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INTERNATIONAL ORGANIZATION OF LEGAL METROLOGY

Sixth Committee Draft Revision International Recommendation 59

“Moisture Meters for Cereal Grain and Oilseeds”

Part 1: Metrological and technical requirements
Part 2: Metrological controls and performance tests
Part 3: Report format for type evaluation

OIML TC17/SC1 Secretariats: China, United States of America

Participating Nations:

Australia, Austria, China, Cuba, Czech Republic, France, Germany, Japan, Netherlands, Poland, Russia, United Kingdom, United States of America, Yugoslavia

Observing Nations:

Bulgaria, Egypt, Finland, Hungary, Indonesia, Ireland,
Norway, Romania, Slovakia, Spain

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OIML R 59

"Moisture Meters for Cereal Grain and Oilseeds"
Part 1: Metrological and technical requirements
Part 2: Metrological controls and performance tests
Part 3: Report format for type evaluation

Explanatory note

This explanatory note section, initially added in December 2008, to the 5 CD of OIML R 59, is in accordance with the guidelines for formatting OIML Recommendations, OIML G xxx Edition 2008 (E), "Format for OIML Recommendations, " OIML B 6-2 "Directives for Technical Work – Part 2" (1993) and the April 2008 Secretariat Training in France. This section provides a history of the TC17/SC1 meetings and draft changes since the initial revision. This explanatory note section is intended to provide the reader with background information on activities and decisions of the TC17/SC1 during meetings and subsequent updates to the draft.

This explanatory note section is a temporary section that appears in the drafts only. The BIML will remove this section in the final stage (i.e. the DR) of publication.

History of TC17/SC1 meetings and committee draft revisions

June 2001 TC17/SC1 meeting to discuss major revisions to OIML R 59.

On June 22, 2001, the TC17/SC1 working group held a meeting at PTB in Berlin, Germany, to review a first committee draft of OIML R 59. Representatives from China, France, United States, Germany, Poland, UK, Japan and the BIML attended the meeting. Participants of the meeting agreed that this draft of OIML R 59 required substantial revisions to reflect new measuring technologies and actual grain analysis. The committee agreed that the U.S., National Institute of Standards and Technology (NIST), Weights and Measures Division would prepare a new version of the first committee draft. The meeting participants agreed to the following points:

- Reference methods will not be covered by the Recommendation,
- This Recommendation applies to measurements in the sphere of legal metrology only (i.e. commercial transactions),
- This Recommendation applies to Static samples, (i.e. not to continuous flows of grain),
- A distinction shall be made between the meter itself a physical instrument and the calibrations for different kinds of grain,
- This Recommendation shall be limited to indirect measuring instruments based on physical methods. It will not apply to drying methods (the questions was left open as to whether or not the drying methods based on infrared or microwave drying should be taken into account,
- This Recommendation shall:
    - define a minimum sample mass,
    - establish rules and fix the minimum numbers of samples for the validation of calibrations, and
    - provide an interpretation of uncertainty of moisture measurement
- Initial verification shall be deleted,
- BIML will contact ISO (TC 34/SC 4) and ICC to establish liaisons, and
- This Recommendation will refer to the importance of sampling but will not cover it.

For additional information concerning this meeting, reference TC17/SC1/WG1 meeting minutes of June 22, 2001.

First and second committee drafts (1 CD, 2 CD) OIML R 59 and October 2003 TC17/SC1 meeting

In April 2002, the U.S. completed a first Committee Draft (1CD). The TC17/SC1 Secretariat, China, circulated the draft to the participating and observing countries for comment. The U.S. responded to the comments received on the OIML R 59 1 CD, made changes to the 1 CD to reflect these comments, and developed the May 2003 2CD of OIML R 59. The Secretariat, China, circulated the May 2003 2 CD to the participating and observing countries of TC17/SC1 for comment. Germany, Japan, and the U.S provided comments.

China hosted a TC17/SC1 meeting on October 15-16, 2003, at the Kunlun Hotel in Beijing, China, to review the comments and revisions to the May 2003 draft (2CD) of OIML R 59 and also, to review R 92 and R 121. Representatives from China, Germany, Japan, and the United States attended the meeting. Dr. Guenter Scholz of Germany chaired the meeting. The Subcommittee reviewed and discussed comments to the May 2003 (2 CD) draft of OIML R 59. After review of the comments and discussion, the subcommittee recommended changes to the 2CD and the U.S. drafted the October 2003 meeting summary.

Many of the comments that were received from the participating countries concerning the May 2003 (2CD) of OIML R 59 and that were discussed at the October 2003 meeting were editorial and/or required that the May 2003 draft OIML R 59 be changed to clarify the intent. Two concerns expressed by Japan during the meeting were the temperature requirements and sample size. Resistance meters, as expressed by representatives from Japan, are about 70% of the market in the Asian countries. The May 2003 2 CD of OIML R 59 includes a temperature test to ensure that meters operate appropriately at specified temperatures. These tests include "Instrument Operating Temperature Range" and "Sample Temperature Range." According to representatives from Japan, it would be difficult for resistance meters to comply with the temperature requirements of the May 2003 2 CD of OIML R 59 as written, due to geometrical and mechanical restrictions. A representative from Germany stated that resistance meters are evaluated in their country and they did not see a problem with the temperature requirements in the draft Recommendation. Representatives from Japan also expressed concerns with the requirements for sample size. The May 2003 2 CD of OIML R 59 requires a minimum sample size that is larger than the sample size required for resistance meters. Resistance moisture meters require a much smaller sample size.

Third and fourth committee drafts (3 CD, 4 CD)and TC17/SC1 September 24-25, 2007 meeting.

The U.S. drafted the April 2004 3 CD of OIML R 59 based on the comments and discussions from the October 2003 meeting. The Secretariat, Dr. Hong Yi of China, circulated the April 2004 3 CD of OIML R 59 and meeting minutes to the participating and observing countries for review, comment and approval of the changes. Japan, Netherlands, Serbia and Montenegro, and Poland provided comments to the April 2004 3 CD of OIML R 59. Mr. Li Zhanyuan of China incorporated the comments to the 3rd CD and circulated the 4th CD of OIML R 59 for comments.

Comments to the 4CD were provide by the Austria, Australia, BIML, Czech Republic, France, Germany, Japan, Netherlands, Poland, United States,

The OIML Technical Committee (TC) 17, Subcommittee (SC)1 meeting, was held in Gaithersburg, Maryland at the National Institute of Standards and Technology (NIST) on September 24-25, 2007, in conjunction with other OIML meetings at NIST. The TC17/SC1 followed the TC/17/SC8 meeting, which was also held at NIST on September 20-21, 2007.

At the TC17/SC1 meeting, the subcommittee reviewed some of the major issues and comments to the 4 CD OIML R 59, which included a review of the items listed below:

- Reference methods,
- The use of direct indicating vs fully automatic to describe the instruments in the Scope section of R59,
- Defining the use of MPEs in both type evaluation and in field inspection,
- Requiring two instruments for type evaluation, and
- Annex B Test Procedure
- Ongoing calibration program and how instruments will be calibrated for the different grains in various countries.

Following the review of some of the major issues and changes to these sections of the draft, the subcommittee began a review of the remaining participating countries comments to the fourth CD of OIML R 59. There were a total of 172 comments to the 4th CD. Due to time constraints the Subcommittee was unable to review the remaining comments to the 4th CD. Following the meeting, the U.S. Co-secretariat to OIML reviewed the remaining comments to the 4 CD and made changes based on these comments and developed a 5 CD. A number of comments to the 4CD were formatting comments. Based on these comments changes were made to the format of the 5 CD to meet the guidelines for formatting OIML recommendations in accordance with OIML G xx, 2008, Guide for “Format for OIML Recommendations,” OIML B 6-2 “Directives for Technical Work – Part 2” (1993) and the April 2008 OIML Secretariat training. additional changes were made to the 5th CD to include description of instruments and OIML D11 tests.

Fifth and Sixth (preliminary) committee drafts (5CD and 6 CD preliminary) and TC17/SC1 September 28-29, 2010 meeting.

The U.S. Co-secretariat developed and sent the fifth committee draft to TC17/SC1 for review in 2009. Responses and/or comments to OIML R59 5CD were received from Australia, Austria, Czech Republic, France, Germany, Japan, Netherlands, Serbia, Slovakia, Poland, United Kingdom, and the United States and the U.S. co-secretariat developed a preliminary 6CD based on comments to the 5CD.

The OIML Technical Committee (TC) 17, Subcommittee (SC)1 meeting, was held in Orlando, Florida at the Double Tree Hotel at the entrance to Universal Orlando, September 28-29, 2010 following the TC/17/SC8 meeting, which was held on September 27-28, 2010. Participants from Australia, Canada, China, Germany, Japan, United States, and representatives from the BIML and AOCS attended the meeting

The TC17/SC1 participants received a preliminary copy of OIML R59 CD6 which included changes per the U.S. Co-secretariat's review of comments to R59 CD5. During the meeting participants reviewed critical issues and comments to R59 CD 5 followed by a detailed review of each comment to R59 CD5. Specifically, the following items were reviewed during the meeting:

1. Efforts to establish recognized traceability under the CIPMA MRA for "moisture in grain" measurements.
2. Printed results
3. Description of Instruments
4. Reference conditions for performance tests
5. Verification
6. Level indicating means
7. Minimum sample size
8. Definition for Error Shift
9. Software
10. Harmonizing the OIML Moisture and Protein Recommendation
11. Revisions to test report forms for consistency with laboratory calibration worksheets
12. Detailed review of comments to R59 CD5

See meeting summary for more details.

Per discussions at the September 2010 meeting, the description of instruments and those OIML D11 tests not considered appropriate tests for grain moisture meters were removed from the OIML R59 6CD. Germany sent proposed changes to software sections of the document and these changes were also incorporated as appropriate into OIML R59 6CD. Additional software information on sealing and audit trails were added to the appendices.

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Foreword

The International Organization of Legal Metrology (OIML) is a worldwide, intergovernmental organization whose primary aim is to harmonize the regulations and metrological controls applied by the national metrological services, or related organizations, of its Member States. The main categories of OIML publications are:

- **International Recommendations (OIML R),** which are model regulations that establish the metrological characteristics required of certain measuring instruments and which specify methods and equipment for checking their conformity. OIML Member States shall implement these Recommendations to the greatest possible extent;
- **International Documents (OIML D),** which are informative in nature and which are intended to harmonize and improve work in the field of legal metrology;
- **International Guides (OIML G),** which are also informative in nature and which are intended to give guidelines for the application of certain requirements to legal metrology; and
- **International Basic Publications (OIML B),** which define the operating rules of the various OIML structures and systems.

OIML Draft Recommendations, Documents and Guides are developed by Technical Committees or Subcommittees which comprise representatives from the Member States. Certain international and regional institutions also participate on a consultation basis. Cooperative agreements have been established between the OIML and certain institutions, such as ISO and the IEC, with the objective of avoiding contradictory requirements. Consequently, manufacturers and users of measuring instruments, test laboratories, etc. may simultaneously apply OIML publications and those of other institutions.

International Recommendations, Documents, Guides and Basic Publications are published in English (E) and translated into French (F) and are subject to periodic revision.

This publication - reference OIML R 59, Edition 2013 - was developed by Technical Subcommittee TC17/SC1. It was approved for final publication by the International Committee of Legal Metrology in 201x and will be submitted to the International Conference of Legal Metrology in 201y for formal sanction. It supersedes the previous edition of R 59 (199x).

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1. Introduction

[1]Moisture content is one of the most critical grain quality measurements because of the direct economic significance of the fraction of the total product weight that is water and because moisture content largely determines the rates at which the grain will degrade during handling and storage. Grain is bought and sold on the basis of weight. Accurate moisture determinations serve as the basis for appropriate price adjustments.

[1]If the moisture content is above the level that ensures safe storage, the grain must be dried to a suitable level. The energy and handling costs associated with drying grain and the reduction in weight of the grain during drying result in substantially reduced prices for high moisture grain. Concomitantly, overly dry grain is discounted from its weight basis and this dockage is partially justified by the increased susceptibility to breakage during handling for drier grain. The direct discounts assessed for moist grain and the indirect penalty (giving away dry matter) for dry grain are powerful inducements to deliver grain with a moisture content that is very close to the established safe storage level. Because of its significance, moisture content is determined virtually every time grain is bought and sold.

[1]An air oven method is the most common rapid reference method for grain moisture determinations. National air oven methods vary widely in procedures and results, but all are based on heating a known mass sample for a prescribed period of time (or until the sample no longer loses mass) at a prescribed temperature and measuring the loss of mass. The amount of mass lost is assumed to be the amount of water that was present in the sample. Unfortunately, water is not the only constituent that is driven off by heating. In the "ideal" oven method, the heating times and temperatures would be set so that the amount of nonaqueous material driven off is approximately equal to the amount of water that remains after drying. Those parameters are determined by comparing the air oven method to other more basic (and more difficult) methods such as the phosphorous pentoxide (P_2O_5) method or the Karl Fischer method. Most air oven methods require hours or days to complete. Clearly, grain producers, handlers, and processors need rapid methods to assess moisture content.

[1]Many technologies have been applied to rapid grain moisture measurement. Rapid indirect methods measure some physical parameter (such as electrical or optical sensing) and predict moisture content using calibration equations or charts. These calibrations can change due to changes in crop varieties planted and seasonal variation in climatic conditions. Invariably, other sample constituents or sample geometry interfere with the signal caused by water. Temperature usually affects both the water signal and the interfering signals. Therefore, calibration equations attempt to achieve a best fit between the measured parameters and the moisture content as defined by an accepted moisture reference method. Accurate grain moisture measurements

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[1] An Investigation of the Nature of the Radio Frequency Dielectric Response in Cereal Grains and Oilseeds with Engineering Implications for Grain Moisture Meters, A Dissertation in Physics and Engineering, David B. Funk, Ph.D., D.H.C.

depend upon successfully overcoming the effects of interfering factors, such as density, temperature, chemical composition, and impurities.

The 200X edition of OIML R 59 contains significant changes to the 1984 edition of OIML R 59. Substantial changes were made to reflect the new measuring technologies and aspects of actual grain analysis.

As noted above, grain moisture meters do not measure moisture directly. An electrical or optical response to the moisture in a grain type is measured and moisture is predicted using calibration equations. As such, these instruments must be calibrated to predict the moisture of each grain type used on the instrument. Grains vary from season to season and also grain types may widely vary from country to country; therefore, a program to address calibration updates is needed to ensure that grain moisture meter calibrations represent the current crops. If grain moisture instruments are sold to other countries the calibrations will need to be verified within that country to ensure that the calibrations are representative of the grains within that particular country. This recommendation does not address an ongoing calibration program for these instruments. An ongoing calibrations program will be the responsibility of the national measurement authority.

PART 1: Metrological and technical requirements

2. Scope

2.1 Requirements and test

This Recommendation specifies the metrological and technical requirements, test methods and maximum permissible errors for type approval of grain moisture meters used in commercial transactions of cereal grains and oilseeds.

2.2 Indications

This Recommendation applies to digitally indicating automatic grain moisture meters that directly display moisture content.

2.3 Application

This Recommendation applies to moisture measuring instruments that estimate moisture based on indirect physical means (e.g. electrical or optical sensing). Drying methods or any other direct moisture measurement technology are not specifically covered, but may qualify if they perform to the requirements of the Recommendation.

2.4 Type of measuring instrument

This Recommendation applies to grain moisture meters that measure the moisture content of fixed representative-size grain sample and does not apply to devices used for in-motion measurement of grain or seed moisture content.

2.5 New technology

This Recommendation specifies instrument performance specifications and is not meant to preclude the application of new technologies to grain moisture measurement.

3. Terminology

3.1 International Vocabulary Metrology (VIM), Basic and General Concepts and Associated Terms, 2010 and OIML VI, International Vocabulary of Terms in Legal Metrology (VILM), 2012

3.1.1 Maximum permissible measurement error (MPE) (maximum permissible error, limit of error).

Extreme value of measurement error, with respect to a known reference quantity value, permitted by specifications or regulations for a given measurement, measuring instrument, or measuring system.

Note 1 Usually the term "maximum permissible errors" or "limits of error" are used, where there are two extreme values.
Note 2 The term "tolerance" should not be used to designate 'maximum permissible error'.

