~~July 2006~~ February 2009

INTERNATIONAL ORGANIZATION OF LEGAL METROLOGY

Fifth Committee Draft Revision International **Recommendation 59**

"Moisture Meters for Cereal Grain and Oilseeds"

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

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.

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 depend upon successfully overcoming the effects of interfering factors, such as density, temperature, chemical composition, and impurities. (editors footnote needs to be a

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.

Below are tables that cross reference OIML Recommendation R 59 200~~X~~9 with OIML B 6-2 "OIML Directives for Technical Work, Part 2" (1993) and OIML D11 (2004).

[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.

Table of Cross Reference of OIML Directives for technical work, Part 2 and CD5 OIML R59 2009

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Table of Cross Reference of Relevant Sections of OIML D11, 2004 to CD 5 OIML R 59, 2009			
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3	Terminology	2	Terminology
3.18	(Types of) checking facilities	2, 6.9	Checking facilities, operating range
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		5.10	Error under rated operating conditions
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		5.9, Annex A	Influence of external disturbances, Test procedures
10-14	Performance tests	Annex A	Test procedures

OIML

COMMITTEE DRAFT OIML R 59/CD5
Date: February 27, 2009
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OIML TC17/SC1 Title: OIML R 59 “Moisture Meters for Cereal Grain and Oilseeds” Secretariat: Japan and the United States	Circulated to P- and O-members and liaison international bodies and external organizations for: ☐ discussion at (date and place of meeting): NIST ☒ comments by: May 21, 2009 ☐ vote (P-members only) and comments by ....

TITLE OF THE CD: Fifth Committee Draft Revision International Recommendation R59

OIML R 59

“Moisture Meters for Cereal Grain and Oilseeds”

CONTENTS (TO BE UPDATED in full after final comments)

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.

Additionally, the OIML publishes or participates in the publication of **Vocabularies (OIML V)** and periodically commissions legal metrology experts to write **Expert Reports (OIML E)**. Expert Reports are intended to provide information and advice, and are written solely from the viewpoint of their author, without the involvement of a Technical Committee or Subcommittee, nor that of the CIML. Thus, they do not necessarily represent the views of the OIML.

This publication - reference OIML R 59, Edition 2009 - was developed by Technical Subcommittee TC17/SC1. It was approved for final publication by the International Committee of Legal Metrology in 200x and will be submitted to the International Conference of Legal Metrology in 200y for formal sanction. It supersedes the previous edition of R 59 (199x).

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1. Scope

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

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

1.3 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.

1.4 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.

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

2. Terminology

The terms and definitions used in this document, where possible are consistent with the International Vocabulary of Basic and General Terms in Metrology (VIM), ISO 1993 [1]and the International Vocabulary of Terms in Legal Metrology, OIML 2000[2]

2.1 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.

2.2 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

2.3 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.).

2.4 Error shift

An error observed on an instrument after it has been 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 testsing.

2.5 Grain

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

2.6 Maximum permissible measurement errors (MPEs) (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'.

This error covers the sum of maximum value for errors, which could appear on a single measurement, when using the instrument within a defined range of use, irrespective of the point in this range. (adopted from OIML D3 "Legal qualification of measuring instruments.") NOTE: The MPESs in Section 5.4.2. are errors associated with a meter in use in the market place. The errors for the OIML test procedures are based on Section 5.4.1.which are half the in field inspection MPES

2.7 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.

b) if a **measurand** is supposed to be represented by a unique **true quantity value** or a set of

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

2.8 Measurement repeatability (repeatability)

Measurement precision **under a set of** repeatability conditions of measurement.

2.9 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.**

2.72.10MMoisture content wet-basis and moisture and volatile matter content.

The wet-basis moisture and volatile matter content of a sample of cereal grains or oilseeds (both called moisture content in this Recommendation) is conventionally defined as is the ration of moisture to the total mass of the grain sample. the amount of mass lost by a sample expressed as a percentage of the original mass, as determined using the reference method defined by the national body.

2.11 Moisture Meter

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

~~2.8~~2.12 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.

2.13 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.

2.14 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.

~~2.9~~2.15 Significant fault

Fault greater than the value specified in the relevant 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 2.15:

(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, emorized 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.

