.05

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Certified By Technician: C. Clemmons Inspected By Auditor: S. Van Zandt

For more information please contact your local UL field representative