NOTE: The MPEs in Section 4.4.2. are errors associated with a meter in use in the market place. The errors for the OIML test procedures are based on Section 4.4.1.

3.1.2 Measurement error (error of measurement, error)

Measured quantity value minus a reference quantity value.
Note 1 The concept of 'measurement error' can be used both

a) when there is a single reference quantity value to refer to, which occurs if a **calibration** is made by means of a **measurement standard** with a **measured quantity value** having a negligible **measurement uncertainty** or if a **conventional quantity value** is given, in which case the measurement error is known, and true quantity values of negligible range, in which case the measurement error is not known, and

b) if a **measurand** is supposed to be represented by a unique **true quantity value** or a set of true quality values of negligible range, in which case the measurement error is not known.

Note 2 Measurement error should not be confused with production error or mistake.

3.1.3 Measurement repeatability (repeatability)
Measurement precision under a set of repeatability conditions of measurement.

3.1.4 Measurement reproducibility (reproducibility)
Measurement precision under **reproducibility conditions of measurement.**
***Note* Relevant statistical terms are given in ISO 5725-1:1994 and ISO 5725-2:1994.**

3.1.5 Rated operating conditions
[Adapted from VIM 5.5]

Conditions of use giving the range of values of influence quantities for which specified metrological characteristics of a measuring instrument are intended to lie within given limits.

3.1.6 Repeatability condition of measurement (repeatability condition)

Condition of measurement, out of a set of conditions that includes the same measurement procedure, same operators, same measuring system, same operating conditions and same location, and replicate measurements on the same or similar objects over a short period of time
Note 1 A condition of measurement is a repeatability condition only with respect to a specified set of repeatability conditions.
Note 2 In chemistry, the term "intra-serial precision condition of measurement" is sometimes used to designate this concept.

3.1.7 Reproducibility condition of measurement (reproducibility condition)

Condition of measurement, out of a set of conditions that includes different locations, operators, measuring systems, and replicate measurements on the same or similar objects
Note 1 The different measuring systems may use different measurement procedures.
Note 2 A specification should give the conditions changed and unchanged, to the extent practical.

3.2 Organization of Legal Metrology(OIML) D 31

3.2.1 Audit trail [OIML D 31, 3.1.2]

Continuous data file containing a time stamped information record of events, e.g. changes in the values of parameters of a device or software updates, or other activities that are legally relevant and which may influence the metrological characteristics.

3.2.2 Cryptographic means [further information in OIML D 31, 3.1.11]

Encryption of data by the sender (storing or transmitting program) and description by the receiver (reading program) with the purpose of hiding information from unauthorized persons. Electronic signing of data with the purpose of enabling the receiver or user of the data to verify the origin of the data, i.e. to prove their authenticity.

3.2.3 Fault [OIML D11, 3.9]

[With reference to a certified measurement standard]: Difference between the error of indication [during or after exposure to a disturbance] and the mean intrinsic error of a measuring instrument.
D 11 NOTES
1 Principally, a fault is the result of an undesired change of data contained in or flowing through an electronic measuring instrument.
2 From the definition it follows that a "fault is a numerical value which is expressed either in a unit of measurement or as a relative value.

If a certified measurement standard is not used, a fault is the difference between a single indication during or after a disturbance, and the mean indication at reference conditions prior to test.

3.2.4 Intrinsic error [OIML D 11, 3.7]

Error of a measuring instrument, determined under reference conditions.

3.2.5 Legally relevant [OIML D 31, 3.1.29]

Software/hardware/data or part of the software/hardware/data of a measuring instrument which interferes with properties regulated by legal metrology, e.g. the accuracy of the measurement or the correct functioning of the measuring instrument.

3.2.6 Open network [OIML D 31, 3.1.35]

Network of arbitrary participants (electronic devices with arbitrary functions). The number, identity and location of a participant can be dynamic and unknown to the other participants. This is in contrast to a closed network [D 31, 3.1.6] which is a network of a fixed number of participants with a known identity functionality and location.

3.2.7 Universal computer [OIML D 31, 3.1.54]

Computer that is not constructed for a specific purpose but that can be adapted to the metrological task by software. In general this software is founded on an operating system that permits loading and execution of software for specific purposes.

3.2.8 Validation [OIML D 31, 3.1.56]

Confirmation by examination and provision of objective evidence (i.e. information that can be proved true, based on facts obtained from observations, measurement, test, etc.) that the particular requirements for the specific intended use are fulfilled. In the present case the related requirements are those of this Recommendation.

3.3 Other terminology

3.3.1 Adjustment Mode

An operational mode of a device which enables the user to make adjustments to sealable parameters, including changes to configuration parameters.

3.3.2 Adjustment

A change in the value of any of a device's sealable calibration parameters or sealable configuration parameters.

3.3.3 Audit Trail

An electronic count and/or information record of the changes to the values of the calibration or configuration parameters of device. The term addresses all forms of audit trail described in this paper.

3.3.4 Auxiliary battery

Battery that is

(a) Mounted in, or connected to, an instrument that can be powered by the mains power as well; and

(b) Capable of completely powering the instrument for a reasonable period of time.

3.3.5 Back-up battery

Battery intended to power specific functions of an instrument in the absence of the primary power supply. Example: to preserve stored data

3.3.6 Calibration Parameter

Any adjustable parameter that can affect measurement or performance accuracy and, due to its nature, needs to be updated on an ongoing basis to maintain device accuracy, (e.g., span adjustments, linearization factors, and coarse zero adjustments.)

3.3.7 Configuration Parameter

Any adjustable or selectable parameter for a device feature that can affect the accuracy of a transaction or can significantly increase the potential for fraudulent use of the device and, due to its nature, needs to be updated only during device installation or upon replacement of a component, (e.g., division value, increment, sensor range, and units of measurement.)3.3.8 Checking facility

Facility incorporated in a measuring instrument and which enables significant faults to be detected and acted upon.

Note: «Acted upon» refers to any adequate response by the measuring instrument (luminous signal, acoustic signal, prevention of the measurement process, etc.).

3.3.9 Enabling/Inhibiting Sealable Hardware

Physically sealable hardware, such as a two-position switch, located on a remotely configurable device, that enables and inhibits the capability to receive adjustment values or changes to sealable configuration parameters from a remote device.

3.3.10 Error shift

An error observed on an instrument as it is subjected to testing. The error is determined by observing the difference between an instrument result of a grain sample under test to the known reference value of that grain sample under test. See Section 5.4.1 for the error shifts associated with grain moisture meter testing.

3.3.11 Event

An action in which one or more changes are made to configuration parameters, or adjustments are made to one value (or values for a set of values) for a calibration parameter, (e.g., adjustments for a set of calibration factors to linearize device output), while in the adjustment mode. If no adjustment is made, then there is no event. In the case of a centralized audit trail, the same values for the same parameter sent to multiple devices shall be considered to be the same event. In the case of a centralized event logger, the event logger must identify both the device and the parameter that was changed.

3.3.12 Event counter

A non-resettable counter that increments once each time the mode that permits changes to sealable parameters is entered and one or more changes are made to sealable calibration or configuration parameters of a device.

Note: An event counter shall have a capacity of at least 1000 values [e.g., 000 to 999].

3.3.13 Event Logger
A form of audit trail containing a series of records where each record contains the number from the event counter corresponding to the change to a sealable parameter, the identification of the parameter that was changed, the time and date when the parameter was changed, and the new value of the parameter.

3.3.14 Grain
For the purpose of this document grain means oil seeds, pulses and cereal grains.

3.3.15 Moisture content wet-basis.
The wet-basis moisture content of a sample of grain is the ratio of moisture to the total mass of the grain sample.

3.3.16 Moisture Meter
An instrument that measures a parameter (electrical, optical, etc) to predict the moisture content of a grain within specified error limits.

3.3.17 Physical Seal
A physical means, such as lead and wire, used to seal a device to detect access to those adjustable features that are required to be sealed.

3.3.18 Rated operating conditions
[Adapted from VIM 5.5]

Conditions of use giving the range of values of influence quantities for which specified metrological characteristics of a measuring instrument are intended to lie within given limits.

3.3.19 Remote Configuration Capability
The ability to adjust a weighing or measuring device or change its sealable parameters from or through some other device that is not itself necessary to the operation of the weighing or measuring device or is not a permanent part of that device.

3.3.20 Remote Device
A device that (1) is not required for the measurement operation of the primary device or computing the transaction information in one or more of the available operating modes for commercial measurements or (2) is not a permanent part of the primary device. In the context of this paper, a remote device has the ability to adjust another device or change its sealable configurable parameters.

3.3.21 Remotely Configurable Device
Any weighing or measuring device with remote configuration capability that permits sealable configuration or calibration parameter values to be deleted, appended to, modified, or substituted in whole or in part by downloading over any type of communications link from another device, such as a geographically local or remote console or computer, whether or not the secondary apparatus is part of the network connecting the devices.

3.3.22 Repeatability condition of measurement (repeatability condition)

Condition of measurement, out of a set of conditions that includes the same measurement procedure, same operators, same measuring system, same operating conditions and same location, and replicate measurements on the same or similar objects over a short period of time
Note 1 A condition of measurement is a repeatability condition only with respect to a specified set of repeatability conditions.
Note 2 In chemistry, the term "intra-serial precision condition of measurement" is sometimes used to designate this concept.

3.3.23 Reproducibility condition of measurement (reproducibility condition)
Condition of measurement, out of a set of conditions that includes different locations, operators, measuring systems, and replicate measurements on the same or similar objects
Note 1 The different measuring systems may use different measurement procedures.
Note 2 A specification should give the conditions changed and unchanged, to the extent practical.

3.3.24 Seal
As a verb, to seal a device is to make a device secure so that access to adjustments and other sealable parameters will be detectable.

3.3.25 Sealable Parameters
Calibration and configuration parameters that are required to be sealed.

3.3.26 Significant fault
Fault greater than the value specified in this Recommendation (see Section 5.4.1)
Note: The relevant Recommendation may specify that the following faults are not significant, even when they exceed the value defined in 5.4.1:
(a) Faults arising from simultaneous and mutually independent causes (e.g. EM fields and discharges) originating in a measuring instrument or in its checking facilities;
(b) Faults implying the impossibility to perform any measurement;
(c) Transitory faults being momentary variations in the indication, which cannot be interpreted, memorized or transmitted as a measurement result;
(d) Faults giving rise to variations in the measurement result that are serious enough to be noticed by all those interested in the measurement result; the relevant Recommendation may specify the nature of these variations.

3.3.27 Unrestricted Access to Sealable Parameters
Unrestricted access means that a physical security seal is not present, so that access to the sealable parameters is available from a remote device at any time at the request of an authorized operator subject to the operating status of the receiving device.

3.4 Abbreviations and acronyms

AC: alternating current
DC: direct current
EM: electromagnetic
EMC: electromagnetic compatibility
e.m.f.: electromotive force
ESD: electrostatic discharge
EUT: equipment under test
IEC: International Electrotechnical Committee
ISO: International Organization for Standardization
MPE: maximum permissible error
OIML: International Organization of Legal Metrology
RH: relative humidity
SD: standard deviation
SDD: standard deviation of differences
M: reference moisture

4 Units of measurement

4.1 Moisture content

The unit of measurement for moisture content of a grain sample, which is to be displayed on a moisture meter is the % moisture by mass. Reference Moisture (M) is expressed as the percentage mass loss of the sample as determined by the reference method. The equation as follows represents wet-basis moisture content.

$$M = \frac{m_0 - m_1}{m_0} \times 100 \ \%$$

where m_0 is the original mass of the sample and m_1 is the final mass of the sample.

5 Metrological requirements

5.1 Influence quantities

5.1.1 Reference conditions

a)	Ambient temperature:	20 °C to 27 °C ± 2 °C
b)	Relative humidity:	30 % to 70 %
c)	Atmospheric pressure:	86 kPa to 106 kPa
d)	Power voltage:	-15% to +10% of mains or test voltage
e)	Power frequency:	nominal frequency, *Fnom*
f)	Instrument tilt position:	5% or maximum allowable on level indicator where indicator is present

5.1.2 Disturbance test ranges

a) AC mains voltage dips, short interruptions and voltage variations: reduction to 0% (0.5 cycle), reduction to 0% (1 cycle), reduction to 70% (25 / 30(1) cycles), reduction to 0% (250 / 300(1) cycles).
b) Bursts (transients) on AC mains: Amplitude 1kV, repetition rate 5 kHz
c) Radiated radio-frequency fields, electromagnetic fields: 26 MHz - 2 GHz, 10 V/m
d) Conducted radio-frequency fields: 0.15 MHz – 80(2) MHz, 10 V (e.m.f.)
e) Electrostatic discharge – direct application: Up to 6 kV contact discharge
f) Electrostatic discharge – indirect application: Up to 8 kV air discharge
h) Storage temperature (extreme shipping conditions): -20 ºC to 50 ºC

NOTES:
(1) The cycle counts apply for 50 Hz / 60 Hz respectively
(2) Testing up to 26 MHz is permitted. Refer to clause C.6.4 for conditions.

5.2 Rated operating conditions

Measuring instruments shall be designed and manufactured such that their errors do not exceed the MPEs for initial verification as defined in 5.4.2 when operated within the operating conditions defined below:

a) Ambient temperature: 10°C to 30°C [(1)]
b) Relative humidity: 85% to 90 % no condensation
c) Atmospheric pressure: 86 kPa to 106 kPa
d) Power voltage: -15% to +10% of mains or test voltage
e) Power frequency: nominal frequency, *Fnom*
f) Instrument tilt position: 5% or maximum allowable on level indicator where indicator is present
g) Grain sample temperature: 0°C to 40°C [(2)]
h) Sample and instrument temperature differential: 10°C [(3)]
i) Grain sample moisture range: Specified by the manufacturer (See Clause 6.1)

(1) This is the minimum range. The manufacturer or national responsible body may specify a wider range. (see clause 5.6)

(2) This is the minimum range. The manufacturer may specify the maximum allowable temperature difference. If the instrument is unable to measure sample temperature then the operating procedure shall be defined by the national responsible body (see clause 5.7).

(3) This is the minimum differential. The manufacturer may specify a larger differential. If the instrument is unable to measure sample temperature then the operating procedure shall be defined by the national responsible body (see clause 5.7).

5.3 Reference method

The reference method for grain moisture content is the method defined by the national responsible bodies. OIML recommends the use of ISO standards where possible.

5.4 Maximum permissible errors (MPEs)

For type evaluation the maximum permissible errors for grain moisture meters as a function of the moisture content is half the MPE that is applied at verification or in-field inspection: The maximum value for a given 2 % moisture interval shall be used for all requirements. For consistency of application in the OIML certificate system, it is recommended that each 2 % moisture intervals should begin and end with an even number.

5.4.1 MPEs for type evaluation

MPEs for type evaluation				
(1) **Grain type**	(2) **MPEs in percent moisture content (M_R)** **%**	(3) **Error shift**	(4) **Repeatability** **SD** **%**	(5) **Reproducibility** **SDD_I** **%**
Corn, oats, pulses, rice, sorghum, sunflower	If 0.025 x *M* < 0.4 then MPEs= 0.4; else MPEs = 0.025 x *M*	0.5 x column 2	0.5 x column 2	0.6 x column 2
All other grains and oil seeds	If 0.02 x *M* < 0.35 then MPEs= 0.35; else MPEs = 0.02 x *M*	0.5 x column 2	0.5 x column 2	0.6 x column 2

5.4.2 MPEs at verification/ in-field inspection

MPEs at verification/ in-field inspection	
Type of grain or seed	**MPE_S in percent moisture content (*M*)**
(I) Corn, oats, pulses, ,rice, sorghum, sunflower	If 0.05 x *M* < 0.8 then MPEs= 0.8; else MPEs = 0.05 x *M*
(II) All other cereal grains and oilseeds	If 0.04 x *M* < 0.7 then MPEs= 0.7; else MPEs = 0.04 x *M*

5.5 Accuracy and precision requirements

The error of a moisture meter for a given sample of grains or seeds is the algebraic difference between the average of a result of a series of repeat measurements of a grain sample and the conventional true value of the moisture content determined using a method defined as the reference by the national responsible bodies.

5.6 Instrument environmental operating temperature range

A meter shall meet the moisture accuracy specification over a minimum environmental operating range of 20 ºC. The minimum environmental operating temperature range is 10 ºC to 30 ºC. If the manufacturer specifies a temperature range, the range shall at least cover 20 °C. No moisture value may be displayed when the instruments environmental operating temperature range is exceeded. An appropriate error message shall be displayed when the moisture meter is outside its specified environmental operating temperature range.