~~A fault the magnitude of which is greater than the magnitude of the maximum permissible errors in 5.4.1.~~

~~NOTE: The following faults are not considered to be significant.~~

~~a) Faults implying the impossibility to perform any measurement;~~

~~b) Transitory faults being momentary variations in the indication, which cannot be interpreted, recorded or transmitted as a measurement result; and~~

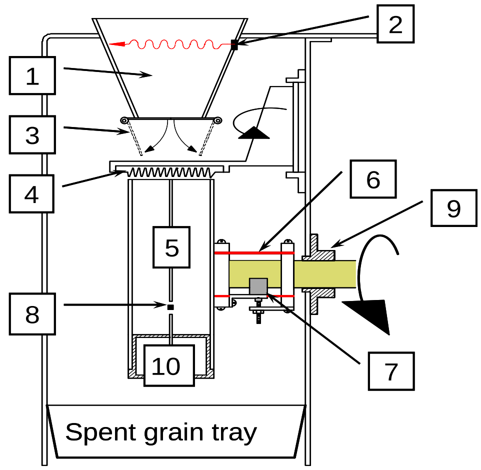
~~c) Faults giving rise to variations in the measurement results that are so large as to be noticed by all users of the instruments.~~

3 Description of instruments

This section includes a brief overview of two different technologies of grain moisture meters. This section is not intended to limit the scope of this document or preclude the application of other or new technology.

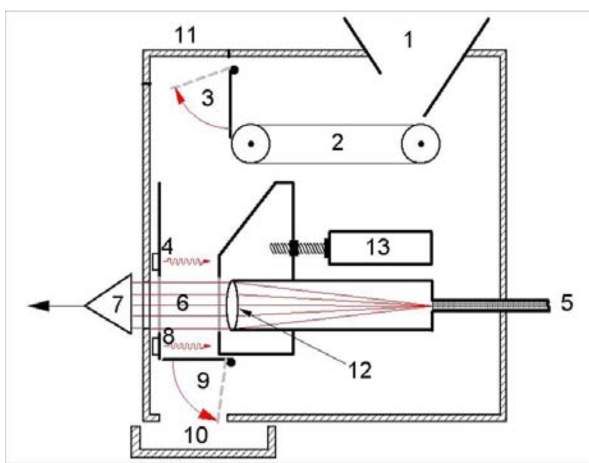
3.1 Basic operation of a typical capacitance (dielectric) grain moisture meter.

The diagram below represents the basic operation and components of a capacitance meter. Grain is placed in (1) the hopper (2) a sensor determines whether or not an adequate amount of grain is in the hopper for proper analysis. The (3) (4) loading mechanism drops the grain into the (5) test cell where a (8) temperature sensor takes a temperature measurement of the grain and a weight measurement is made by the (7) weight sensor with the help of (6) flexors and (9) axle supports. The (10) A/D converter converts the measurement to digital code to provide a percent moisture reading.



3.2 Basic operation of a typical near infrared grain moisture meter.

The diagram below represents of the basic operation and components of a near infrared grain analyzer. Grain is dropped through a hopper (1) to a sample chamber (6), which has windows on both sides of the chamber. Light from a scanning monochromator (5) is applied to the chamber filled with grain and a detector (7) senses the amount of near infrared light passing through the chamber.



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

5 Metrological requirements

5.1 Reference conditions for performance tests

During type evaluation, reference environmental conditions for the moisture meter and grain samples shall be as follows:

Reference conditions	
Influence	**Value**
Ambient temperature	22 °C ± 5 2 °C
Relative humidity(RH)	30 % to 70 %

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 45.4.2. (Note: these are environmental conditions for the instruments in use)

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 (MPEss)

The maximum permissible errors for grain moisture meters as a function of the moisture content and 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) MPE_{sS} in percent moisture content (*M*) %	(3) Error shift	(4) Repeatability SD %	(5) Reproducibility SDD_I %
Corn, rice, sorghum, sunflower ~~P~~pulses and oats	If 0.025 x *M* < 0.4 then MPE_{sS}= 0.4; else MPE_{sS} = 0.025 x *M*	0.5 x column 2	0.5 x column 2	0.6 x column 2
All other grains	If 0.02 x *M* < 0.35 then MPE_{sS}= 0.35; else MPE_{sS} = 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	
~~Index~~ Type of grain or seed	MPE_S in percent moisture content (*M*)
~~I~~ (I) Maize, rice, sorghum, sunflower, oats	If 0.05 x *M* < 0.8 then MPE_{sS}= 0.8; else MPE_{sS} = 0.05 x *M*
~~II~~ (II) All other cereal grains and oilseeds	If 0.04 x *M* < 0.7 then MPE_{sS}= 0.7; else MPE_{sS} = 0.04 x *M*

5.5 Accuracy, repeatability, and reproducibility requirements for type approval at reference conditions.

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. 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.

