International Standard 7700/1

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Check of the calibration of moisture meters — Part 1 : Moisture meters for cereals

Contrôle d'étalonnage des humidimètres — Partie 1 : Humidimètres pour céréales

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Foreword

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It has been approved by the member bodies of the following countries :

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Check of the calibration of moisture meters — Part 1 : Moisture meters for cereals

0 Introduction

The calibration of moisture meters may, for stable samples and ideal measuring conditions, prove entirely satisfactory. On the other hand, the results obtained with the same moisture meter can be affected by many variables of cultivation, ripeness, humidity, temperature, harvesting, transport and level of impurities, particularly for cereals received with high moisture content.

1 Scope and field of application

This part of ISO 7700 specifies a method of checking the calibration of moisture meters in service for measuring the moisture content of cereal grains, by checking some values or a range covering all the values for which the moisture meter is used.

It is applicable to oats, durum wheat, wheat, maize, barley, rice, rye and sorghum.[1)]

2 References

ISO 712, *Cereals and cereal products — Determination of moisture content (Routine method).*

ISO 5223, *Test sieves for cereals.*

ISO 6540, *Maize — Determination of moisture content (on milled grains and on whole grains).*

3 Principle

Preparation of several test samples, or a range of test samples, with different moisture contents, under specified conditions, determination of their moisture contents by a reference method and measurement with the moisture meter to be checked.

4 Reagent

Use only distilled water or water of equivalent purity.

4.1 Sodium hypochlorite (bleach) solution of approximately 5,7 % (*m*/*m*) active chlorine (18 chlorometric degrees).

5 Apparatus

Usual laboratory apparatus, and in particular

5.1 Bottles, with airtight seals, of capacity approximately 2 l, cleaned with a bactericide and fungicide, such as the bleach (4.1), rinsed three times with distilled water and dried.

5.2 Apparatus required for the routine reference method of determining moisture content (see ISO 712 or ISO 6540).

5.3 Sieves, for cleaning the grain, complying with the requirements of ISO 5223, and in particular sieves with long rounded apertures of width 1,80; 2,00; and 2,24 mm and with round holes of diameter 4,50 mm, or a **mechanical separator.**

6 Procedure

6.1 Selection and cleaning of samples

Select a variety or varieties or better still a mixture of varieties of a cereal from those which are the most prevalent in the region where the moisture meter is used. In the case of maize, the choice depends on the type of grain (dent, flint, dent-flint) rather than on the variety.

Clean the samples by removing undersize material, including shrivelled grains, by manual sieving using appropriate sieves (see 5.3) and removing larger impurities by hand or using a mechanical separator (5.3).

As an indication, use the following sieves :

— sieve with long rounded apertures of width 1,80 mm for rye and durum wheat;

— sieve with long rounded apertures of width 2,00 mm for wheat;

— sieve with long rounded apertures of width 2,24 mm for barley;

— sieve with long round holes of diameter 4,50 mm for maize.

1) The case of sorghum has not been studied in depth, but it would seem that it can be put in the same catergory as maize for the preparation of test samples.

6.2 Preparation of test samples

6.2.1 Procedure when checking several values

6.2.1.1 According to the number of values to be checked, prepare a greater or lesser number of test samples, each having a mass of approximately 1 kg and various moisture contents between 10 and 25 % (*m*/*m*) for cereals other than maize, and between 12 and 45 % (*m*/*m*) for maize.

Preferably choose moisture contents close to those which are most frequently observed in the region where the moisture meter is used.

6.2.1.2 To prepare the test samples, in the case of cereals other than maize, use by preference the samples selected in 6.1 which in their natural state have the moisture contents necessary for the test, or if necessary samples specially conditioned by the procedure specified in 6.2.3.

In the case of maize, it is essential to select samples which, in their natural state, have the moisture contents necessary for the test, as any drying or wetting is prohibited for instruments measuring electrical properties.

Place the samples in the bottles (5.1) and seal them.

6.2.2 Procedure when checking a range

6.2.2.1 Prepare a range of 10 test samples each having a mass of approximately 1 kg and various moisture contents, at intervals as regular as possible, between 10 and 25 % (*m*/*m*) for cereals other than maize, and between 12 and 45 % (*m*/*m*) for maize.