5.7 Sample temperature range

The manufacturer shall specify the temperature range for each grain or seed for which the meter is to be used. The minimum sample temperature range for each grain shall be 0 °C to 40 °C. No moisture value shall be displayed when the temperature range is exceeded. An appropriate error message shall be displayed when the temperature of the grain sample exceeds the specified temperature range for the grain. The manufacturer shall specify the maximum allowable difference in temperature between the meter and the sample for which an accurate moisture determination can be made. The moisture meter shall be able to take into account a temperature difference of at least 10 °C. No moisture value may be displayed when the maximum allowable temperature difference is exceeded. An appropriate error message shall be displayed when the difference in temperature between the meter and the sample exceeds the specified difference. If the instrument is not able to measure sample temperature, then the operating procedure shall be defined by the national responsible body.

6 Technical requirements

6.1 Grains and minimum moisture ranges

Due to climatic and crop variability, the national responsible body shall specify a list of kinds and commercially important moisture ranges (at least 6 % moisture) for those grains and minimum number of grains (at least three) for which a manufacturer may seek national moisture meter approval. The grains specified are typically those which:

(a) are of greatest economic importance, and
(b) are significantly different in their physical structure to adequately test the instrumentation (e.g., large grains, ~~2~~ small grains, and ~~3~~ oil seeds.)
(c) are variable and are typically grown in regions of the national responsible body.

The manufacturer shall specify the grain and oil seed types and the applicable moisture range for the meter, subject to the minimum ranges specified in paragraph 6.1.

6.2 Selection of grain on the instrument

Moisture meters shall permit the selection of grain or seeds being measured and the selection of the grain shall be clearly identified and visible to all parties present.

6.3 Minimum sample size

Meters shall be designed to measure the moisture content of representative size grain samples. The minimum allowable sample size used in analysis shall be 100g or 400 kernels or seeds , whichever is smaller, except where national authorities determine otherwise.

6.4 Determination of quantity and temperature

The moisture meter system shall not require the operator to judge the precise volume or weight and temperature needed to make an accurate moisture determination. External grinding, weighing, and temperature measurement operations are not permitted.

6.5 Instrument warm up period.

When a meter is turned on it shall not display or record any usable values until the operating temperature necessary for accurate determination has been attained or the meter shall bear a conspicuous statement adjacent to the indication stating that the meter shall be turned on for a time period specified by the manufacturer prior to use. Additionally, the average warm-up time may be indicated on the display or stated clearly and permanently on the housing adjacent to the indication.

6.6 Digital display and recording elements.

Meters shall be equipped with a digital indicating element.

The minimum height for the digits used to display moisture content shall be 10 mm.

Moisture content results shall be displayed as percent moisture, wet basis and if recorded, recorded as percent moisture content, wet basis. Subdivisions of this unit shall be in terms of decimal subdivisions (not fractions).

The display shall permit moisture value determination to 0.1 % resolution. The 0.1 % resolution is for commercial transactions; at the national responsible body's option the display and printout shall also permit 0.01 % resolution for type evaluation only.

National responsible bodies may require meters to be equipped with an internal recording element and/or a communication interface that permits interfacing with an external recording element. Correspondence between displayed information and remote recording element shall be verified.

The measurement records shall include at least the date, grain type, grain moisture results, and calibration version identification.

A digital indicating element shall not display, and a recording element shall not record, any moisture content values before the end of the measurement cycle.
Especially on multi-constituent meters (e.g., meters which also measure grain protein), provision shall be made to ensure an unambiguous relation between the displayed/recorded values and the constituents.

If data storage is required, the measurement data must be stored automatically when the measurement is concluded. The storage device must have sufficient permanency to ensure that the data are not corrupted under normal storage conditions. There shall be sufficient memory storage for any particular application.

When external stored data are considered as legally relevant, the following additional requirements have to be fulfilled:

- The data shall be protected by software means to guarantee the authenticity and integrity. The software that displays or further processes the measurement values and accompanying data shall check the time of measurement, authenticity, and integrity of the data after having read them from the insecure storage or after having received them from an insecure transmission channel. If an irregularity is detected, the data shall be discarded or marked unusable. For instruments using an open network, a higher severity level according to D 31 is required.
  Note: Software modules that prepare data for storing or sending, or that check data after reading or receiving belong to the legally relevant software part.
- The measurement shall not be inadmissibly influenced by a transmission delay
- If a Transmission interruption occurs because the network services become unavailable, no measurement data shall be lost. The measurement process should be stopped to avoid the loss of measurement data.

Note: General national regulations (for instance for tax purposes) may contain strict limitations for the deletion of stored measurement data.

6.7 Meter construction

Moisture meters and all accessory equipment shall be of such materials, design, and construction as to make it probable that, under normal service conditions (a) accuracy will be maintained, (b) operating parts will continue to function as intended, and (c) adjustments will remain reasonably permanent. Undue stresses, deflections, or distortions of parts shall not occur to the extent that accuracy or permanence is detrimentally affected.

The housing of moisture meters shall be constructed so that the main components of the instrument are protected from dust and moisture.

The measured quantity may be a quantity or a function of various quantities such as: mass, volume, temperature, electrical resistance, spectral data or capacitance.

When the principle of measurement of a moisture meter requires the use of a grinding mill, the mill shall be considered an integral part of the moisture determining process. Its design, method of use and integration with the moisture meter shall be appropriate and complete for the measurement.

6.8 Marking

6.8.1 General marking

Each moisture meter shall be clearly and permanently marked for the purposes of identification with the following information:

(a) manufacturer's name or trademark,
(b) designation of instrument type (model number) and serial number, given by the

manufacturer

(c) type approval mark, if instrument is approved.

6.8.2 Location of marking

The required information shall be so located that it is readily observable without the necessity of the disassembling parts, requiring the use of any means separate from the device.

6.8.3 Marking operational controls, indications, and features

All operational controls, indications, and features indicating switches, lights displays and push buttons shall be clearly and definitely identified. Keys visible only to the operator need only be marked to the extent that a trained operator can understand the function of each key.

6.9 Operating ranges

A meter shall automatically and clearly indicate when the operating range of the meter has been exceeded by either an error indication, or blanking the display.

6.9.1 Moisture range of grain and seed

A meter shall not display or record any moisture content values when the moisture content of the grain sample is beyond the operating range of the device, unless the moisture representation includes a clear error indication (and recorded error message with the recorded representation).

6.9.2 Temperature Range

A meter shall not display or record any moisture content values and an appropriate error message must be displayed when its temperature range and/or temperature range of the grain and seed and/or the maximum allowable difference in the meter temperature and sample temperature are exceeded. If the moisture meter is not able to measure the sample temperature then the operating procedure shall be defined by national responsible bodies.

6.10 Provision for sealing and calibration security

Provision shall be made for applying a security seal in a manner that requires the security seal to be broken, or for using an audit trail, or other approved means of providing security, before any change that affects the metrological integrity of the device can be made to any mechanism.

Note: Zero-setting and test point adjustments are considered to affect metrological characteristics and must be sealed.

6.11 Manufacturers manual

The Manufacturer shall provide with each instrument, a manual that describes the installation, operation, and routine maintenance of the moisture meter and its accessories. In addition, the manual must include the following information:

(a) name and address of the manufacturer;

(b) the type or pattern of the meter with which it is intended to be used;

(c) date of issue;

(d) the kind or varieties of grain for which the meter is designed to be used;

(e) the limitations of use, including, but not confined to the moisture measurement range, grain or seed temperature, maximum allowable temperature difference between grain sample and meter, meter operating temperature range, voltage and frequency ranges, electromagnetic interferences and electromagnetic compatibility. In addition this manual shall be supplied to the owner/user of the instrument in the official language(s) of the countries where it is used or in a language accepted by the national responsible body.

6.12 Place of installation and environment

The place of installation and environment for the instrument must conform with manufacturers recommendations.

6.13 Visibility of the moisture meter and of the measurement operations

Moisture meters in service shall be so placed that all parties present have the possibility of seeing simultaneously all the measurement operations. The indicating or recording device should be seen at the same time, and all necessary steps shall be taken to eliminate any possibility of error or fraud.

6.14 Power Supply

A meter that uses alternating current must perform within applicable limits when tested in accordance with Section A.2.2.

6.15 Battery-operated instruments

Battery operated instruments shall not indicate or record values outside the applicable tolerance limits when battery power output is excessive or deficient.

6.15.1 Non-rechargeable batteries

Instruments powered by non-rechargeable batteries or by rechargeable batteries that cannot be (re)charged during the operation of the measuring instrument, shall comply with the following requirements:

(a) The instrument provided with new or fully charged batteries of the specified type shall comply with the metrological requirements;

(b) As soon as the battery voltage has dropped to a value specified by the manufacturer as the minimum value of voltage at which the instrument complies with metrological requirements, this shall be detected and acted upon by the instrument.

For these instruments, no special tests for disturbances associated with the "mains" power have to be carried out.

In the criteria for (categories of) instruments, a minimum period of time shall be stated during which the instrument shall function correctly without renewing or recharging the batteries and (in particular for continuous totalizing measuring equipment) provisions may be prescribed that prevent the loss of stored data.

6.15.2 Rechargeable auxiliary batteries
Instruments powered by rechargeable auxiliary batteries that are intended to be (re)charged during the operation of the measuring instrument shall both:
(a) Comply with the requirements of 6.15.1 with the mains power switched off; and
(b) Comply with the requirements for AC mains powered instruments with the mains power switched on.

6.15.3 Back-up batteries
Instruments powered by the mains power and provided with a back-up battery for data-storage only, shall comply with the requirements for AC mains powered instruments.

A minimum period of time shall be stated during which the relevant function of the instrument shall function properly without renewing or recharging the batteries.

The provisions of 6.15.1(b) and 6.15.2 do not apply for back-up batteries.

6.16 Level indicating means
A meter shall be equipped with a level indicator and leveling adjustment if its performance is changed by an amount greater than the applicable tolerance when the meter is moved from a level position to a position that is out of level in any upright direction up to 5%. The level indicating means shall be readable without removing any meter parts requiring a tool.

6.17 Software-controlled electronic devices and security

The requirements of OIML D 31 must be fulfilled. In general, for moisture meters the severity level I, examined with validation procedure A, is required. For moisture meters with an open network, the severity level II, examined with validation procedure B, is required.

Note: The severity levels describe different protection levels of the software, depending on the risk of fraud or on the level of conformity. The validation procedures define the level of examination for type approvals.

6.17.1 Specifications of the software requirements

For instruments and modules operated by software, the manufacturer shall describe or declare how the software is implemented within the instrument or module, i.e. if it is used in a fixed hardware and software environment (embedded) or on an universal computer system (implemented into the housing or external).

The legally relevant software shall fulfil the following requirements:

- the legally relevant software shall be clearly identifiable via an unique Software version and a checksum.
  In the normal operation mode of the instrument, the software version and the checksum shall be displayed or printed out on command or shall be displayed during the start up

procedure of the instrument.
- the conformity of the legally relevant software installed on the instruments in the market to the approved software shall be at level B (see D 31, 5.2.5)
- it shall be possible to display or print out on demand the current parameter settings
- when a fault is detected further measurements shall not be possible any more (see D 31, 5.1.4.1)
- if the software of the instrument is separated in a legally relevant part and non-relevant parts, the requirements of D 31, 5.2.1.2 have to be fulfilled.
- when using an open network, the higher severity level, achieved via cryptographic methods, is required (see D 31, 5.2.3
- For Instruments/ measuring systems using an universal computer (internal or external), the legally relevant software shall be operated only in the environment specified for its correct functioning. It may be necessary to fix the operating system strictly to a defined invariant configuration in order to secure the correct functioning of the legally relevant software.
- If the minimal or invariant configuration is not met, the legally relevant software shall prevent further measurements.
- For instruments which allow traced updates or for instruments with open networks, also a fixed legally relevant software is required.

The software identification shall be provided by the instrument and listed in the OIML Certificate.

6.17.2 Acceptable solutions for software identification

The software identification is provided in the normal operation mode by either:

- a clearly identified operation of a physical or soft key, button, or switch; or
- a continuously displayed version number or checksum, etc.

accompanied in both cases by clear instructions on how to check the actual software identification against the reference number (as listed in the OIML Certificate) marked on or displayed by the instrument.

6.17.3 Software documentation

In addition to the documentation required in 8.2, the manufacturer shall submit the following documentation.

1. description of the legally relevant software and how the requirements are met.
2. description of suitable system configuration and minimal required resources;
3. description of security means of the operating system (password, etc. if applicable);
4. description of the (software) sealing method(s);

5. overview of the system hardware, e.g. topology block diagram, type of computer(s),
6. type of network, etc. Where a hardware component is deemed legally relevant or where it
7. performs legally relevant functions, this should also be identified;
8. description of the accuracy of the algorithms (e.g. filtering of A/D conversion results,
9. price calculation, rounding algorithms, etc.);
10. description of the user interface, menus and dialogues;
11. description of the software identification which has to be clearly assigned to the legally relevant functions including the description of all encryption means (if any);
12. clear instructions on how to check the actual software identification against the reference number as listed in the type approval certificate. This reference may be additionally marked on or displayed by the instrument.
13. list of commands of each hardware interface of the measuring instrument / electronic
14. device / sub-assembly including a statement of completeness;
15. list of durability errors that are detected by the software and if necessary for understanding,
16. description of the detecting algorithms;
17. description of data sets stored or transmitted;
18. if fault detection is realized in the software, a list of faults that are detected and a description of the detecting algorithm; and a
19. operating manual.

6.17.4 Grain calibrations and integrity

Grain moisture meters measure the effect of moisture on certain electrical or optical properties of grain. So, as the grain crop changes the effect of moisture on these physical properties of the grain may change based on the crop year. As such, some national authorities update the grain calibrations based on grain data collected during the year. This data is used to adjust the grain calibrations due to the seasonal and crop year variations. This grain calibration data in many cases are downloaded to the instrument using an RS232 port. These are not considered software changes that would require a change to the software identification. Changes to the grain calibrations of the device shall be recorded in an audit trail or event logger.

6.17.4.1 Calibration Version

A meter must be capable of displaying calibration constants, a unique calibration name, or a unique calibration version number for use in verifying that the latest version of the calibration is being used to make moisture content determinations.

6.17.4.2 Calibration protection

If calibration constants are digitally stored in an electronically alterable form, the meter shall be designed to make automatic checks to detect unauthorized modification. An error message must be displayed if calibration constants have been electronically altered.

6.17.4.3 Calibration Transfer

The instrument hardware/software design and calibration procedures shall permit calibration development and the transfer of calibrations between instruments of like models without requiring user slope or bias adjustments.

[Note: Only the manufacturer or the manufacturer's designated service agency may make standardization adjustments on moisture meters. This does not preclude the possibility of the operator installing manufacturer-specified calibration constants under the instructions of the manufacturer or its designated service agency.] Standardization adjustments (not to be confused with grain calibrations) are those physical adjustments or software parameters which make meters of like type respond identically to the grain(s) being measured.]

6.17.5 Correctness of algorithms and functions

The measuring algorithms and functions of a measuring device shall be functionally correct.

The measurement result and any accompanying information shall be displayed, recorded and printed correctly.

It shall be possible to examine algorithms and functions either by metrological tests, software tests or software examination (as described in D31).

6.17.6 Software protection

6.17.6.1 Prevention misuse

A measuring instrument and especially the software, shall be constructed in such a way that possibilities for unintentional, accidental, or intential misuse are minimal.

6.17.6.2 Fraud Protection

For protection against fraudulent use, the following requirements have to be fulfilled.

- The legally relevant software shall be secured against unauthorized modification, loading, or changes by swapping the memory device. In addition to mechanical sealing, technical means may be necessary to secure measuring instruments having an operating system or an option to load software.

- Only clearly documented functions are allowed to be activated by the user interface, which shall be realized in such a way that it does not facilitate fraudulent use.
- Parameters that fix the legally relevant characteristics of the measuring instrument shall be secured against unauthorized modification. If necessary for the purpose of verification, the current parameter settings shall be able to be displayed or printed.

6.17.7 Fault Detection

Appropriate fault detection criteria (i.e. operating ranges) is included in the relevant sections of this recommendation.