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 covers 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 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. ~~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 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 ~~5~~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.

5.8 Influence factors

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, ~~T~~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	
Power source variation: voltage* ~~frequency~~ battery voltage* ~~(if applicable)~~ *etc, whichever is appropriate	A.2.4
Instrument stability	A.2.2
Instrument warm-up time	A.2.3
Instrument leveling	A.2.6
Instrument temperature sensitivity	A.2.8
Instrument humidity sensitivity	A.2.7
Instrument storage temperature	A.2.5
Low voltage of internal battery	A.2.9
Sample temperature test	
Sample temperature sensitivity	A.3

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

5.9 Other test for electronic instruments – 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 2.~~6~~15.

Other test for electronic instruments – disturbance tests	**Test Procedure Section** (As appropriate, severity levels are included in test procedures, Annex A)
Sand and Dust	A.4.1
Short time power reduction	A.4.2
Bursts	A.4.3
Radiated radiofrequency, electromagnetic susceptibility	A.4.4
Conducted radiofrequency fields	A.4.5
Electrostatic discharges	A.4.6
Mechanical shock	A.4.7

5.10 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.

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 ~~kinds~~ grains and minimum number of ~~kinds~~ grains (at least three) for which a manufacturer may seek national moisture meter approval. The ~~kinds of~~ 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., ~~(1~~ large grain~~s~~s, ~~(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~~s~~ for the meter ~~for type approval~~, subject to the minimum ranges specified in paragraph 6.1.~~1.~~

6.2 Selection of grain on the instrument

Moisture meters shall permit the selection ~~of the species~~ of grain or seeds being measured and the selection of the ~~species~~ 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.

~~6.2~~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 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.~~.~~ This performance may not be necessary for the meters, which do not require any warm up time.

~~6.3~~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.

Meters ~~shall~~ may be equipped with a communication interface (some national responsible bodies will require that the meter be equipped with a communication interface) that permits interfacing with a recording element and transmitting the date, grain type, grain moisture results, and calibration version identification. Correspondence between displayed information and remote recording element shall be verified.

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.

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 ~~manufacturers~~ national responsible body's option the display and printout ~~shall~~ shall also permit 0.01 % resolution for type evaluation only.

On multi-constituent meters (e.g., meters which also measure grain protein), provision shall be made for displaying and recording the constituent label (such as moisture, protein, etc.) to make it clear which constituent is associated with each of the displayed and recorded values.

~~6.4~~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.

The moisture meter 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~~6.8 Marking

~~6.5.1~~6.8.1 General marking

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

~~bear the following markings:~~

(a) identification of trade-mark of the manufacturer,
(b) designation of instrument type 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 disassembly of a part requiring the use of any means separate from the device.

~~6.5.2~~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.

~~6.6~~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 the temperature range of the meter and/or~~,~~ temperature range of the grain and seed and/or the maximum allowable difference in temperature between the meter and sample 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.

~~6.7~~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.

If calibration constants are digitally stored in an electronically alterable form, the meter shall be designed to make automatic checks to detect corruption. ~~due to adjustment or changing calibration constants.~~ An error message must be displayed if calibration constants have been electronically altered and no further measurement shall be possible.

~~6.8~~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 ~~the~~ this manual shall be ~~written~~ 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.

~~6.9~~6.12 Place of installation and environment

The moisture meter shall be installed in conformity with the requirements given in the manual provided by the manufacturer.

~~6.10~~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.

~~6.11~~6.14 Power Supply

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

~~6.12~~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 5.5.16.15.1(b) and 5.56.15.2 do not apply for back-up batteries.

~~6.13~~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

Note: **More general requirements for, and advice on software-controlled devices and measuring instruments may exist in other OIML publications.**

6.17.1 Instruments with embedded software

For instruments and modules with embedded software, the manufacturer shall describe or declare that the software of the instrument or module is embedded, i.e. it is used in a fixed hardware and software environment and cannot be modified or uploaded via any interface or by other means after securing and/or verification. In addition to the documentation required in 8.2. the manufacturer shall submit the following documentation:

- Description of the legally relevant functions;
- Software identification that is clearly assigned to the legally relevant functions;
- Securing measures foreseen to provide for evidence of an intervention.