6.2.2.2 To prepare this range of test samples, proceed as specified in 6.2.1.2.

6.2.3 Conditioning of samples

This subclause does not apply to maize; maize shall not be conditioned (see 6.2.1.2).

6.2.3.1 If conditioning is necessary, take a sample (see 6.1) having a moisture content at the time of harvesting equal to or less than the lowest moisture content selected for the calibration range, or failing that, bring the required quantity of sample selected to this minimum moisture content by drying very gradually at a temperature not exceeding 30 °C, using ventilation if necessary.

6.2.3.2 For each desired moisture content, place in a bottle (5.1) a quantity of the sample such that the bottle is between a half and two-thirds full.

6.2.3.3 Calculate the quantity of distilled water necessary to bring each sample to the selected moisture content, using the formula

$$m \times \frac{H_2 - H_1}{100 - H_2}$$

where

m is the mass, in grams, of the sample;

H_1 is the moisture content, expressed as a percentage by mass, of the sample;

H_2 is the moisture content, expressed as a percentage by mass, selected for the calibration.

Using a burette or graduated pipette, add in rapid drops to each sample, in one or two portions, as the case may be (see 6.2.3.4), the volume of distilled water thus calculated, while shaking the bottle. Seal the bottle.

6.2.3.4 In order to ensure that the water is evenly distributed, shake the bottles by inverting them by hand, under the following conditions :

— If the difference between the desired moisture content and the moisture content of the sample is less than 10 % (*m*/*m*) (absolute), add the quantity of the water calculated above in one portion, and shake energetically over 4 days as described in table 1, taking great care to turn the bottle upright again after shaking.

— If the difference between the desired moisture content and the moisture content of the sample is more than 10 % (*m*/*m*) (absolute), add the quantity of the water calculated above in two equal portions at an interval of 24 h and shake energetically at regular intervals over 5 days as described in table 2, taking great care to turn the bottle upright again after shaking.

In all cases, the bottles shall be kept at a temperature of approximately 5 °C, for example in a refrigerator.

NOTE — Instead of shaking by hand, it is possible to use an apparatus allowing either very slow, continuous shaking to be carried out over 5 days at 5 °C, or vigorous shaking in accordance with the timetable given in tables 1 and 2 for manual shaking.

Table 1

Period		Approximate duration of shaking s
First day	As soon as water has been added	60
	First hour	15
	Second hour	15
	Third hour	15
	Between the third hour and the end of the first day	15
Second day		15
Third day		15
Fourth day		15

Table 2

Period		Approximate duration of shaking s
First day	As soon as the first fraction of water has been added	60
	First hour	15
	Second hour	15
	Third hour	15
	Between the third hour and the end of the first day	15
Second day	As soon as the second fraction of water has been added	60
	First hour	15
	Second hour	15
	Third hour	15
	Between the third hour and the end of the second day	15
Third day		15
Fourth day		15
Fifth day		15

6.3 Checking the moisture meter

6.3.1 Procedure when checking several values

6.3.1.1 If the test samples have not been conditioned, ensure that they have been kept under the same temperature conditions as the moisture meter before the test; if not keep them under these conditions to allow them to reach thermal equilibrium with the moisture meter. If the test samples have been conditioned, remove the bottles from the refrigerator at least 16 h (usually overnight) before the test, to allow them to reach thermal equilibrium with the moisture meter. In all cases, note the temperature at which thermal equilibrium is reached.

Reject the test samples if they emit an odour of fermentation or are mouldy (in the case of a range, it is necessary to start again).

6.3.1.2 On each previously mixed test sample, carry out the following operations :

a) Determine the moisture content by the routine reference method specified in ISO 712 or, in the case of maize, in ISO 6540.

Take as the result the arithmetic mean of two determinations. It is imperative to comply with this condition.

b) Using the moisture meter, carry out four successive measurements using four test portions taken from the test sample.

In the case of moisture meters designed to take readings on whole grains, which in general require large test portions, transfer each test portion back into the bottle containing the test sample after each measurement, and mix by shaking the bottle before taking a new test portion.