PART 2: Metrological controls and performance tests

7 Practical instructions

7.1 Type approval grain samples

The grain samples should be natural; that is, the moisture should not be adjusted by soaking the sample in water or by spraying the sample with water or by extended exposure of the sample to high humidity air, or by any other method of moistening. Sufficient sample should be available to complete the tests, and satisfy the minimum allowable sample size requirements for the meter and to allow for reference testing.

7.2 Sample records

The sample records should include: the identification number assigned, the date received, source, grain type, moisture, and other pertinent information.

7.3 Sample handling

Upon receipt the integrity of the sample enclosure should be checked and the new enclosure used if necessary. Heat-sealed polyethylene bags (e.g. 0.15 mm thickness) are commonly used as enclosures. Most grain samples are to be stored at 2 °C to 8 °C prior to use, unless tested within 24 hours of receipt. Prior to testing, samples are removed from cold storage and equilibrated overnight to room temperature. Samples over 18 % moisture content are equilibrated to room temperature over a time period of at least 4 hours on the day of testing.

7.4 Sample cleaning

The sample must be clean. The condition of the sample (odor, appearance, damage, remaining foreign material, etc.) is recorded on the sample record. The sample is mixed.

7.5 Representative sample size

The sample must be divided into representative portions slightly in excess of the amounts needed for the meter plus reference method analysis.

8 Metrological controls

8.1 Units submitted for type test

Manufacturers shall provide the national responsible body with at least two instruments and an operating manual. A manufacturer may also provide data and other information that support a determination of whether the performance of the instrument meets requirements according to this Recommendation.

8.2 Documentation

The documentation submitted with the application for type approval shall include:

(a) description of its general principle of measurement;

(b) lists of the essential sub-assemblies, components (in particular electronics and other essential ones) with their essential characteristics;

(c) mechanical drawings;
(d) electric/electronic diagrams;
(e) installation requirements;
(f) security sealing plan;
(g) panel layout;
(h) Software documentation as described in 6.17.3
(i) test outputs, their use, and their relationships to the parameters being measured.
(j) operating instructions that shall be provided to the user, documents or other evidence that supports the assumption that the design and characteristics of the measuring instrument comply with the requirements of this Recommendation.
(k) a list of grains and moisture ranges to be approved on the instrument

8.3 Type approval

The national responsible body shall review the operating manual for its completeness and clarity of operating instructions and shall visually inspect the instrument in conjunction with a review of its specifications by the manufacturer to determine that the technical requirements in clause 6 are met. The national responsible body shall carry out the tests defined in Annex A to confirm that electronic moisture measuring instruments perform and function as intended in a specified environment and under specified conditions.

8.3.1 Accuracy, repeatability, and reproducibility tests

Due to the natural variability of grain and oil seeds, grain moisture meters shall be statistically tested for accuracy, repeatability, and reproducibility with natural moisture test samples for all approved grain types. The entire range of moistures will be tested at 2 % moisture intervals. These tests will be carried out under reference environmental conditions The two tests for accuracy are moisture error, i.e., $\bar{y}$, average of the difference between meter reading and reference method, and the Standard Deviation of this Difference, SDD, as defined in clause A.1.2. The standard deviation, SD, of the sample replicates is used as the measure of the repeatability of the instrument and reproducibility between submitted instruments is estimated by calculating the instrument's standard deviation of differences, SDD_I. Details of the necessary sampling and the mathematical analysis for $\bar{y}$, SDD, SD and SDD_I can be found in Annex A Section A.1.

8.3.2 Influence factors tests

During type evaluation, a moisture meter shall be tested for the following influence factors using the applicable reference conditions in Section 5.1. Unless otherwise specified, the national responsible body shall select a single well performing grain type and 2 % moisture interval for the basic instrument tests. Meter indicated moisture difference determinations shall be made for each influence factor according to details of the analysis contained in the test procedures in Annex A.

Influence Factors	Test Procedure Section (as appropriate, Severity levels are included in test procedures, Annex A)

Basic instrument tests	
Instrument stability	A.2.2
Instrument warm-up time	A.2.3
Power source variation: voltage* battery voltage* * whichever is appropriate	A.2.4
Instrument storage temperature	A.2.5
Instrument leveling	A.2.6
Instrument humidity sensitivity	A.2.7
Instrument temperature sensitivity	A.2.8
Sample temperature test	
Sample temperature sensitivity	A.3

A description of the performance tests for these influence factors are given in Annex A, test procedures.

8.3.3 Disturbance tests

When subjected individually to the disturbances specified in the immunity tests of IEC 61326 (latest revision)[8] and/or recommended disturbances in OIML D 11 the meter shall not exhibit a significant fault as defined in 3.15.

Disturbance test	Test Procedure Section (As appropriate, severity levels are included in test procedures, Annex A)
AC mains voltage dips, short interruptions and voltage variations	A.4.1 (OIML D11, Sub clause 13.4)
Bursts (Transients) on AC mains	A.4.2 (OIML D11, Sub clause 13.5)
Radiated radiofrequency, electromagnetic susceptibility	A.4.3 (OIML D11, Sub clause 12.1.1)
Conducted radiofrequency fields	A.4.4 (OIML D11, Sub clause 12.1.2)
Electrostatic discharges	A.4.5 (OIML D11, Sub clause 12.2)

8.3.4 Error under rated operating conditions

The type of measuring instrument is presumed to comply with the provisions specified in 5.1 to 5.9 of this Recommendation, if it passes the tests in Annex A, confirming that the error of the measuring instrument does not exceed the maximum permissible error on initial verification specified in 5.4.1 under the reference conditions in 5.1.

8.4 Test report

The test report on the grain moisture meter tests carried out at type approval shall contain, as a minimum, the items of information according to the format provided in Part 3: Report format for type evaluation, Annex B. A specific form may be developed according to national preference. The manufacturer shall be provided specific comments about any test failures.

9 Bibliography

At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and the users of this Document are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

The actual status of the Standards referred to can also be found on the Internet:
- IEC Publications: http://www.iec.ch/searchpub/cur_fut.htm
- ISO Publications: http://www.iso.org/iso/iso_catalogue.htm
- OIML Publications: http://www.oiml.org/publications/
  (with free download of PDF files).

In order to avoid any misunderstanding, it is highly recommended that all references to Standards in OIML Recommendations and International Documents be followed by the version referred to (generally the year or date).

Ref.	Standards and reference documents	Description
[1]	ISO/IEC Guide 99; OIML V 2-200 (2008) International Vocabulary of Metrology – Basic and General Concepts and Associated Terms (VIM: 2008)	An international agreement on terminology, prepared as a collaborative work of experts appointed by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML. This vocabulary covers subjects relating to measurement and includes information on the determination of physical constants and other fundamental properties of materials and substances. In practice, these publications are usually referred to as the "VIM".
[2]	OIML V1 (2012) International Vocabulary of Terms in Legal Metrology (VIML)	No abstract available
[3]	OIML D 11:2004 General requirements for electronic measuring instruments	Guidance for establishing appropriate metrological performance testing requirements for influence quantities that may affect the measuring instruments covered by International Recommendations
[4]	OIML D31: 2008 General requirements for software controlled measuring instruments	Specifies the general requirements applicable to software related functionality in measuring instruments and gives guidance for verifying the compliance of an instrument with these requirements.
[5]	ISO/DIS 7700-2: 20XX Check of the calibration of moisture meters in use - Part 2:moisture meters for oilseeds	Specifies a method of checking the performance of meters in service for measuring the moisture content of oilseeds.
[6]	IEC/TR 61000-2-1: 1990-05 Electromagnetic compatibility (EMC) Part 2	Provides information on the various types of disturbances that can be expected on public power

	Environment Section 1: Description of the environment-Electromagnetic environment for low-frequency conducted disturbances and signaling in public power supply systems	supply systems.
[7]	IEC 61000-2-2: 2002 Electromagnetic compatibility (EMC) Part 2-2: Environment- Compatibility levels for low-frequency conducted disturbances and signaling in public power supply systems	This standard is concerned with conducted disturbances in the frequency range from 0 kHz to 9 kHz, with an extension up to 148,5 kHz specifically for mains signalling systems.
[8]	IEC 61000-4-1: (2000-04) Basic Electromagnetic compatibility (EMC) Part 4-1: Testing and measurement techniques-Overview of IEC 61000-4 series	Provides EMC standards on testing and measurement techniques and to provide general recommendations concerning the choice of relevant tests.
[9]	IEC 61326-1: 2005 Electrical equipment for measurement, control and laboratory use-EMC requirements.	Specifies minimum requirements for immunity and emissions regarding electromagnetic compatibility (EMC) for electrical equipment, operating from a supply of less than 1000 V a.c. or 1500 V d.c.,
[10]	National Conference on Weights and Measures, Publication 14, Grain moisture meters and Near infrared grain analyzers: 2006	U.S. type evaluation procedures for grain moisture meters and protein, starch and oil analyzers
[11]	An Investigation of the Nature of the Radio frequency Dielectric Response in cereal Grains and oilseeds with Engineering Implications for Grain Moisture Meters, A Dissertation in Physics and Engineering, David B. Funk, Ph.D. H.C: 2001	A dissertation in physics and engineering.
[12]	OIML D3: 1979 Legal qualification of measuring instruments	This document deals with official actions which may be undertaken by a State for the purpose of attributing a « legal » quality to measuring instruments. Every effort has been made to consider all possible methods involved in these official actions.
[14]	ISO 650: 1977 Relative density 60/60 degrees F hydrometers for general purposes	The requirements for five series of glass hydrometers concern reference levels for adjustment and reading, materials, dimensions, form, scale and handling.
[15]	OIML R76-1:	This Recommendation specifies the metrological and technical requirements for non-automatic weighing instruments that are subject to official metrological control. It is intended to provide standardized requirements and testing procedures to evaluate the metrological and technical characteristics in a uniform and traceable way.
[17]	ISO 7700-1: 2008	Food products – checking the performance of moisture meters in use part 1: moisture meters for cereals
[18]	IEC 61000-4-6 (2003-05) with amendment 1 (2004-10) Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques Section 6: Immunity to conducted disturbances, induced by	Relates to the conducted immunity requirements of electrical and electronic equipment to electromagnetic disturbances coming from intended radio-frequency (RF) transmitters in the frequency range 9 kHz up to 80 MHz. Equipment not having at least one conducting cable

	radio-frequency fields	(such as mains supply, signal line or earth connection), which can couple the equipment to the disturbing RF fields is excluded. This standard does not intend to specify the tests to be applied to particular apparatus or systems. Its main aim is to give a general basic reference to all concerned product committees of the IEC. The product committees (or users and manufacturers of equipment) remain responsible for the appropriate choice of the test and the severity level to be applied to their equipment.
[19]	IEC 61000-4-2 Edition 2.0 (2008-12) Basic EMC Publication Electromagnetic compatibility (EMC) Part 4-2 Testing and measurement techniques - Electrostatic discharge immunity test.	This publication is based on IEC 60801-2 (second edition: 1991). It relates to the immunity requirements and test methods for electrical and electronic equipment subjected to static electricity discharges, from operators directly, and to adjacent objects. It additionally defines ranges of test levels which relate to different environmental and installation conditions and establishes test procedures. The object of this standard is to establish a common and reproducible basis for evaluating the performance of electrical and electronic equipment when subjected to electrostatic discharges. In addition, it includes electrostatic discharges which may occur from personnel to objects near vital equipment
	OIML R XX July2012 CD3 Protein measuring instruments for cereal grains and oil seeds	TC17/SC8
	IEC 61000-4-11 (2004-03) Electromagnetic compatibility (EMC) - Part 4-11: Testing and measuring techniques - Voltage dips, short interruptions and voltage variations immunity tests	Defines the immunity test methods and range of preferred test levels for electrical and electronic equipment connected to low-voltage power supply networks for voltage dips, short interruptions, and voltage variations. This standard applies to electrical and electronic equipment having a rated input current not exceeding 16 A per phase, for connection to 50 Hz or 60 Hz AC networks. It does not apply to electrical and electronic equipment for connection to 400 Hz AC networks. Tests for these networks will be covered by future IEC standards. The object of this standard is to establish a common reference for evaluating the immunity of electrical and electronic equipment when subjected to voltage dips, short interruptions and voltage variations. It has the status of a Basic EMC Publication in accordance with IEC Guide 107.
	IEC 61000-6-1 (1997-07) Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 1: Immunity for residential, commercial and light-industrial environments	Defines the immunity test requirements in relation to continuous and transient, conducted and radiated disturbances, including electrostatic discharges, for electrical and electronic apparatus intended for use in residential, commercial and light-industrial environment, and for which no dedicated product or product-family standard exists. Immunity

		requirements in the frequency range 0 kHz to 400 GHz are covered and are specified for each port considered. This standard applies to apparatus intended to be directly connected to a low voltage public mains network or connected to a dedicated DC source which is intended to interface between the apparatus and the low-voltage public mains network.
	IEC 61000-6-2 (1999-01) Electromagnetic compatibility (EMC) - Part 6-2: Generic standards – Immunity for industrial environments	Applies to electrical and electronic apparatus intended for use in industrial environments, for which no dedicated product or product-family immunity standard exists. Immunity requirements in the frequency range 0 Hz to 400 GHz are covered, in relation to continuous and transient, conducted and radiated disturbances, including electrostatic discharges. Test requirements are specified for each port considered. Apparatus intended to be used in industrial locations are characterized by the existence of one or more of the following: – a power network exists powered by a high or medium voltage power transformer dedicated for the supply of an installation feeding a manufacturing or similar plant; – industrial, scientific and medical (ISM) apparatus; – heavy inductive or capacitive loads are frequently switched; and – currents and associated magnetic fields are high.
	IEC 61000-4-4 (2004-07) Electromagnetic compatibility (EMC) Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	Establishes a common and reproducible reference for evaluating the immunity of electrical and electronic equipment when subjected to electrical fast transient/burst on supply, signal, control and earth ports.
	IEC 61000-4-3 consolidated Edition 2.1 (2002-09) with amendment 1 (2002-08) Electromagnetic compatibility (EMC) Part 4: Testing and measurement Techniques Section 3: Radiated, radio-frequency, electromagnetic field immunity test	Applies to the immunity of electrical and electronic equipment to radiated electromagnetic energy. Establishes test levels and the required test procedures. Establishes a common reference for evaluating the performance of electrical and electronic equipment when subjected to radio-frequency electromagnetic fields.

ANNEX A. TEST PROCEDURES.

General
This annex defines the program of performance tests intended to ensure that electronic moisture measuring instruments perform and function as intended in a specified environment and under specified conditions. Each test indicates, where appropriate, the reference conditions under which the intrinsic error is determined.

When the effect of one influence quantity or disturbance is being evaluated, all other influence quantities and disturbances are to be held relatively constant, at values close to reference conditions.

The instrument shall be stabilized according to the manufacturer's specifications. If the manufacturer does not recommend a warm-up time, assume that accurate results will be provided immediately after the instrument is turned on.

For testing, the display should allow resolution to 0.01%.

Specification of grain moisture samples used in type evaluation testing:
(a) The samples shall be naturally occurring grain. Sample sets should be as homogeneous as possible.
(b) The test samples of grain shall be clean, sound and fit for purpose.

A.1 Accuracy, repeatability, and reproducibility

A.1.1 Sample Selection
Testing laboratory shall chose well performing moisture-stable grain samples comprising three adjacent 2 % moisture intervals within a minimum range of 6% moisture. (e.g. 10 % to 12 %, 12 % to 14 %, 14 % to 16 %) for conducting type approval testing. Grain and seed types chosen should be economically important and significantly different in their physical structure to adequately test the instrumentation. The national authority will be responsible for determining the variable grains used for conducting testing. Moisture intervals selected should bracket commercially important moisture levels for the grain type. For uniformity of application, each 2 % moisture intervals should begin and end with an even number. The maximum value calculated for a given 2 % moisture interval (i.e 10 % to 12 %, 12 % to 14 %, 14 % to 16 %) shall be used when calculating the MPEs.

A sample set for accuracy, repeatability and reproducibility shall consist of a minimum of 30 samples with ten samples selected from each 2 % moisture interval. Grain sample sets will be prescreened for moisture homogeneity by comparing an approved moisture meter result to the result of determinations using the reference moisture method. No sample set will be used where the standard deviation of the differences (*SDD*) between the approved moisture meter and reference method for the samples in any of the 2 % moisture intervals exceed the MPEs defined in column 2 of table 5.4.1 minus 0.1.