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 Grain calibrations and integrity

Note: 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 electrical or optical 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

6.17.3.1 Calibration Version

A meter must be capable of displaying either 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.

6.17.3.2 Calibration Corruption

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

6.17.3.3 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.]***

6.17.4 Correctness of algorithms and functions

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

6.17.5 Software protection

6.17.5.1 Prevention misuse

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

6.17.5.2 Fraud Protection

Metrological critically software shall be secured against unauthorized modification, loading, or changes by swapping of hardware

6.17.6 Fault Detection

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

7 Practical instructions

7.1 Type approval samples

The 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. 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. 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 ~~S~~samples are to be stored at 2 °C to 8 °C prior to use, unless tested within 24 hours of receipt.

7.3 Sample handling

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) ~~general information on the s~~Software documentation, which may include: ~~required for a micro-processor equipped measuring instrument.~~
~~In particular the requirement 7.5 shall be covered;~~

1. a description of the legally relevant software and how the requirements are met.
2. a description of suitable system configuration and minimal required resources;
3. a description of security means of the operating system (password, etc. if applicable);
4. a description of the (software) sealing method(s);
5. an 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 performs legally relevant functions, this should also be identified;
7. a description of the accuracy of the algorithms (e.g. filtering of A/D conversion results, price calculation, rounding algorithms, etc.);
8. a description of the user interface, menus and dialogues;
9. the software identification and instructions for obtaining it from an instrument in use;
10. list of commands of each hardware interface of the measuring instrument / electronic device / sub-assembly including a statement of completeness;
11. list of durability errors that are detected by the software and if necessary for understanding,
12. a description of the detecting algorithms;
13. a description of data sets stored or transmitted;
14. if fault detection is realized in the software, a list of faults that are detected and a
15. description of the detecting algorithm;
16. an overview of the system hardware, e.g. topology block diagram, type of computer(s),
17. type of network, etc;
18. the operating manual.

(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 ~~following~~ performance tests as defined in annex A~~,~~ to confirm acceptable performance for the following moisture meter tests:
~~(a)accuracy, repeatability, and reproducibility~~
~~(b)power source variation: voltage and frequency; battery voltage (if applicable)~~
~~(c)instrument stability~~
~~(d)instrument warm-up time~~
~~(e)instrument leveling~~
~~(f)instrument temperature sensitivity~~
~~(g)instrument humidity sensitivity~~
~~(h)instrument storage temperature~~
~~(i)grain temperature sensitivity~~
~~(j)Short time power reduction~~
~~(k)Bursts~~
~~(l)Electrostatic discharges~~
~~(m)~~(a) ~~Electromagnetic susceptibility~~

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 Annex ~~C~~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).

~~(1) D 11: General requirements for electronic measuring instruments, 2004~~
~~(2) ISO 712 Cereals and Cereal products- Determination of moisture content-Routine Reference method~~

(3) ~~ISO 7700-2 Check of the calibration of moisture meters-Part 2:moisture meters for oilseeds 1987~~
(4) ~~IEC/TR3 61000-2-1 Electromagnetic compatibility (EMC) Part 2 Environment Section 1: Description of the environment-Electromagnetic environment for low-frequency conducted disturbances and signaling in public power supply systems~~
(5) ~~IEC 61000-2-2 Electromagnetic compatibility (EMC) Part 2-2: Environment-Compatibility levels for low-frequency conducted disturbances and signaling in public power supply systems~~
(6) ~~IEC 61000-4-1 Electromagnetic compatibility (EMC) Part 4-1: Testing and measurement techniques-Overview of IEC 61000-4 series~~
(7) ~~IEC 61326 Electrical equipment for measurement, control and laboratory use-EMC requirements.~~
(8) ~~National Conference on Weights and Measures, Publication 14, 2006 edition.~~
(9) ~~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~~