In the case of moisture meters for taking readings on ground grains, which, in general, require small test portions (less than 50 g), carry out the grinding and measurement strictly according to the manufacturer's instructions. Discard all test portions after use.

c) After four measurements have been taken, again determine the moisture content by the routine reference method, proceeding as described in a).

6.3.2 Procedure when checking a range

On each test sample, carry out the same operations specified in 6.3.1 and repeat the operations specified in 6.3.1.2 at an interval of 24 h using the same test samples for cereals other than maize, and different test samples for maize.

7 Expression of results

7.1 Procedure when checking several values

7.1.1 For each test sample, the following values are available :

— two results obtained by the routine reference method, x.

The difference between these two results shall not exceed 0,15 g of moisture per 100 g of sample for products not requiring pre-conditioning (defined in 6.2.3), and 0,20 g of moisture per 100 g of sample for products requiring pre-conditioning. Otherwise, repeat the test;

— four measurements carried out with the moisture meter, y.

7.1.2 For each test sample, calculate the difference between the result of each measurement carried out with the moisture meter, y, and the mean of the two results obtained by the routine reference method, $\bar{x}$, i.e. $y - \bar{x}$.

The values $y - \bar{x}$ shall be less than the maximum permitted errors such as those specified in the annex.

7.2 Procedure when checking a range

7.2.1 Deal separately with the two series of measurements carried out at an interval of 24 h and compare them to ensure that there has been no development of the grain (maize excluded) and/or variation in the response of the moisture meter over this 24 h period.

7.2.2 For each test sample and for each series of measurements, the following values are available :

— two results obtained by the routine reference method, x.

The difference between these two results shall not exceed 0,15 g of moisture per 100 g of sample for products not requiring pre-conditioning (defined in 6.2.3), and 0,20 g of moisture per 100 g of sample for products requiring pre-conditioning. Otherwise, repeat the test.

— four measurements carried out with the moisture meter, y.

7.2.3 For each test sample and for each series of measurements, calculate the difference between the mean of the four measurements carried out with the moisture meter, $\bar{y}$, and the mean of the two results determined by the routine reference method, $\bar{x}$, i.e. $\bar{y} - \bar{x}$.

For each series of measurements, the values of $\bar{y} - \bar{x}$ should be less than the maximum permitted errors, such as those specified in the annex. If a value of $\bar{y} - \bar{x}$ is greater than the maximum permitted error, repeat the measurements on the corresponding test sample.

8 Test report

The test report shall show the method used, the test temperature, the type of moisture meter used and its precision class, and the results obtained. In addition, it shall mention any operating details not specified in this International Standard, or regarded as optional, as well as any incidents likely to have influenced the results.

The test report shall include all the information necessary for the complete identification of the sample.

Annex

Maximum permitted errors

The maximum permitted errors for moisture meters in service, in accordance with draft OIML International Recommendation No. 59 concerning moisture meters for cereals and oilseeds, are as follows.[1)]

A.1 Class I moisture meters (see also the figure)

— For cereals other than maize, rice and sorghum :

0,7 (absolute) for a moisture content, $\bar{x}$, less than 10 % (m/m);

0,4 (absolute) plus 3 % (relative) for a moisture content, $\bar{x}$, greater than 10 % (m/m).

— For maize, rice and sorghum :

0,8 (absolute) for a moisture content, $\bar{x}$, less than 10 % (m/m);

0,4 (absolute) plus 4 % (relative) for a moisture content, $\bar{x}$, greater than 10 % (m/m).

A.2 Class II moisture meters

— For cereals other than maize, rice and sorghum :

0,8 (absolute) for a moisture content, $\bar{x}$, less than 10 % (m/m);