A.1.2 Accuracy test.

The accuracy test consists of two test: error determination and SDD. Accuracy acceptance requirements for both are defined in column 2 of table 5.4.1 for the appropriate 2 % moisture intervals. Reference method portions shall be cut off from each sample and submitted to the reference procedure before and after the above tests and the results recorded. The two tests for accuracy are moisture error, $\overline{y}$, (meter reading versus reference method) and the Standard Deviation of the Differences, SDD, between the meter and the reference method for each of the 2 % moisture intervals. Each Instrument will be individually tested. The equations for $\overline{y}$ and SDD follow:

$$\overline{y} = \frac{\sum_{i=1}^{n}(\overline{x_i} - r_i)}{n} \qquad SDD = \sqrt{\frac{\sum_{i=1}^{n}\left(y_i - \overline{y}\right)^2}{n-1}}$$

where,

$\overline{y}$ = average over all y_i

y_i = $\overline{x_i} - r_i$

$\overline{x_i}$ = average meter moisture value for sample i (3 replicates)

r_i = reference moisture value for sample i

n = number of samples per 2 % moisture interval (n = 10)

The manufacturer may adjust the calibration bias to compensate for differences from the type evaluation laboratory in reference methods or sample sets.

A.1.3 Repeatability.

The repeatability of a meter is defined as the Standard Deviation, SD, of the three replicates. It shall be calculated for each sample in a 2 % moisture interval and pooled across samples. Each instrument is to be tested individually. The equation used to calculate SD is:

$$SD = \sqrt{\frac{\sum_{i=1}^{n}\sum_{j=1}^{3}\left(x_{ij} - \overline{x_i}\right)^2}{2n}}$$

where,

x_{ij} = meter moisture value for sample i and replicate j,

$\overline{x_i}$ = average of the three moisture values for sample i,

n = number of samples per 2 % moisture interval (n = 10)

Repeatability requirements for SD are defined in column 4 of table 5.4.1 for the appropriate 2 % moisture interval.

A.1.4 Reproducibility.

Reproducibility between submitted instruments is estimated by calculating the standard deviation of differences, SDD_I over the 6 % moisture range. The equation used to calculate instrument reproducibility is:

$$SDD_I = \sqrt{\frac{\sum_{i=1}^{n}\left(d_i - \bar{d}\right)^2}{n-1}}$$

where,

$d_i = \bar{x}_i^{(1)} - \bar{x}_i^{(2)}$

$\bar{x}_i^{(1)} =$ mean of three replicates for sample i on instrument 1

$\bar{x}_i^{(2)} =$ mean of three replicates for sample i on instrument 2

$\bar{d} =$ mean of the d_i

$n =$ number of samples in all 2 % moisture ranges

Reproducibility requirements are defined in column 5 of table 5.4.1 for the 6 % moisture range.

A.2 Basic instrument tests - influence factors

A.2.1 Sample selection

Unless otherwise specified the following tests will be performed using a single, stable moisture sample. Throughout the influence factor testing, portions of the grain samples shall be tested to determine that the moisture content is appropriate for the test and that the sample was stable throughout the test. As an example a reference moisture method or master instrument can be used. In any case, the method used to assess the sample stability shall be indicated in the test report.

A.2.2 Instrument stability

Three samples, one from each of the three 2 % moisture interval samples of a single grain type (e.g. 10 % to 12 %, 12 % to 14 %, 14 % to 16 %)
Number of repetitions = 5

Minimum time period for assessing instrument stability shall be four weeks. Each of the 3 samples will be measured 5 times through all of the meters submitted for type approval, prior to running any other type evaluation tests. The mean moisture content obtained for the 15 observations (3 samples x 5 replicates) will be recorded. The 3 samples shall be stored and retested once all other type evaluation testing has been completed. The maximum permitted difference between the means of the two tests is defined in column 3 of table 5.4.1.

A.2.3 Instrument warm-up time

Number of repetitions = 5

The following test procedures will be used to check warm-up times recommended by the manufacturer. If the manufacturer does not recommend a warm-up time, assume that turning the instrument power on will immediately provide accurate results.

Test Sequence:
(1) instrument powered off and stabilized at reference conditions (overnight).
(2) instrument powered on, test after waiting for the specified warm-up time
(3) test after waiting one hour or twice the manufacturer recommended warm-up time, whichever is greater

For an instrument where no warm-up time is specified, the sample would be tested immediately upon the instrument being powered on and then again after 1 hour. The maximum permitted difference between the means of the two tests is defined in column 3 of table 5.4.1.

A.2.4 Instrument power supply

A.2.4.1 Main voltage variation

Number of repetitions = 10
Applicable standards: IEC/TR3 61000-2-1, IEC 61000-2-2, IEC 61000-4-1
Voltage variation nominal voltage (U_{nom}) U_{nom} - 15 %, U_{nom} + 10 %

Voltage will be varied to the above stated levels. Voltage settings shall be determined and recorded to ± 0.1 V. The difference between the mean moisture indication at the nominal voltage and mean moisture indication at the tested extremes of voltage shall be evaluated.

The maximum permitted difference between the mean moisture meter value at nominal voltage and the mean value determined at the high and low voltage test points is defined in column 3 of table 5.4.1. The maximum allowable standard deviation of 10 repeat measurements at any of the voltage levels is 0.10 %. For battery powered devices the SD for 10 repeat measurements for a nominal battery charge is 0.10%.

After each change in the voltage, allow the meter to stabilize for 30 minutes before testing.

A.2.4.2 Low voltage of internal battery (not connected to the mains power)

The test method is variation in supply voltage. The objective of this test is to verify compliance with the provisions in 5.4.1 under conditions of low battery voltage.

The test procedure consists of exposure to the specified condition of the battery(s) for a period sufficient for achieving temperature stability and for performing the required measurements. If an alternative power source (standard power supply with sufficient current capacity) is used in bench testing to simulate the battery, it is important that the internal impedance of the specified type of battery also be simulated. The maximum internal impedance of the battery is to be specified by the manufacturer of the instrument.

The test sequence follows:

Stabilize the power supply at a voltage within the defined limits and apply the measurement and/or loading condition. Record the following data:

a) Date and time
b) Temperature
c) Power supply voltage
d) Functional mode
e) Measurements and/or loading condition
f) Indications (as applicable)
g) Errors
h) Functional performance

Reduce the power voltage to the EUT until the equipment clearly ceases to function properly according to the specifications and metrological requirements, and note the following data:
i) Power supply voltage
j) Indications
k) Errors
l) Other relevant responses of the instrument

The severity for this test is level 1. At level 1 the lower limit of the voltage is the lowest voltage at which the EUT functions properly according to the specifications and the number of cycles is at least one test cycle for each functional mode.

A.2.5 Instrument storage temperature.
Number of repetitions = 10

The purpose of this is to simulate extreme shipping conditions. National authorities may specify different temperature limits. A single sample is analyzed (*n*=10) at reference conditions (5.1) prior to temperature cycling. The instrument is then powered down and placed in the environmental chamber. The chamber temperature is then increased to 55 °C over a 1-hour period and maintained at that temperature for 3 hours. Chamber temperature is then decreased to -20 °C over a 1-hour period and maintained at that temperature for 3 hours. Repeat the temperature cycle. Instrument is equilibrated at reference conditions (5.1) for at least 12 hours unpowered. The instrument is turned on for the specified warm-up period and the test sample analyzed a second time (*n*=10).
The mean of each replicate measurement is to be determined before and after temperature cycling. The maximum allowable difference in the mean values due to temperature cycling is defined in column 3 of table 5.4.1.

A.2.6 Instrument Leveling

A.2.6.1 Instruments without level indicators
Number of repetitions = 5

Reference tilt condition: instrument leveled to 0.1°

Degree of tilt: 5% front to back and left to right (minimum of 2 orientations of tilt)
The test procedure is to measure the single sample with the instrument mounted on a level surface (reference alignment); then in each of the two orientations of tilt front-to-back and left to right, at a tilt of 5%; returning to the reference alignment for the final test. Reference method portions shall be cut out from the bulk sample and submitted to the reference procedure before and after the instrument level tests and the results recorded.

The mean of each replicate measurement is to be determined for each orientation. The maximum allowable difference in the mean values of each tilt orientation from the mean of the two reference orientations is defined in column 3 of table 5.4.1.

A.2.6.2 Instruments with level indicators
Meters equipped with leveling indicators will be tested at the indicated limits of the level indicator (front to back and left to right) rather than the specified tilt in A.2.6.1. Orientations similar to those in A.2.6.1 shall be applied with the same performance requirements.

A.2.7 Humidity

Number of repetitions = 10
Instruments (power on) shall be placed in an environmental chamber at 22 °C and a relative humidity of 20 % for 16 hours. Samples shall be stored sealed at reference conditions. After equilibration the sample will then be analyzed in the chamber. The relative humidity will be raised to 90 % (22 °C) and, after the instrument has equilibrated at this humidity for at least 16 hours, the sample will again be analyzed.

The mean of each replicate measurement is to be determined for each humidity level. The maximum allowable difference in the mean values between the two humidity levels is defined in column 3 of table 5.4.1.

A.2.8 Instrument Temperature Sensitivity (Converting to heat test and cold test).

One grain type
Three samples, one from each of the three 2 % moisture intervals of a single grain type (e.g. 10 % to 12 %, 12 % to 14 %, 14 % to 16 %)

Instruments are to be tested in an environment chamber at:
(1). reference temperature, T_R, (5.1), 65 % RH
(2). the lower operating temperature (T_1), 65 % RH
(3). the upper operating temperature (T_2), constant humidity ratio of 0.011 kg of water per kg of dry air. Manufacturer is to declare T_1 and T_2, as the instruments operating range, if the operating range is not declared then the minimum operating temperature range from 10 ºC to 30 ºC will apply.

Instrument temperature sensitivity tests will be run using three moisture level samples. Each sample will be cut into 3 portions for testing at T_R, at T_1, and at T_2. Instruments will remain in the chamber throughout cycling to the appropriate temperatures; the sample will be placed in the test chamber to the test temperature for at least 4 hours in a covered moisture inert container before instrument moisture measurements. Instruments shall be equilibrated to the new environmental conditions at least four hours prior to sample testing. The mean of each replicate measurement is to be determined for each temperature level. The maximum allowable difference in the mean values between T_R, and T_1 and T_R, at T_2 is 0.8 x the value in column 2 of table 5.4.1.

Note: To facilitate testing of instrument temperature sensitivity, manufacturers shall provide a means of disabling the instrument feature for suppressing the display of moisture results when temperature ranges are exceeded. (Note: National authorities may address these requirements procedurally).

A.3 Sample temperature sensitivity - influence factor test:

Three grain types
Three 2 % moisture interval samples: (e.g. 10 % to 12 %, 12 % to 14 %, 14 % to 16 %)
Number of Samples: (3 grain types, 3 moisture levels, duplicate samples at each moisture level)
Number of repetitions = 3

Instruments temperature: at reference conditions (5.1), reference temperature (T_{ref})
Grain or seed temperatures: reference temperature (T_{ref}), manufacturer declared $T_{ref} \pm \Delta T$ or minimum ΔT of ± 10 °C in case of no separate specification.

Additional testing is required to verify that accurate results are provided when the sample and instrument are at different temperatures. This will be referred to as the sample temperature sensitivity test. The purpose of this test is to verify that the instrument provides accurate results when th*ere is a* difference in temperature between the sample and the instrument. The sample temperature sensitivity test will be conducted using the three grain or seed types comprising three 2 % moisture intervals. For practical reasons due to ability of accurately determining the reference value of elevated temperature grain samples, the maximum sample temperature for type approval testing shall be 45 °C.

The Grain and seed test temperature shall be per the manufacturer's specification or if there is no separate specification, the minimum temperature difference requirement shall be ± 10 °C from reference temperature. Tests will be conducted with the instrument at reference temperature (T_{ref} , see 5.1) and the sample temperature varying from $T_{ref} - \Delta T_C$ to $T_{ref} + \Delta T_H$, where T_{ref} is the : reference temperature. T_{ref}. The manufacturer specified sample temperature for the sample above the instrument temperature is represented as $T_{ref} + \Delta T_H$ and below as $T_{ref} - \Delta T_C$. The two temperature differences need not be equal. In no case will $T_{ref} + \Delta T_H$ be allowed to exceed 45 °C for the test.

Three moisture level analyses will be made for each grain sample at each of the three test temperatures. The means for the 18 observations (2 samples x 3 moisture intervals x 3 replicates) of each grain or seed type shall be determined. The maximum permitted difference at the sample temperature extreme from moisture levels measured at reference sample temperature is 2.25 x column 3 of table 5.4.1. for grain types in table 5.4.2 of Row I, otherwise it is 2 x column 3 of table 5.4.1. for grain types in table 5.4.2 of Row II.

A.4 Additional test for electronic instruments - disturbance tests

The tests, which are specific to electronic instruments, as described in this Section, are test from the International Electrotechnical Commission (IEC) and OIML International Document D 11.

References to the IEC publications have been made in each section as appropriate and publication dates for these documents are included in Section 9, Bibliography, of this Recommendation. When conducting these tests for electronic instruments, the test should be conducted on the basis of the most recent versions valid at the time of testing. Note in the test report the standard and version date used for the test.

A.4.1 AC mains voltage dips, short interruptions and voltage variations

Standards	IEC 61000-4-11 [18], IEC 61000-6-1 [19], IEC 61000-6-2 [20]
Test method	Short-time reductions in mains voltage
Sample	One sample from a single grain type Consecutive measurements per sample at each condition: 10
Test procedure in brief	Over four tests, the EUT shall be subjected to voltage reductions and interruptions of varying intensity and duration. A test generator suitable to reduce for a defined period of time the amplitude of the AC mains voltage is used. The performance of the test generator shall be verified before connecting to the EUT. The mains voltage interruptions and reductions shall be repeated with a time interval less than the time required for a single measurement so that at least one voltage interruption occurs per measurement. At least 10 cycles are necessary for each test to enable the required number of measurements. Record the following prior and during each test: a) *moisture* measurements; b) indications and errors; and c) functional performance.
Test severity	Test a) U_{nom} to zero for a duration equal to half a cycle of frequency Test b) U_{nom} to zero for a duration equal to one cycle of frequency Test c) U_{nom} to 70% reduction for a duration equal to 25/30* cycles of

	frequency Test d) U_{nom} to zero for a duration equal to 250/300* cycles of frequency
Notes	*Values are for 50 Hz and 60 Hz respectively
Requirements	All operational functions shall operate as designed (e.g. indicators). The effect of the disturbance on P_{MB} measurements shall not exceed a significant fault or the instrument shall detect and react to the fault

A.4.2 Bursts (Transients) on AC Mains

Standards	IEC 61000-4-1 [17], IEC 61000-4-4 [21]
Test method	Electrical bursts
Sample	Sample described in clause 7.3.3. Consecutive measurements per sample at each condition: 10
Test procedure in brief	The test consists of subjecting the EUT to bursts of double exponential Wave form transient voltages. All bursts shall be applied during the same measurement in symmetrical mode and asymmetrical mode. The characteristics of the burst generator shall be verified before connecting the EUT. The duration of the test shall not be less than 1 min for each amplitude and polarity. The injection network on the mains shall contain blocking filters to prevent the burst energy being dissipated in the mains. Record the following prior to test and during the application of bursts: a) Moisture measurements; b) indications and errors; and c) functional performance.
Test severity	Amplitude (peak value): 1 kV Repetition rate: 5 kHz
Number of test cycles	At least 10 positive and 10 negative randomly phased bursts shall be applied at 1000 V. The bursts are applied during all the time necessary to perform a measurement. At least 10 measurements shall be made with the bursts applied.
Requirements	All operational functions shall operate as designed (e.g. indicators). The effect of the disturbance on P_{MB} measurements shall not exceed a significant fault or the instrument shall detect and react to the fault (see clauses 2.1.18 and 4.8).