Ref.	Standards and reference documents	Description
[1]	ISO/IEC Guide 99:2007 International vocabulary of metrology - Basic and general concepts and associated terms (VIM)	Provides a set of definitions and associated terms, in English and French, for a system of basic and general concepts used in metrology
[2]	The international vocabulary of terms in legal metrology, OIML 2000	Provides terms and definitions that are fully adopted by OIML and applicable in the field of legal metrology.
[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]	ISO 712: 1998 Cereals and Cereal products- Determination of moisture content (Routine Reference method)	Routine reference method for the determination of the moisture content of cereals and cereal products
[5]	ISO 7700-2: 1987 Check of the calibration of moisture meters-Part 2:moisture meters for oilseeds	A method of checking the calibration of moisture meters in service for measuring the moisture content of previously cleaned oilseeds
[6]	IEC/TR 61000-2-1: 1990 Electromagnetic compatibility (EMC) Part 2 Environment Section 1: Description of the environment-Electromagnetic environment for low-frequency conducted disturbances and signaling in public power supply systems	Provides information on the various types of disturbances that can be expected on public power 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: 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.
[13]	ISO 711: 1985 Cereals and cereal products - Determination of moisture content (Basic reference method)	This method serves as a standard for checking and perfecting routine methods for the determination of moisture content
[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.
[16]	IEC 60512-11-8	
[17]	IEC 60721-2-5	
[18]	IEC 61000-4-6	
[19]	IEC 61000-4-2	
[20]	IEC 60068-2-31	

ANNEX A
TEST PROCEDURES ~~(MANDATORY)~~

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.

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 45.4.1 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. 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)

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 45.4.1 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. The equation used to calculate instrument reproducibility is:

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

where,

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

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

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

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

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

Reproducibility requirements are defined in column 5 of table ~~4~~5.4.1 for the 6 % moisture range.

~~A.1.5~~A.2 Basic instrument tests - influence factor tests

~~A.1.5.1~~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.1.6~~A.2.2 Instrument stability

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 ~~4~~5.4.1.

~~A.1.7~~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.1.8~~

~~A.1.9~~A.2.4 Instrument power supply

~~A.1.10~~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.1.11~~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 45.4.1.

~~A.1.12~~A.2.6 Instrument Leveling

~~A.1.12.1~~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 four orientations of tilt; 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.1.13~~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 ~~B.3.5~~A.2.6.1 Orientations similar to those in ~~B.3.5~~A.2.6.1 shall be applied with the same performance requirements.

~~A.1.14~~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 ~~30~~ 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 ~~70~~ 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 54.4.1.

~~A.1.15~~A.2.8 **Instrument Temperature Sensitivity (Converting to heat test and cold test).**
One grain ~~or seed~~ type
Three 2 % moisture interval samples (i.e 10 % to 12 %, 12 % to 14 %, 14 % to 16 %)
Number of repetitions = 3
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 4.4.1.

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.2.9 Low voltage of internal battery (not connected to the mains power)
There is no reference to standards for this test. 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.1.16A.3 Sample temperature sensitivity - influence factor test:

Three grain or seed 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 ± 510 °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 there *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 manufacturers specification or if there is no separate specification, the minimum temperature difference requirement shall be ± 510 °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 5.3.1. for grain types of Row I, otherwise it is 2 x column 3 of table 5.4.1. for grain types 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 10, 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 Sand and dust

The applicable standards for the Sand and dust test are IEC 60512-11-8, IEC 60529, and IEC 60721-2-5 and the test method is Sand and dust. The objective of the test is to verify compliance with the provisions in 5.4.1 under a dust-laden atmosphere and the instrument shall not exhibit a significant fault after the disturbance as defined in 2.15. The test procedure consists of exposure to cyclic temperature variation between 30 °C and 65 °C, maintaining the following conditions:

- Relative humidity: less than 25 %
- Air velocity: 3 m/s
- Particle concentration: 5 g/m3
- Composition of the particles: as specified in 3.2.1 of IEC 60512-11-8 [17]

The severity level for this test is level 1. Severity level 1 consist of 1 cycle of testing.

~~A.1.18~~A.4.2 Short time power reductions:

The equipment under test(EUT) shall be exposed to mains voltage interruptions from nominal voltage to zero voltage, for a duration equal to a half cycle of line frequency (severity level 1a), and to mains voltage reductions from nominal voltage to 50 % of nominal voltage, for a duration equal to one cycle of line frequency (severity level 1b).

At least ten interruptions and ten reductions are applied, with a time interval of at least ten seconds between tests. The interruptions and reductions are repeated throughout the time necessary to measure the error (of indication) of the EUT; therefore more than ten interruptions and reductions may be necessary.