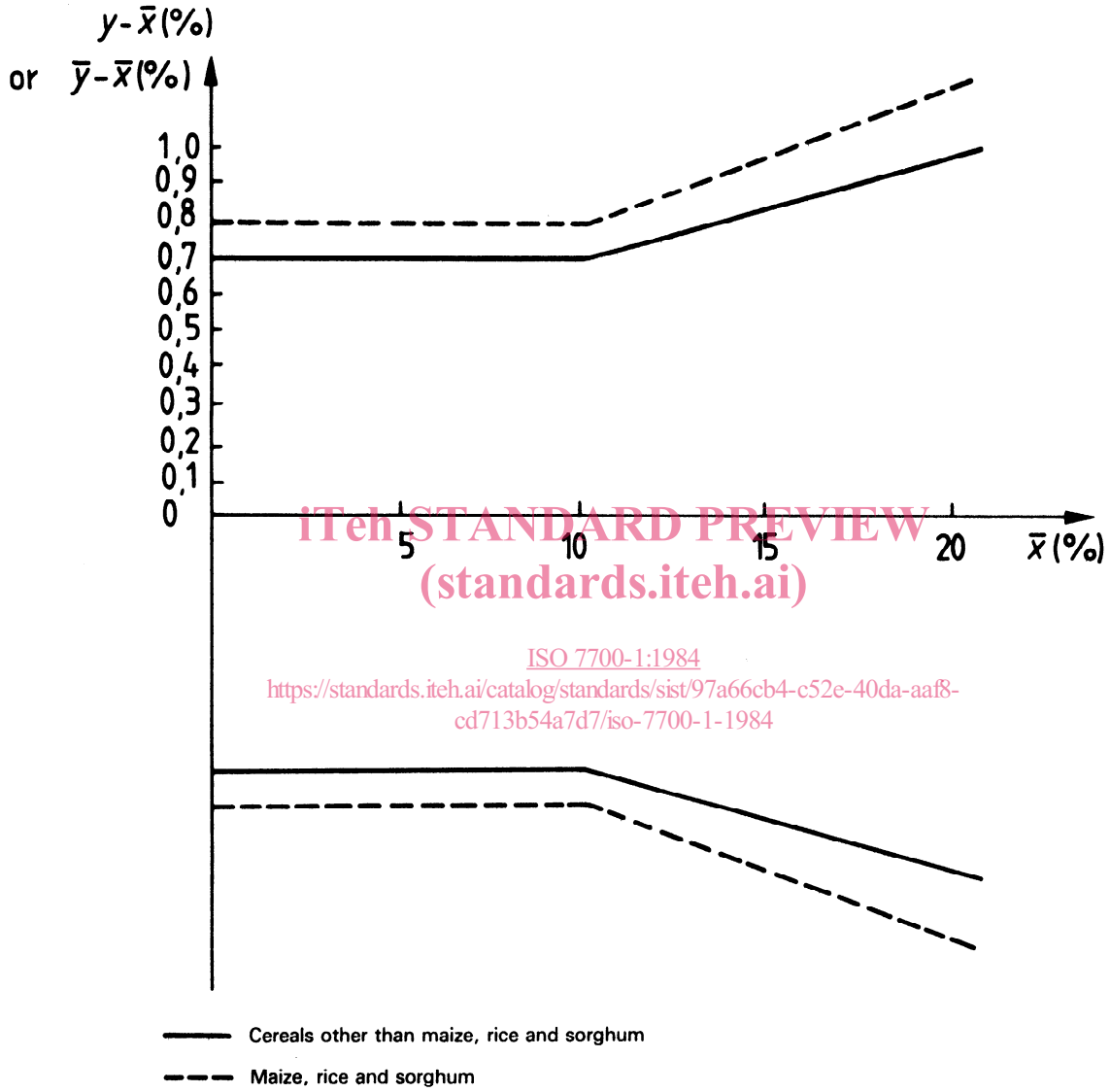
0,4 (absolute) plus 4 % (relative) for a moisture content, $\bar{x}$, greater than 10 % (m/m).

— For maize, rice and sorghum :

0,9 (absolute) for a moisture content, $\bar{x}$, less than 10 % (m/m);

0,4 (absolute) plus 5 % (relative) for a moisture content, $\bar{x}$, greater than 10 % (m/m).

1) The precision classes of moisture meters are also defined in draft OIML International Recommendation No. 59.



The values of $y - \bar{x}$ (see 7.1) or $\bar{y} - \bar{x}$ (see 7.2) shall be situated within the limits defined by this graph.

Figure — Graph showing the maximum permitted errors for class I moisture meters