A.4.3 Radiated, radio-frequency, electromagnetic susceptibility

Standards	IEC 61000-4-3 [22]
Test method	Radiated electromagnetic fields
Sample	Sample described in clause 7.3.3. Consecutive measurements per sample at each setting: as many as possible over the sweep across the frequency range.
Test procedure in brief	The test procedure involves the exposure of the EUT to electromagnetic field strength as specified by the severity level and field uniformity as defined by the referred standard. The specified field strength shall be established prior to the actual testing (without EUT in the field). The field shall be generated in two orthogonal polarizations and the frequency range shall be scanned slowly. If antennas with circular polarization (i.e. log-spiral or helical antennas) are used to generate the electromagnetic field, a change in the position of the antennas is not required. When the test is carried out in a shielded enclosure to comply with international laws prohibiting interference on radio communications, care needs to be taken to handle reflections from the walls. The frequency ranges to be considered are swept with the modulated signal, pausing to adjust the RF signal level or to switch oscillators and antennas as necessary. Where the frequency range is swept incrementally, the step size shall not exceed 1% of the preceding frequency value. The dwell time of the amplitude modulated carrier at each frequency shall not be less than the time necessary for the EUT to be exercised and to respond, but shall in no case be less than 0.5 s. The sensitive frequencies (e.g. clock frequencies) shall be analyzed separately. Record the following prior to test and then with radiated EM fields: a) Moisture measurements; b) indications and errors; and c) functional performance.
Test severity	EM frequency range: 26 MHz– 2 GHz Field strength: Radiated 10 V/m

	Modulation: 80 % AM, 1 kHz sine wave
Requirements	All operational functions shall operate as designed (e.g. indicators). The effect of the disturbance on P_{MB} measurements shall not exceed a significant fault or the instrument shall detect and react to the fault (see clauses 2.1.18 and 4.8).
Notes	The EM field can be generated in different facilities, however the use of which is limited by the dimensions of the EUT and the frequency range of the facility: a) the strip line is used at low frequencies (below 30MHz or in some cases 150MHz) for small EUT; b) the long wire is used at low frequencies (below 30 MHz) for larger EUT; c) dipole antennas or antennas with circular polarisation placed at least 1 m from the EUT are used at high frequencies.

A.4.4 Conducted radio-frequency fields

Standards	IEC 61000-4-6 [23]
Test method	Conducted electromagnetic fields
Sample	Sample described in clause 7.3.3. Consecutive measurements per sample at each setting: as many as possible over the sweep across the frequency range.
Test procedure in brief	The test procedure involves the use of radio frequency EM current, simulating the influence of EM fields coupled or injected into the power ports and I/O ports of the EUT using coupling/decoupling devices as defined in the referred standard. The performance of the test equipment consisting of an RF generator, coupling devices, attenuators, etc. shall be verified. Record the following prior to test and then with conducted EM fields: a) *Moisture* measurements; b) indications and errors; and c) functional performance.
Test severity	EM frequency range: 0.15 – 80* MHz *For the frequency range 26-80 MHz, the testing laboratory may carry out

	the test according to clause 8.4.3. However, in case of dispute, the result from the test according to clause 8.4.4 shall prevail. RF amplitude (50 Ω): 10 V (e.m.f) Modulation: 80 % AM, 1 kHz sine wave
Requirements	All operational functions shall operate as designed (e.g. indicators). The effect of the disturbance on the P_{MB} measurement shall not exceed a significant fault or the instrument shall detect and react to the fault (see clauses 2.1.18 and 4.8).

A.4.5 Electrostatic discharge

Standards	IEC 61000-4-2 [24]
Test method	Electrostatic discharge (ESD)
Sample	Sample described in clause 7.3.3. Consecutive measurements per sample at each condition: 10
Test procedure in brief	A capacitor of 150PF is charged by a suitable d.c. voltage source. The capacitor is then discharged through the EUT by connecting one terminal to ground (chassis) and the other via 330 Ω to surfaces which are normally accessible to the operator. The test includes the paint penetration method, if appropriate. For direct discharges, the air discharge shall be used where the contact discharge method cannot be applied. Before starting the tests, the performance of the ESD generator shall be verified. For EUT not equipped with a ground terminal, the EUT shall be fully discharged between discharges. Direct application: In the contact discharge mode to be carried out on conductive surfaces, the electrode shall be in contact with the EUT. In the air discharge mode on insulated surfaces, the electrode is approached to the EUT and the discharge occurs by spark. Indirect application:

	The discharges are applied in the contact mode to coupling planes mounted in the vicinity of the EUT. Record the following prior to test and then during application of ESDs: a) *Moisture* measurements; b) indications and errors; and c) functional performance.
Test severity	Air discharge voltage: 2,4,6, 8 kV Contact discharge voltage: 2, 4, and 6 kV
Number of test cycles	At least one direct discharge and one indirect discharge shall be applied during the one measurement. At least 10 deliveries shall be made with the discharges applied. The time interval between successive discharges shall be at least 10 seconds.
Requirements	All operational functions shall operate as designed (e.g. indicators). The effect of the disturbance on the P_{MB} measurement shall not exceed a significant fault or the instrument shall detect and react to the fault (see

PART 3: Report format for type evaluation

Annex B. Test report format for type evaluation of grain moisture meters for cereal grain and oil seeds

B. 1 Introduction

Implementation of this Test Report Format is informative with regard to the implementation of OIML Recommendation R 59 in national regulations; however, its implementation is mandatory within the framework of the OIML Certificate System for Measuring Instruments.

Note concerning the references: All references are to OIML R 59 2013, in the text of this Test Report Format referred to as "R 59".

This Test Report Format applies for any kind of instrument for measuring cereal grain and oilseed moisture (independent of its technology). It presents a standardized format for the results of the various tests and examinations, described in Annex A of R 59(2009), to which a type of an instrument for measuring cereal grain and oilseed moisture shall be submitted with a view to its approval based on this OIML Recommendation.

It is recommended that all metrology services or laboratories evaluating and/or testing types of instruments for measuring cereal grain and oilseed moisture according to OIML R 59, or to national or regional regulations based on R 59, use this Test Report Format, directly or after translation into a language other than English or French. In case of a translation, it is highly recommended to leave the structure and the numbers of the clauses unchanged: in this case most of the contents is also understandable for those who can not read the language of the translation. The user is free to change the length of the cells (for instance “Remarks”) as required is a specific case.

In the practical application of the Test Report Format, it is not necessary to include Section 1, 2, and 3 of Annex B. They can be replaced by a cover page by the Issuing Authority and/or in accordance with national custom or legislation. So only Sections xxxxx shall be included.

It is also recommended that this Test Report Format in English or in French (or in both languages) be transmitted by the country performing the tests to the relevant authorities of another country, when requested for issuing a national or regional type-approval.

B. 2 Applicability of this Report Format

In the framework of the *OIML Certificate System for Measuring Instruments*, and the OIML *Mutual Acceptance Arrangement* (MAA) applicable to instruments for measuring cereal grain and oilseed moisture in conformity with R 59, use of this report format is mandatory, in French and/or in English with translation into the national languages of the countries issuing such certificates, if appropriate.

B. 3 Guidance for the application of this Test Report Format

The results of the tests" shall be recorded according to the following example:

Action	Passed	Failed
when the instrument has passed the test:	X	
when the instrument has failed the test:		X
when the test is not applicable:	NA	NA
Not able to conduct the test	⦸	⦸

B. 4 Applicant information, responsible authority and other testing laboratories

Applicant

Company Name:

____

Address:

____

City: ____________________________State: ______________Zip Code: __________

Country: ________________ Representative or Contact:___________________________

Telephone (if applicable, include extension): _________________ Fax: _________________

Email:___________________________Web site: __________________________________

Responsible laboratory authority for OIML report:
Name: ____
Address:____

Report Number:_________________________ Application Number:____________________

Date of tests:___________________________Date report issued:_______________________

Person responsible for test report:____

Other Laboratories performing testing (complete information for all laboratories performing testing)

Name:____
Address____
Application number:____
Test(s) performed by this laboratory:____
____
Date of tests:____
Laboratory accredited by:____
Accreditation number and expiration date:_____________ or Peer assessment date:___________
Location and types of tests conducted outside the premises of the laboratory:________________
____
Name and Signature of responsible person:____
Date of signature:____

Remarks:____
____
____

B. 5 General information concerning the type

Measurement Technology (NIR, Dielectric Meters, etc.):

____

Manufacturer (if different from Applicant):

____

Model: ________________________Serial No. (Device to be tested): _______________________

Prototype Device:□ Production Device:□ Operating Manual Submitted (if available):□Yes□ No

B. 6 Features

Mark each feature as S for standard features, O for optional features (i.e., features available in addition to those included as part of the standard device), and leave blank if not applicable. Check all that apply. List additional features at the end of this list under "Other".

B.6.1 Display, controls and recording element:

_____Moisture Percentage Display
_____Printer Interface Capability
_____Error Message(s) Display
_____Variable Print Format
_____Alphanumeric Display
_____Integral Printer
_____Liquid Crystal Display If so, Indicate Type/Capabilities:
_____Remote Customer Display

_____Ticket Printer
_____LED Display
_____Tape Printer
_____Method of Grain Selection
_____Label Printer
_____Menu

_____Thermal Printer
_____Other
_____Dot Matrix Printer
_____Alphanumeric Keypad
_____Prints Time and Date
_____Prints Identification Number
_____Consecutive Ticket Numbering
_____Other:______________________

B.6.2 Other Features

_____Audit Trail
_____Battery Power Supply AC to DC
_____Adapter
_____Battery Saving Feature
_____(Automatic Shut-Off)

Comments:____

B.7 Temperature ranges

Specified Temperature Range (Environment):

____

Specified Temperature Difference (Room Temp. to Grain Temp.):

____

Specified Grain Temperature Range (see Section 10 below):

____

B. 8 Moisture increment, character height, level indicator, sample size and warm-up

Value of minimum moisture increment:

____

Digital display character height:

____

Is device equipped with a level indicator: □ Yes □ No

Stated minimum sample size:

____

State warm up time:

____

B.9 Power

Instrument Power requirements:

Nominal voltage: ____

Nominal frequency: ____

Battery operation specified voltage range: _______________________________

Battery operated? □ Yes □ No

B.10 Remote communication and method of sealing

Remote communication capability? □Yes □ No

Means of sealing; indicate all that apply and briefly describe:

____

____

□ Audit Trail
□ Wire Security Seal
□ Other: ________________________________

B. 11 Grain types and moisture ranges for which the instrument will be approved

*Grain types	* Type evaluation required moisture range	Manufacturer specified moisture range	Indicate grain(s) for which calibration data is being submitted
Corn	12-18%		
Soybeans	10-16%		
Hard red winter wheat	10-16%		
Durum wheat	10-16%		
Soft white wheat	10-16%		
Hard red spring wheat	10-16%		
Soft red winter wheat	10-16%		
Hard White Wheat	8-14%		
Two-Row Barley	10-16%		
Six-Row Barley	10-16%		
Oats	8 -14%		
Sunflower Seed (Oil Type)	6-12%		
Long Grain Rough Rice	10-16%		
Medium Grain Rough Rice	10-16%		
Grain Sorghum or Milo	10-16%		

* These columns are for example only. The national responsible body may select the grains and moisture ranges that will be included in the type evaluation program in accordance with R59 Sections 6.1 and 7.

B.12 Reference Method

Identify the laboratory reference method for moisture: ________________________________

B.13 Test Report

B.13.1 Power Supply

Equipment needed		2 variable auto-transformers, voltmeter
Temperature	**Instruments**	22 ºC ± 2 ºC
	Grain	22 ºC ± 2 ºC
Sample used	*** Grain**	HRW Wheat
	*** Moisture Range**	12% -14%
Separate sample required for each model:		No
Separate sample required for each instrument:		Yes
Number of repetitions:		10

Instrument ID	**Measurements**			**Calculations**				**Results**				
				Mean meter moist. value at nom. voltage	**Mean meter moist. value at low voltage**	**Mean meter moist. value at high voltage**	**Moist. value diff. between nom, low and high**	**SD of repeat msmts (Max =0.10%)**	**MPE for max. diff bet. nom, low and high**	**Passed**	**Failed**	**Comments**
(1)	**Nom. Voltage** ______	1	6									
		2	7									
		3	8									
		4	9									
		5	10									
	Low Voltage ______	1	6									
		2	7									
		3	8									
		4	9									
		5	10									
	High Voltage ______	1	6									
		2	7									
		3	8									
		4	9									
		5	10									
(2)	**Nom. Voltage** ______	1	6									
		2	7									
		3	8									
		4	9									
		5	10									
	Low Voltage ______	1	6									
		2	7									
		3	8									
		4	9									
		5	10									
	High Voltage ______	1	6									
		2	7									
		3	8									
		4	9									
		5	10									

Additional Comments:

B.13.2 Storage Temperature

Equipment needed		Environmental cabinet
Temperature	**Instruments**	22 ºC ± 2 ºC
	Grain	22 ºC ± 2 ºC
Sample used	*** Grain**	HRW Wheat
	*** Moisture Range**	12% -14%
Separate sample required for each model:		No
Separate sample required for each instrument:		Yes
Number of repetitions:		10

Instrument ID	**Measurements**			**Calculations**			**Results**			
				Mean before Temp cycling	**Mean after temp. cycling**	**Diff. in mean values of before and after temp cycling**	**MPE for diff bet. Mean values of before and after temp cycling Table 5.4.1 Column 3**	**Passed**	**Failed**	**Comments**
(1)	**Before Temp. Cycling**	1	6							
		2	7							
		3	8							
		4	9							
		5	10							
	After Temp. Cycling	1	6							
		2	7							
		3	8							
		4	9							
		5	10							
(2)	**Before Temp. Cycling**	1	6							
		2	7							
		3	8							
		4	9							
		5	10							
	After Temp. Cycling	1	6							
		2	7							
		3	8							
		4	9							
		5	10							

*For example only. The national responsible body may select the grains and moisture ranges that will be included in the type evaluation program in accordance with R59 Sections 6.1 and 7.

Additional Comments: ______________________________

____

____

____

B.13.3 Instrument Leveling (Instruments without a level)

Equipment needed		shims
Temperature	**Instruments**	22 ºC ± 2 ºC
	Grain	22 ºC ± 2 ºC
Sample used	*** Grain**	HRW Wheat
	*** Moisture Range**	12% -14%
Separate sample required for each model:		No
Separate sample required for each instrument:		No
Reference Tilt		Instrument level to 0.1º
Degree of tilt (front or back) and (right or left) Min 2 orientations of tilt		5%
Number of repetitions		5

Instrument ID	**Measurements**			**calculations**			**Results**			
	Tilt Position	**At tilt**	**At Reference**	**Mean at tilt**	**Mean at reference**	**Mean diffs. between tilts and ref.**	**MPE for max. diff bet. tilt and ref. mean values Table 5.4.1 Column 3**	**Passed**	**Failed**	**Comments**
(1)	**Level**		1							
			2							
			3							
			4							
			5							
	Right or left tilt – (choose direction w/ greatest effect)	1	1							
		2	2							
		3	3							
		4	4							
		5	5							
	Front or back tilt (choose direction w/ greatest effect)	1	1							
		2	2							
		3	3							
		4	4							
		5	5							
(2)	**Level**		1							
			2							
			3							
			4							
			5							
	Right or left tilt – (choose direction w/ greatest effect)	1	1							
		2	2							
		3	3							
		4	4							
		5	5							
	Front or back tilt (choose direction w/ greatest effect)	1	1							
		2	2							
		3	3							
		4	4							
		5	5							

*For example only The national responsible body may select the grains and moisture ranges that will be included in the type evaluation program in accordance with R59 Sections 6.1 and 7.

Additional Comments: ______________________________

B.13.4 Instrument Leveling (Instruments with a level indicator)

Equipment needed		shims
Temperature	**Instruments**	22 ºC ± 2 ºC
	Grain	22 ºC ± 2 ºC
Sample used	*** Grain**	HRW Wheat
	*** Moisture Range**	12% -14%
Separate sample required for each model:		No
Separate sample required for each instrument:		No
Reference Tilt		Instrument level to 0.1º
Degree of tilt (front or back) and (right or left) Min 2 orientations of tilt		Tested to the limits of the level indicator
Number of repitions		5

Instrument ID	**Measurements**			**calculations**			**Results**			
	Tilt Position	**At tilt**	**At Reference**	**Mean at tilt**	**Mean at reference**	**Mean diffs. between tilts and ref.**	**MPE for max. diff bet. tilt and ref. mean values Table 5.4.1 Column 3**	**Passed**	**Failed**	**Comments**
(1)	**Level**		1							
			2							
			3							
			4							
			5							
	Right or left tilt – (choose direction w/ greatest effect)	1	1							
		2	2							
		3	3							
		4	4							
		5	5							
	Front or back tilt (choose direction w/ greatest effect)	1	1							
		2	2							
		3	3							
		4	4							
		5	5							
(2)	**Level**		1							
			2							
			3							
			4							
			5							
	Right or left tilt – (choose direction w/ greatest effect)	1	1							
		2	2							
		3	3							
		4	4							
		5	5							
	Front or back tilt (choose direction w/ greatest effect)	1	1							
		2	2							
		3	3							
		4	4							
		5	5							

*For example only. The national responsible body may select the grains and moisture ranges that will be included in the type evaluation program in accordance with R59 Sections 6.1 and 7.