The difference between the intrinsic error and the error (of indication) measured whilst the EUT is subjected to mains voltage interruptions and reductions, at the same reference conditions, shall not exceed the maximum permissible error in the specified operating range (or significant faults are detected and acted upon by means of a checking facility).

~~A.1.19~~A.4.3 Bursts

The equipment under test is subjected to electrical bursts superimposed on the mains supply voltage. The EUT is subjected to bursts of double exponential waveform transient voltages with a peak amplitude of 1000 V (for electromagnetic environment E1. The class, E1 applies to instruments used in locations with electromagnetic disturbances corresponding to those likely to be found in residential, commercial and light industrial buildings.) and 2000 V (for electromagnetic environment E2. The class E2 applies to instruments used in locations with electromagnetic disturbances corresponding to those likely to be found in industrial buildings).

Each voltage spike shall have a rise time of 5 ns and a one half amplitude duration of 50 ns. The burst length shall be 15 ms and the burst period (repetition time interval) shall be 300 ms. All bursts shall be applied asynchronously, in asymmetrical mode (common mode). The bursts shall be applied for at least one minute during the measurement, or simulated measurement, for each polarity.

The error (of indication) of the EUT shall be measured during the application of the mains voltage bursts. The difference between the intrinsic error and the error (of indication) measured ~~whilst~~ while the EUT is subjected to mains voltage bursts, at the same reference conditions, shall not exceed the maximum permissible error in the specified operating range (or significant faults are detected and acted upon by means of a checking facility).

A.4.4 Radiated, radio-frequency, electromagnetic fields

The applicable standard for the radiated, radiofrequency, electromagnetic fields test is IEC 61000-4-3. The test method is Radiated electromagnetic fields. The object of the test is to verify compliance with the provisions in 5.4.1 and the instrument shall not exhibit a significant fault during the disturbance as defined in Section 2.15 under conditions of electromagnetic fields.

The test procedure involves the exposure of the EUT to electromagnetic field strength as specified by the severity level and a field uniformity as defined by the referred standard. 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. 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.

The severity levels for electromagnetic fields of general origin in the frequency ranges of 80 - 800 MHz, 26-800 MHz, and 960 - 1400 MHz is severity Level 2 (residential, commercial and light industrial environment) and severity, Level 3 (for industrial environment). Level 2 is 3V/m and Level 3 is 10 V/m

The severity levels for electromagnetic fields specifically caused by digital radio telephones in the frequency ranges of 800 - 960 MHz and 1400 - 2000 MHz is severity Level 3 and 4. Level 3 is 10 V/m and Level 4 is 30 V/m.

~~A.1.21Electromagnetic susceptibility – electromagnetic fields:~~

The equipment under test is subjected to 20 discrete frequency bands of electromagnetic radiation in the frequency range 26 MHz to 1000 MHz, at a field strength of either 10 V/m (for electromagnetic environment E1) or 10 V/m (for electromagnetic environment E2).

The difference between the intrinsic error and the error (of indication) measured ~~whilst~~ while the EUT is subjected to the electromagnetic radiation, at the same reference conditions, shall not exceed the maximum permissible error in the specified operating range (or significant faults are detected and acted upon by means of a checking facility).

A.4.5 Conducted radio-frequency fields

The applicable standard for the conducted radio-frequency field test is IEC 61000-4-6. the test method is Conducted electromagnetic fields. The objective of the test is to verify compliance with the provisions in 5.4.1 and the instrument shall not exhibit a significant fault during the disturbance as defined in Section 2.15 under conditions of electromagnetic fields.

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, (de-)coupling devices, attenuators, etc. shall be verified.

The severities (for a frequency range of 0.15 to 80 MHz, an RF amplitude (50 Ω) and Modulation 80 % AM and a 1 kHz sine wave) that are recommended for this test are level 2 for residential, commercial and light industrial environments and Level 3 for industrial environments:
For level 2 the severity is 3 V
For level 3 the severity is 10V

~~A.1.20~~A.4.6 Electrostatic discharge

The applicable standard for the electrostatic discharge test is IEC 61000-4-2. The test method is Electrostatic discharge (ESD) and the objective of the test is to verify compliance with the provisions in 5.4.1 under conditions of direct and indirect electrostatic discharges.