Additional Comments: ____

B.13.5 Instrument Warm-up

Equipment needed		N/A
Temperature	**Instruments**	22 ºC ± 2 ºC
	Grain	22 ºC ± 2 ºC
Sample used	*** Grain**	HRW Wheat
	*** Moisture Range**	12% -14%
Separate sample required for each model:		No
Separate sample required for each instrument:		No
Number of repetitions:		5

Instrument ID	**Measurements**		**Calculations**			**Results**			
			Mean after warm-up	**Mean after 1 hr or twice manufacturer specified warm-up**	**Diff. in mean values of warm-ups**	**MPE for diff bet. Mean values of warm-ups Table 5.4.1 Column 3**	**Passed**	**Failed**	**Comments**
(1)	**After Warm-up**	1							
		2							
		3							
		4							
		5							
	1hr after instrument is turned on or twice the manufacturers warm-up (whichever is greater)	1							
		2							
		3							
		4							
		5							
(2)	**After Warm-up**	1							
		2							
		3							
		4							
		5							
	1hr after instrument is turned on or twice the manufacturers warm-up (whichever is greater)	1							
		2							
		3							
		4							
		5							

*For example only. The national responsible body may select the grains and moisture ranges that will be included in the type evaluation program in accordance with R59 Sections 6.1 and 7.

Additional Comment: ____

____

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B.13.6 Humidity

Equipment needed		Environmental chamber
Temperature	**Instruments**	22 ºC ± 2 ºC
	Grain	22 ºC ± 2 ºC
Sample used	*** Grain**	HRW Wheat
	*** Moisture Range**	12% -14%
Separate sample required for each model:		No
Separate sample required for each instrument:		No
Number of repetitions:		10

Instrument ID	Measurements			Calculations			Results			
				Mean at 20% humidity	Mean at 90% humidity	Diff. in mean values of 20% and 90% humidity	MPE for diff. bet. Mean values of 20% and 90% humidity Table 5.4.1 Column 3	Passed	Failed	Comments
(1)	20% humidity	1	6							
		2	7							
		3	8							
		4	9							
		5	10							
	90% humidity	1	6							
		2	7							
		3	8							
		4	9							
		5	10							
(2)	20% humidity	1	6							
		2	7							
		3	8							
		4	9							
		5	10							
	90% humidity	1	6							
		2	7							
		3	8							
		4	9							
		5	10							

*For example only. The national responsible body may select the grains and moisture ranges that will be included in the type evaluation program in accordance with R59 Sections 6.1 and 7.

Additional Comments: ____

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B.13.7 Instrument stability

Equipment needed		N/A
Temperature	**Instruments**	22 ºC ± 2 ºC
	Grain	22 ºC ± 2 ºC
Sample used	*** Grain**	HRW Wheat
	*** Moisture Range**	HRW Wheat 1 each at 10% - 12%, 12% -14%, and 14%-16%
Separate sample required for each model:		Yes
Separate sample required for each instrument:		No
Number of repetitions:		5

Instrument ID	*** Grain Type**	*** 6 % Moisture Range**	**Msmts after warm-up**	**Msmt after type evaluation (4-6 weeks)**	**Avg of 15 msmts After warm-up**	**Avg of 15 Msmts after Type Evaluation (4 -6 wee ks)**	**Results**			
							Diff between Avg after warm-up and Avg after type evaluation	**Passed**	**Failed**	**Comments**
Instrument 1	**HRW wheat**	**10-12%**	**1**	**1**						
			2	**2**						
			3	**3**						
			4	**4**						
			5	**5**						
		12-14%	**1**	**1**						
			2	**2**						
			3	**3**						
			4	**4**						
			5	**5**						
		14-16%	**1**	**1**						
			2	**2**						
			3	**3**						
			4	**4**						
			5	**5**						
Instrument 2	**HRW wheat**	**10-12%**	**1**	**1**						
			2	**2**						
			3	**3**						
			4	**4**						
			5	**5**						
		12-14%	**1**	**1**						
			2	**2**						
			3	**3**						
			4	**4**						
			5	**5**						
		14-16%	**1**	**1**						
			2	**2**						
			3	**3**						
			4	**4**						
			5	**5**						

*For example only. The national responsible body may select the grains and moisture ranges that will be included in the type evaluation program in accordance with R59 Sections 6.1 and 7.

B.13.8 Instrument Temperature Sensitivity

Equipment needed		Thermometers, Grain sample separator, Environmental chamber
Temperature	**Instruments**	22 ºC ± 2 ºC, ± Manufacturer specified low and high operating limits
	Grain	22 ºC ± 2 ºC ± Manufacturer specified low and high operating limits
Sample used	*** Grain**	HRW Wheat
	*** Moisture Ranges**	HRW Wheat: 1 each at 10%-12% 12% -14%, 14-16%
Separate sample required for each model:		No
Separate sample required for each instrument:		No
Repetitions:		3

Instrument ID	* Grain Type	* 6 % Moisture Range	At room temp grain 22 ºC Msmts	Cold 22ºC - ΔT Grain and instrument Msmts	Hot 22ºC + ΔT Grain and instrument Msmts	Results					
						Avg values at 22 ºC, 22ºC - ΔT, 22ºC + ΔT			MPE for diff bet mean temps Table 5.4.1 Column 2 x 0.8	Mean diff of Rm temp msmts-Cold temp msmt	Mean diff of Rm temp msmt- Hot temp msmt
Instrument 1	HRW wheat	10-12%	1	1	1	22 ºC	22 ºC - ΔT	22ºC + ΔT			
			2	2	2						
			3	3	3						
		12-14%	1	1	1	22 ºC	22 ºC - ΔT	22ºC + ΔT			
			2	2	2						
			3	3	3						
		14-16%	1	1	1	22 ºC	22 ºC - ΔT	22ºC + ΔT			
			2	2	2						
			3	3	3						
Instrument 2	HRW Whet	10-12%	1	1	1	22 ºC	22 ºC - ΔT	22ºC + ΔT			
			2	2	2						
			3	3	3						
		12-14%	1	1	1	22 ºC	22 ºC - ΔT	22ºC + ΔT			
			2	2	2						
			3	3	3						
		14-16%	1	1	1	22 ºC	22 ºC - ΔT	22ºC + ΔT			
			2	2	2						
			3	3	3						

*For example only. The national responsible body may select the grains and moisture ranges that will be included in the type evaluation program in accordance with R59 Sections 6.1 and 7.

Additional Comments: ____

____

____

____

B.13.9 Sample Temperature Sensitivity (page 1 of 2)

Equipment needed		Thermometers, Environmental cabinet
Temperature	**Instruments**	22 ºC ± 2 ºC
	Grain	22 ºC ± 2 ºC ± manufacturer temperature difference
Sample used	*** Grain**	HRW Wheat, Soybeans, corn
	*** Moisture Ranges**	HRW Wheat: 2 each at 10%-12% 12% -14%, 14-16% Soybeans: 2 each at 10%-12%, 12%-14%, 14%-16% Corn: 2 each at 12%-14%, 14%-16%, 16%-18%
Separate sample required for each model:		Yes
Separate sample required for each instrument:		No
Number of repetitions:		3

Instrument ID	* Grain Type	* 6 % Moisture Range	At room temp grain 22 ºC Msmts		Cold 22ºC - ΔT Grain Msmts		Hot 22ºC + ΔT Grain Msmts		Results					
			Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2	Mean values of all 6% at 22 ºC, 22ºC - ΔT, 22ºC + ΔT	Mean diff of Rm temp msmt-Cold temp msmt	Mean diff of Rm temp msmt- Hot temp msmt	Passed	Failed	Comments
Instrument 1	HRW wheat	10-12%	1	1	1	1	1	1	22 ºC					
			2	2	2	2	2	2						
			3	3	3	3	3	3						
		12-14%	1	1	1	1	1	1	22ºC - ΔT					
			2	2	2	2	2	2						
			3	3	3	3	3	3						
		14-16%	1	1	1	1	1	1	22ºC + ΔT					
			2	2	2	2	2	2						
			3	3	3	3	3	3						
	Soybeans	10-12%	1	1	1	1	1	1	22 ºC					
			2	2	2	2	2	2						
			3	3	3	3	3	3						
		12-14%	1	1	1	1	1	1	22ºC - ΔT					
			2	2	2	2	2	2						
			3	3	3	3	3	3						
		14-16%	1	1	1	1	1	1	22ºC + ΔT					
			2	2	2	2	2	2						
			3	3	3	3	3	3						
	Corn	12-14%	1	1	1	1	1	1	22 ºC					
			2	2	2	2	2	2						
			3	3	3	3	3	3						
		14-16%	1	1	1	1	1	1	22ºC - ΔT					
			2	2	2	2	2	2						
			3	3	3	3	3	3						
		16-18%	1	1	1	1	1	1	22ºC + ΔT					
			2	2	2	2	2	2						
			3	3	3	3	3	3						

Sample Temperature Sensitivity (Page 2 of 2)

Instrument ID	* Grain Type	* 6 % Moisture Range	At room temp grain 22 °C Msmts		Cold 22°C - ΔT Grain Msmts		Hot 22°C + ΔT Grain Msmts		Results					
			Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2	Mean values of all 6% at 22 °C, 22°C - ΔT, 22°C + ΔT	Mean diff of Rm temp msmt-Cold temp msmt	Mean diff of Rm temp msmt- Hot temp msmt	Passed	Failed	Comments
Instrument 2	HRW wheat	10-12%	1	1	1	1	1	1	22 °C					
			2	2	2	2	2	2						
			3	3	3	3	3	3						
		12-14%	1	1	1	1	1	1	22°C - ΔT					
			2	2	2	2	2	2						
			3	3	3	3	3	3						
		14-16%	1	1	1	1	1	1	22°C + ΔT					
			2	2	2	2	2	2						
			3	3	3	3	3	3						
	Soybeans	10-12%	1	1	1	1	1	1	22 °C					
			2	2	2	2	2	2						
			3	3	3	3	3	3						
		12-14%	1	1	1	1	1	1	22°C - ΔT					
			2	2	2	2	2	2						
			3	3	3	3	3	3						
		14-16%	1	1	1	1	1	1	22°C + ΔT					
			2	2	2	2	2	2						
			3	3	3	3	3	3						
	Corn	12-14%	1	1	1	1	1	1	22 °C					
			2	2	2	2	2	2						
			3	3	3	3	3	3						
		14-16%	1	1	1	1	1	1	22°C - ΔT					
			2	2	2	2	2	2						
			3	3	3	3	3	3						
		16-18%	1	1	1	1	1	1	22°C + ΔT					
			2	2	2	2	2	2						
			3	3	3	3	3	3						

*For example only. The national responsible body may select the grains and moisture ranges that will be included in the type evaluation program in accordance with R59 Sections 6.1 and 7.

Additional Comments: ____

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____

B.13.10 Accuracy Test

* Grain Type	* 6 % Moisture Range	MPEs defined in Table 5.4.1 Column 2	No. of Samples per 2% Moist. Interval	Analyze each sample 3x on each instrument Tot. Msmts.	Instrument ID (1)________ (2)________	Results						
						Meter Results	Reference Results	$\bar{y}$	SDD	Passed	Failed	Comments
Corn	12-14%		10	30	(1)							
				30	(2)							
	14-16%		10	30	(1)							
				30	(2)							
	16-18%		10	30	(1)							
				30	(2)							
HRW wheat	10-12%		10	30	(1)							
				30	(2)							
	12-14%		10	30	(1)							
				30	(2)							
	14-16%		10	30	(1)							
				30	(2)							
Soybeans	10-12%		10	30	(1)							
				30	(2)							
	12-14%		10	30	(1)							
				30	(2)							
	14-16%		10	30	(1)							
				30	(2)							

* These columns are for example only. The national responsible body may select the grains and moisture ranges that will be included in the type evaluation program in accordance with OIML R59 Sections 6.1 and 7.

$$\bar{y} = \frac{\sum_{i=1}^{n} (\bar{x}_i - r_i)}{n} \qquad SDD = \sqrt{\frac{\sum_{i=1}^{n} \left(y_i - \bar{y}\right)^2}{n-1}}$$

Additional Comments: ____

____

____

____

B.13.11 Repeatability

* Grain Type	* 6 % Moisture Range	MPEs defined in Table 5.4.1 Column 4	No. of Samples per 2% Moist. Interval	Analyze each sample 3x on each instrument Tot. Msmts.	Instrument ID (1)________ (2)________	Results					
						SD	Pooled SD (1)	Pooled SD (2)	Passed	Failed	Comments
Corn	12-14%		10	30	(1)						
				30	(2)						
	14-16%		10	30	(1)						
				30	(2)						
	16-18%		10	30	(1)						
				30	(2)						
HRW wheat	10-12%		10	30	(1)						
				30	(2)						
	12-14%		10	30	(1)						
				30	(2)						
	14-16%		10	30	(1)						
				30	(2)						
Soybeans	10-12%		10	30	(1)						
				30	(2)						
	12-14%		10	30	(1)						
				30	(2)						
	14-16%		10	30	(1)						
				30	(2)						

* These columns are for example only. The national responsible body may select the grains and moisture ranges that will be included in the type evaluation program in accordance with OIML R59 Sections 6.1 and 7.

$$SD = \sqrt{\frac{\sum_{i=1}^{n}\sum_{j=1}^{3}\left(x_{ij} - \overline{x_i}\right)^2}{2n}}$$

Additional Comments: ____

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B.13.12 Reproducibility

* Grain Type	* 6 % Moisture Range	MPEs defined in Table 5.4.1 Column 4	No. of Samples per 2% Moist. Interval	Analyze each sample 3x on each instrument Tot. Msmts.	Instrument ID	Results				
						Avg.	SDD	Passed	Failed	Comments
Corn	12-14%		10	30	(1)					
				30	(2)					
	14-16%		10	30	(1)					
				30	(2)					
	16-18%		10	30	(1)					
				30	(2)					
HRW wheat	10-12%		10	30	(1)					
				30	(2)					
	12-14%		10	30	(1)					
				30	(2)					
	14-16%		10	30	(1)					
				30	(2)					
Soybeans	10-12%		10	30	(1)					
				30	(2)					
	12-14%		10	30	(1)					
				30	(2)					
	14-16%		10	30	(1)					
				30	(2)					

* These columns are for example only. The national responsible body may select the grains and moisture ranges that will be included in the type evaluation program in accordance with OIML R59 Sections 6.1 and 7.

$$SDD_I = \sqrt{\frac{\sum_{i=1}^{n}\left(d_i - \overline{d}\right)^2}{n-1}}$$

Additional Comments: ____

____

____

____

B.13.13 AC mains voltage dips and short interruptions

Observer	
Instrument 1 ID	
Instrument 2 ID	
Sample ID	

	At start	**At End**	
Tenp:			**ºC**
RH			**%**
Date and Time			**mm / dd / yr hh / mm /ss**

	n = 10		**mean**
Reference Moisture			
Error Shift Limit **(see table 5.4.1 column 3)**			

Note other details about the test

Settings				**Results**				
Test	Voltage reduction New V	Voltage reduction % Reduction	Duration cycles	Moisture readings n = 10 readings per voltage reduction	**Diff (Measured Moisture – Ref Moisture)**	**If diff ≤ Error shift limit Pass**	**If diff ≥ Error shift limit Fail**	**Comments**
1	**0**	100	0.5					
2	**0**	**100**	**1**					
3	**0**	**70**	**25/30**					
4	**0**	**100**	**250/300**					