The test procedure involves the use of an ESD generator with a performance as defined in the referred standard. Before starting the tests, the performance of the generator shall be verified. At least 10 discharges shall be applied. The time interval between successive discharges shall be at least 10 seconds. For EUT not equipped with a ground terminal, the EUT shall be fully discharged between discharges. If the EUT is an integrating instrument, the test pulses shall be continuously applied during the measuring time. Contact discharge is the preferred test method. Air discharge shall be used where contact discharge cannot be applied.

Direct application:
In the contact discharge mode, which is to be carried out on conductive surfaces, the electrode shall be in contact with the EUT.

In the air discharge mode, which is to be carried out 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.

The test severity level for this test is level 3. At level 3 the contact discharge is 6 kV and the air discharge is 8 kV.

The error (of indication) of the equipment under test shall be measured while the EUT is subjected to electrostatic discharges at a severity level of 6 kV for contact discharges and of 8 kV for air discharges.

At each test location, at least ten discharges shall be applied with intervals of at least 10 seconds between discharges, throughout the period of the error (of indication) measurement. Air discharges shall only be applied where contact discharges cannot be applied. For indirect discharges, a total of ten discharges shall be applied on the horizontal coupling plane and a total of ten discharges for each of the various positions of the vertical coupling plane. The difference between the intrinsic error and the error (of indication) measured ~~whilst~~ while the EUT is subjected to electrostatic discharges, at the same reference conditions, shall not exceed the maximum permissible error in the specified operating range (or significant faults are detected and acted upon by means of a checking facility).

A.4.7 Mechanical shock

The applicable standard for the mechanical shock test is IEC 60068-2-31. The test method is Dropping on to a face. The object of the test is to verify compliance with the provisions in 5.4.1 under conditions of mechanical shocks and the instrument shall not exhibit a significant fault after the disturbance.

The test procedure involves the EUT, placed in its normal position of use on a rigid surface, the ETU is tilted towards one bottom edge and is then allowed to fall freely onto the test surface. The height of fall is the distance between the opposite edge and the test surface. However, the angle made by the bottom and the test surface shall not exceed 30°.

The severities for this test are severity levels 1 or 2, which ever is appropriate. For Severity level 1 the height of fall is 25 mm and for severity level 2 the height of fall is 50 mm.

Annex B
Test Report Format for
type evaluation of grain moisture meters for cereal grain and oil seeds

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 2009, 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.

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.

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:	---	---

4. Applicant information

Company Name:

____

Address:

____

City: ________________________________State: ________________Zip Code: ____________

Country: ___________________ Representative or Contact:_______________________________

Telephone (if applicable, include extension): ____________________ Fax: ___________________

Email:_____________________________Web site: ______________________________________

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

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".

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:______________________

6.2 Other Features

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

Comments:____
____
____

7. Temperature ranges

Specified Temperature Range (Environment):

____

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

____

Specified Grain Temperature Range (see Section 10 below):

____

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:

____

9. Power

Instrument Power requirements:

Nominal voltage: ____

Nominal frequency: ____

Battery operation specified voltage range: ________________________________

Battery operated? ☐ Yes ☐ No

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: ________________________________

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 (except white club)	10-16%		
Hard red spring wheat (and white club)	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.

12. Reference Method

Identify the laboratory reference method for moisture: ________________________________

13. 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:

14. 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: ____

____

____

____

15. 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:

16. 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 repititions		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: ____

17. 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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18. Humidity

<table>
<tr><td colspan="2">Equipment needed</td><td>Environmental chamber</td></tr>
<tr><td rowspan="2">Temperature</td><td>Instruments</td><td>22 ºC ± 2 ºC</td></tr>
<tr><td>Grain</td><td>22 ºC ± 2 ºC</td></tr>
<tr><td rowspan="2">Sample used</td><td>* Grain</td><td>HRW Wheat</td></tr>
<tr><td>* Moisture Range</td><td>12% -14%</td></tr>
<tr><td colspan="2">Separate sample required for each model:</td><td>No</td></tr>
<tr><td colspan="2">Separate sample required for each instrument:</td><td>No</td></tr>
<tr><td colspan="2">Number of repetitions:</td><td>10</td></tr>
</table>

<table>
<tr><th rowspan="2">Instrument ID</th><th rowspan="2" colspan="3">Measurements</th><th colspan="3">Calculations</th><th colspan="4">Results</th></tr>
<tr><th>Mean at 20% humidity</th><th>Mean at 90% humidity</th><th>Diff. in mean values of 20% and 90% humidity</th><th>MPE for diff. bet. Mean values of 20% and 90% humidity Table 5.4.1 Column 3</th><th>Passed</th><th>Failed</th><th>Comments</th></tr>
<tr><td rowspan="10">(1)</td><td rowspan="5">20% humidity</td><td>1</td><td>6</td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="10"></td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td></tr>
<tr><td>2</td><td>7</td></tr>
<tr><td>3</td><td>8</td></tr>
<tr><td>4</td><td>9</td></tr>
<tr><td>5</td><td>10</td></tr>
<tr><td rowspan="5">90% humidity</td><td>1</td><td>6</td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td></tr>
<tr><td>2</td><td>7</td></tr>
<tr><td>3</td><td>8</td></tr>
<tr><td>4</td><td>9</td></tr>
<tr><td>5</td><td>10</td></tr>
<tr><td rowspan="10">(2)</td><td rowspan="5">20% humidity</td><td>1</td><td>6</td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="10"></td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td></tr>
<tr><td>2</td><td>7</td></tr>
<tr><td>3</td><td>8</td></tr>
<tr><td>4</td><td>9</td></tr>
<tr><td>5</td><td>10</td></tr>
<tr><td rowspan="5">90% humidity</td><td>1</td><td>6</td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td></tr>
<tr><td>2</td><td>7</td></tr>
<tr><td>3</td><td>8</td></tr>
<tr><td>4</td><td>9</td></tr>
<tr><td>5</td><td>10</td></tr>
</table>

*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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19. 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%**								
		12-14%								
		14-16%								
Instrument 2	**HRW wheat**	**10-12%**								
		12-14%								
		14-16%								

*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: ____

20. Instrument Temperature Sensitvity

Equipment needed		Thermometers, Boerner, Environmental chamber
Temperature	**Instruments**	22 ºC ± 2 ºC, Manufacturer specified low and high operating limits
	Grain	22 ºC ± 2 ºC ± Manufacturerspecified 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**	**Passed**	**Failed**	**Comments**
Instrument 1	**HRW wheat**	**10-12%**				**22 ºC**						
		12-14%				**22ºC - ΔT**						
		14-16%				**22ºC + ΔT**						
Instrument 2	**HRW Whet**	**10-12%**				**22 ºC**						
		12-14%				**22ºC - ΔT**						
		14-16%				**22ºC + ΔT**						

*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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21. 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%**							**22 ºC**					
		12-14%							**22ºC - ΔT**					
		14-16%							**22ºC + ΔT**					
	Soybeans	**10-12%**							**22 ºC**					
		12-14%							**22ºC - ΔT**					
		14-16%							**22ºC + ΔT**					
	Corn	**12-14%**							**22 ºC**					
		14-16%							**22ºC - ΔT**					
		16-18%							**22ºC + ΔT**					

Sample Temperature Sensitivity (Page 2 of 2)

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 2	HRW wheat	10-12%							22 ºC					
		12-14%							22ºC - ΔT					
		14-16%							22ºC + ΔT					
	Soybeans	10-12%							22 ºC					
		12-14%							22ºC - ΔT					
		14-16%							22ºC + ΔT					
	Corn	12-14%							22 ºC					
		14-16%							22ºC - ΔT					
		16-18%							22ºC + ΔT					

*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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13. 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	$\overline{y}$	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.

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

Additional Comments: ____

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14. 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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15. 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.

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

Additional Comments: ____

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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.2.4.1	Main voltage variation				
A.2.1	Instrument stability				
A.2.3	Instrument warm-up time				
A.2.6	Instrument leveling				
A.2.8	Instrument temperature sensitivity				
A.2.7	humidity				
A.2.5	Instrument storage temperature				
A.3	Sample temperature sensitivity				
A.4	Disturbance test for electronic instruments				
A.4.1	Sand and dust				
A.4.2	Short time power reduction				
A.4.3	Bursts				
A.4.6	Electrostatic discharges				
A.4.4	Radiated, radiofrequency, electromagnetic field				
A.2.3	Instrument warm up time				
A.2.9	Low voltage of internal baterry (not connected to the mains power)				

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			