B.13.14 Burst (Transients) on AC Mains

Observer	
Instrument 1 ID	
Instrument 2 ID	
Sample ID	

	At start	At End	
Tenp:			**ºC**
RH			**%**
Date and Time			mm / dd / yr hh / mm /ss

L = phase, N = neutral, PE = protective earth,

G= Ground

Error Shift Limit **(see table 5.4.1 column 3)**	

Note other details about the test

Settings		Pre test and test measurements			Results				
Connections	Test V (kV) & Polarity	Measurements prior to bursts: n = 10 readings per voltage reduction	Measurements prior to bursts: Mean	Test: n = 10 readings per voltage reduction	**Diff (Measured Moisture – Ref Moisture)**	**If diff ≤ Error shift limit Pass**	**If diff > Error shift limit Fail**	**Sig Fault detected & acted upon**	**Comments**
L ↓ G									
N ↓ G									
PE ↓ G									

B.13.15 Radiated, radio-frequency, electromagnetic fields

Observer	
Instrument 1 ID	
Instrument 2 ID	
Sample ID	

	At start	**At End**	
Tenp:			**°C**
RH			**%**
Date and Time			**mm / dd / yr** **hh / mm /ss**

V = vertical H = Horizontal

Error Shift Limit **(see table 5.4.1 column 3)**	

Note other details about the test

Settings		Measurements prior to disturbance (reference)		Test		**Results**				
Location	Antenna polarization	n = 10 readings per position	Mean	Frequency (MHz)	Moisture measurement n = 10 per frequency	**Diff (Measured Moisture – Mean Ref Moisture)**	**If diff ≤ Error shift limit Pass**	**If diff > Error shift limit Fail**	**Sig Fault detected & acted upon**	**Comments**
Front	**V**			**26**						
				2000						
	H			**26**						
				2000						
Left	**V**			**26**						
				2000						
	H			**26**						
				2000						
Right	**V**			**26**						
				2000						
	H			**26**						
				2000						
Rear	**V**			**26**						
				2000						
	H			**26**						
				2000						

B.13.16 Conducted, radio-frequency fields

Observer	
Instrument 1 ID	
Instrument 2 ID	
Sample ID	

	At start	At End	
Tenp:			**°C**
RH			**%**
Date and Time			**mm / dd / yr hh / mm /ss**

Error Shift Limit (see table 5.4.1 column 3)	

Note other details about the test

Settings	**Measurements prior to disturbance (reference)**		Test		**Results**				
Name of cable or interference	n = 10 readings	Mean	Frequency (MHz)	Moisture measurement n = 10 per frequency	**Diff (Measured Moisture – Mean Ref Moisture)**	**If diff ≤ Error shift limit Pass**	**If diff > Error shift limit Fail**	**Sig Fault detected & acted upon**	**Comments**
			0.15						
			80*						
			0.15						
			80*						
			0.15						
			80*						
			0.15						
			80*						

*** Testing up to 26 MHz is permitted. Refer to clause A.4.4**

B.13.17 Electrostatic discharge

B.13.17.1 Direct application

Observer	
Instrument 1 ID	
Instrument 2 ID	
Sample ID	

	At start	At End	
Tenp:			**ºC**
RH			**%**
Date and Time			**mm / dd / yr hh / mm /ss**

Contact discharge (Y or N)
Paint penetration (Y or N)
Air discharge (Y or N)

Error Shift Limit (see table 5.4.1 column 3)	

Note other details about the test

Settings		Measurements prior to disturbance (reference)		Test	**Results**				
Test V (kV)	**Polarity**	n = 10 readings per position	Mean	Moisture measurement n = 10 per polarity and test V	**Diff (Measured Moisture – Mean Ref Moisture)**	**If diff ≤ Error shift limit Pass**	**If diff > Error shift limit Fail**	**Sig Fault detected & acted upon**	**Comments**
2	+								
	–								
4	+								
	–								
6	+								
	–								
8	+								
	–								

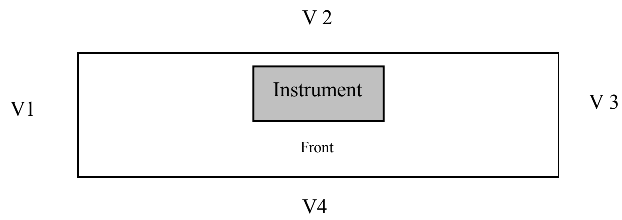
B.13.17.2 Indirect application

Observer	
Instrument 1 ID	
Instrument 2 ID	
Sample ID	

	At start	**At End**	
Tenp:			**ºC**
RH			**%**
Date and Time			**mm / dd / yr** **hh / mm /ss**

V = vertical H = horizontal

Refer to diagram for vertical coupling plane positions



Error Shift Limit **(see table 5.4.1 column 3)**	

Settings		Measurements prior to disturbance (reference)		Test	**Results**				
Coupling plane position	Test V (kV)	n = 10 readings per test V	Mean	Moisture measurements n = 10 per Test V	**Diff (Measured Moisture – Mean Ref Moisture)**	**If diff ≤ Error shift limit Pass**	**If diff > Error shift limit Fail**	**Sig Fault detected & acted upon**	**Comments**
H	**2**								
	4								
	6								
V1	**2**								
	4								
	6								
V2	**2**								
	4								
	6								
V3	**2**								
	4								
	6								
V4	**2**								
	4								
	6								

Summary of type evaluation test results
Application Number: ______________________________
Type Designation: ________________________________

Clause	Tests	Report page	PASSED	FAILED	Remarks
A.1.2	Accuracy				
A.1.3	Repeatability				
A.1.4	Reproducibility				
A.2	Basic Instrument test-Influence factors				
A.2.2	Instrument stability				
A.2.3	Instrument warm-up time				
A.2.4	Instrument power supply				
A.2.4.1	Main voltage variation				
A.2.4.2	Low voltage of internal battery (not connected to the mains power)				
A.2.5	Instrument storage temperature				
A.2.6	Instrument leveling				
A.2.6.1	Instruments without leveling				
A.2.6.2	Instruments with leveling				
A.2.7	humidity				
A.2.8	Instrument temperature sensitivity				
A.3	Sample temperature sensitivity				
A.4	Disturbance test for electronic instruments				
A.4.1	AC mains voltage dips, short interruptions and voltage variations				
A.4.2	Bursts (Transients) on AC mains				
A.4.3	Radiated, radiofrequency, electromagnetic Susceptibility				
A.4.4	Conducted radio frequency fields				
A.4.5	Electrostatic discharges				

Technical Requirements Checklist				
Clause	**Technical Requirement**	**Passed**	**failed**	**Comments**
6.1	Grains and minimum moisture ranges			
6.2	Selection of grain on the instrument			
6.3	Minimum sample size			
6.4	Determination of quantity and temperature			
6.5	Instrument warm-up period			
6.6	Digital display and recording elements			
6.7	Meter construction			
6.8	Marking			
6.9	Operating ranges			
6.10	Provisions for sealing and calibration security			
6.11	Manufacturers manual			
6.12	Place of installation and environment			
6.13	Visibility of the moisture meter and of the measurement operations			
6.14	Power supply			
6.15	Battery-operated instruments			

Technical Requirements Checklist				
Clause	**Technical Requirement**	**Passed**	**failed**	**Comments**
6.16	Level indicating means			
6.17	Software-controlled electronic devices and security			

Annex C

C.1 Philosophy for Sealing

C.1.1 Typical features to be sealed and principles for determining features to be sealed

The need to seal some features depends upon:

- The ease with which the feature or the selection of the feature can be used to facilitate fraud. **AND**
- The likelihood that the use of the feature will result in fraud not being detected.

Features or functions which the operator routinely uses as part of device operation, such as selecting the grain calibration to be used, are not sealable parameters and shall not be sealed.

If a parameter (or set of parameters) selection would result in performance that would be obviously in error, such as the selection of parameters for different countries, then it is not necessary to seal the selection of these features.

If individual device characteristics are selectable from a "menu" or a series of programming steps, then access to the "programming mode" must be sealable. Note: If an audit trail is the only means of security, then the audit trail shall update only after at least one sealable parameter has been changed; simply accessing the sealable parameters via a menu shall not update the audit trail.

The current language in NIST Handbook 44, paragraph G-S.8. states: "A device shall be designed with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that detrimentally affects the metrological integrity of the device can be made to any electronic mechanism." Thus, for parameters protected by physical means of security, once a physical security seal is applied to the device, it should not be possible to make a metrological change to those parameters without breaking that seal. Likewise, for parameters protected by electronic means of security, it should not be possible to make a metrological change to those parameters without that change being reflected in the audit trail. Since this philosophy addresses provisions for protecting access to any metrological adjustment, the philosophy should be applied consistently to all electronic device types.

If a device must undergo a physical act, such as cutting a wire and physically repairing the cut to reactivate the parameter, then this physical repair process would be considered an acceptable way to select parameters without requiring a physical seal or an audit trail.

C.1.2 Typical features and parameters to be sealed

The following provides examples of configuration and calibration parameters that are to be sealed. The examples are provided as a guide and are not intended to cover all possible parameters.

C.1.2.1 Calibration Parameters

Calibration parameters are those parameters whose values are expected to change as a result of accuracy adjustments. Calibration parameters can be classified into three categories:

1. Those parameters, which are adjusted, to standardize or normalize instrument response to changes in the physical parameter being measured, (e.g., zero-setting and test point adjustments, weight sensing element zero and span adjustments, temperature sensing element zero and span adjustments, amplifier gain settings, optical wavelength standardization adjustments, capacitance settings, resistance settings, etc.) These are parameters normally set by the manufacturer or a competent service representative.

2. Those parameters, which are common to all instruments of, like type for a given grain, (e.g., grain calibration coefficients.) The certificate of conformance lists the calibration coefficients (or a unique identifier) for each grain which has been approved for use on that instrument under the NTEP program.
3. Those parameters, which are adjusted for each grain type to standardize moisture readings on, like instruments, (e.g., slope and bias settings.)

C.1.2.2 Configuration Parameters

Configuration parameters are those parameters whose values are expected to be entered once only and not changed after all initial installation settings have been made.

1. System date and time (only if used by an event logger as audit trail information.)
2. Value of minimum indicated and recorded moisture.
3. Sample size and/or number of sub portions measured (if not determined by individual grain calibrations.)
4. Password for access to sealable parameters (if used.)
5. Enable/disable display of non-NTEP parameters, (e.g., approximate test weight.)
6. Format for results display and recording.
7. Operating range limits (temperatures.)
8. Enable/disable display or recording of results for out-of-limits conditions.

C.1.3 Grain Moisture Meter Features and Parameters

Typical Features or Parameters to be Sealed	Typical Features or Parameters NOT to be Sealed
• Measuring Element Adjustments (both mechanical and electronic) • Weight Sensing Adjustments (both mechanical and electronic) • Temperature Sensing Adjustments (both mechanical and electronic) • Any tables or parameters residing in software to normalize the response of like instruments. • Temperature probes and temperature offsets in software. • Grain Calibration Coefficients • Slope and Bias Coefficients • System Date and Time (only if used by an event logger as audit trail information)	• Communications Protocol

Note: The above examples of adjustments, parameters, and features to be sealed are to be considered "typical" or "normal." This list may not be all inclusive, and there may be parameters other than those listed which affect the metrological performance of the device and must, therefore, be sealed. If listed parameters or other parameters which may affect the metrological function of the device are not sealed, the manufacturer must demonstrate that all settings comply with the most stringent requirements for the application of the device.

C.1.4 Requirements for Metrological Audit Trails

C.1.4.1 Scope

This discussion lists the requirements for the acceptable forms of metrological audit trail for providing acceptable security for commercial grain moisture meters.

With the ability of users to make changes that affect the metrological integrity of the device, (e.g., slope, bias, etc.) in normal operation and the remote configuration capability of commercial grain moisture meters, these requirements help to ensure appropriate means of sealing are implemented.

C.1.4.2 Categories of Device and Methods of Sealing

Categories of Device	Method of Sealing
Category 1: No remote configuration capability	Seal by physical seal or two event counters: one for calibration parameters (000 to 999) and one for configuration parameters (000 to 999.) If equipped with event counters, the device must be capable of displaying, or printing through the device or through another on-site device, the contents of the counters.
Category 2: Remote configuration capability, but access is controlled by physical hardware. Device shall clearly indicate that it is in the remote configuration mode and shall not be capable of operating in the measure mode while enabled for remote configuration.	The hardware enabling access for remote communication must be at the device and sealed using a physical seal or two event counters; one for calibration parameters (000 to 999) and one for configuration parameters (000 to 999.) If equipped with event counters, the device must be capable of displaying, or printing through the device or through another on-site device, the contents of the counters.
Category 3: Remote configuration capability, access may be unlimited or controlled through a software switch (e.g. password.) When accessed remotely for the purpose of modifying sealable parameters, the device shall clearly indicate that it is in the configuration mode and shall not be capable of operating in the measure mode.	An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change and the new value of the parameter (for calibration changes consisting of multiple constants, the calibration version number may be used rather than the calibration constants.) A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to twenty-five (25) times the number of sealable parameters in the device, but not more than 1000 records are required. *(Note: Does not require 1000 changes to be stored for each parameter.)*
Category 3a: No remote capability, but operator	Same as Category 3

is able to make changes that affect the metrological integrity of the device (e.g. slope, bias, etc.) in normal operation.	
Category 3b: No remote capability, but access to metrological parameters is controlled through a software switch (e.g. password.)	Same as Category 3

C.1.4.3 Event Loggers: Acceptable Form of Audit Trails

1. The event logger is the minimum form of audit trail for grain moisture meters and near infrared grain analyzers (those that have unrestricted or remote access to the configuration or calibration parameters.) The event logger shall contain the following information:

Event Counter	Date and Time	Parameter ID	New Value

2. This information shall be automatically entered into the event logger by the device. Additional relevant information is permitted, (e.g., the identification of the person who made the adjustment or the old value of the parameter that was changed.)
3. The date and time shall be presented in understandable format. The date shall include month, day, and year. The time shall include the hour and minutes.

   Note: For devices incorporating an event logger, date and time are considered sealable parameters, and changes to date or time must be logged the same as any other sealable parameter.

4. A hard-copy printout of the contents of the event logger shall be available upon demand from the device or an associated device on the site of the device installation. The printing of the event logger contents shall exclude other information not relevant to the changes logged, such as transaction data, number of measurements performed, etc.
5. An event logger shall have a capacity of at least 25 times the number of sealable parameters; however, it is not required to retain more than 1000 events for all parameters combined.

C.1.4.4 General Requirements for Metrological Audit Trails

The following general requirements for metrological audit trails must be satisfied:

1. The adjustment mode shall address only sealable parameters in order to avoid entering the adjustment mode to access non-sealable parameters that must be routinely changed as part of the normal use of the device.
2. An event counter shall have a capacity of at least 1000 values, (e.g., 000 to 999.) In the case of the event logger, the event counter will increment once for each change to a sealable parameter since each new value must be retained in the event logger. If an adjustment mode is entered but no changes are made, this does not constitute an event and the counter must not increment.
3. When the storage memory of the event logger has been filled to capacity, any new event shall cause the oldest event to be deleted. The event counter used in the event logger shall continue to increment to its capacity, although the event logger may retain fewer records than the count capacity of the event counter. The event counter provides the necessary information to indicate the number of records that have been overwritten in the event logger as new information overwrites the old records.

4. The audit trail data shall be:
   a. Stored in non-volatile memory and shall be retained for at least 30 days if power is removed from the device. **AND**
   b. Protected from unauthorized erasure, substitution, or modification.
5. Access to the audit trail information for the purpose of printing the contents must be "convenient" for the enforcement official.
   a. Accessing the audit trail information for review shall be separate from the calibration mode so there is no possibility for officials to change or corrupt the device configuration or the contents of the audit trail.
   b. Accessing the audit trail information shall not affect the normal operation of a device before or after accessing the information.
   c. A key (for a panel lock) may be required to gain access to the means to view the contents of the audit trail. Access may be through the supervisor's mode of operation of the device.
   d. Accessing the audit trail information shall not require the removal of any additional parts other than normal requirements to inspect the integrity of a physical seal.
6. The printed form of the audit trail information shall be readily interpretable by the official.
7. The information from an event logger shall be printed in order from the most recent event to the oldest event. If a device is not capable of printing all the information for a single event on one line or at one time, the information shall be displayed in blocks of information, which are readily understandable.