भारतीय मानक

Indian Standard

IS 4333 (Part 3) : 2023
ISO 7971-3 : 2019

खाद्यानों की विश्लेषण पद्धति

भाग 3 द्रव्यमान प्रति हेक्टोलीटर नामक बल्ब घनत्व का निर्धारण (सामान्य विधि)

(तीसरा पुनरीक्षण)

Methods of Analysis for Foodgrains

Part 3 Determination of Bulk Density, Called Mass Per Hectolitre (Routine Method)

(Third Revision)

ICS 67.060

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May 2023 **Price Group 8**

Foodgrains, Allied Products and Other Agricultural Produce Sectional Committee, FAD 16

NATIONAL FOREWORD

This Indian Standard (Third Revision) which is identical with ISO 7971-3 : 2019 ‘Cereals — Determination of bulk density, called mass per hectolitre — Part 3: Routine method’ issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on recommendation of the Foodgrains, Allied Products and Other Agricultural Produce Sectional Committee and approval of the Food and Agriculture Division Council.

This standard was first published in 1967 and then revised subsequently in 2002 and 2018. In 2002, the standard was revised to align it with ISO 7971-2 : 1995 ‘Cereals — Determination of bulk density, called mass per hectolitre — Part 2: Routine method’ under dual numbering system. Second revision was undertaken to align the standard with ISO 7971-3 : 2009 ‘Cereals — Determination of bulk density, called mass per hectolitre — Part 3: Routine method’ which had replaced ISO 7971-2 : 1995 after incorporation of technical changes. This revision (third) has been brought out to align the standard with the latest version of ISO 7971-3 : 2019.

This standard is published in 5 parts under the general title ‘Methods of analysis for foodgrains’, the other parts are:

Part 1 Refractions
Part 2 Determination of moisture content
Part 4 Determination of the mass of 1 000 grains
Part 5 Determination of uric acid

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words ‘International Standard’ appear referring to this standard, theyshould be read as ‘Indian Standard’.
b) Comma (,) has been used as a decimal marker while in Indian Standards, the currentpractice is to use a point (.) as the decimal marker.

The technical committee has reviewed the provision of the following International Standards referred in this adopted standard and has decided that they are acceptable for use in conjunction with this standard:

International Standard	*Title*
ISO 7971-2 : 2009	Cereals — Determination of bulk density, called mass per hectoliter — part 2: Method of traceability for measuring instruments through reference to the international standard

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’.

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Indian Standard

METHODS OF ANALYSIS FOR FOODGRAINS

PART 3 DETERMINATION OF BULK DENSITY, CALLED MASS PER HECTOLITRE (ROUTINE METHOD)

(Third Revision)

1 Scope

This document specifies a routine method for the determination of bulk density, called "mass per hectolitre", of cereals as grain using manual or automatic, mechanical, electric or electronic mass per hectolitre measuring instruments.

NOTE Further details of the measuring instruments are specified in ISO 7971-2:2019, 6.4.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7971-2:2019, *Cereals — Determination of bulk density, called mass per hectolitre — Part 2: Method of traceability for measuring instruments through reference to the international standard instrument*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
mass per hectolitre
bulk density
test weight
<cereals> ratio of the mass of a cereal to the volume it occupies after being poured into a container under defined manufacturer's conditions

Note 1 to entry: Mass per hectolitre is expressed in kilograms per hectolitre of grains as received.

Note 2 to entry: Mass per hectolitre, as defined in this document, is different from "packing density" or "intrinsic density" of cereals.

[SOURCE: ISO 7971-1:2009, 2.1, modified — In the definition, "defined manufacturer's conditions" has replaced "well-defined conditions".]

4 Principle

The mass per hectolitre of a cereal is obtained from the mass of a volume of cereal determined under controlled sample filling and flow conditions.

The mass per hectolitre can be affected by

a) space between the grains, which depends on the grain size and shape, and

b) density of the grains.

5 Apparatus

5.1 General requirement for mass per hectolitre apparatus. Any apparatus (5.2 and 5.3) shall be verified in accordance with ISO 7971-2 and shall fulfil the performance demands specified therein.

5.2 Hand-operated measuring instrument. Apparatus consisting of a filling hopper, a measuring container and the accessories necessary for their use.

The manner in which the grain is poured into the measuring container and the way in which it packs into the container can cause the measurements taken by the various instruments to vary and lead to measurement errors.

To minimize such variations, special attention should be given to ensuring that the design of the instruments and their size, material and shape are appropriate.

NOTE Annexes A and B contain examples of technical specifications of two hand-operated instruments with a capacity of 1 l.

5.3 Automatic measuring instrument. This category includes various types of devices, some of which can be used on their own or combined with an infrared analyser.

The measurement is based on the application of formulae to allow the correcting of the bias and/or the drifts monitored. It does not include manual weighing. The numeric value of the hectolitre mass is directly displayed.

5.4 Analytical balance, capable of being read to the nearest 0,1 g or 0,01 g depending on the volume of the container (see 6.2).

5.5 Spirit level.

6 Procedure

6.1 General

The measurements shall be taken using grain from which large impurities (straw, stones, large amounts of loose husks, etc.) have been discarded, taking environmental conditions into consideration to ensure that there is no difference in temperature between the grain and the room in which the test is performed.

Determine the mass per hectolitre in duplicate. For all the devices and for every sample, it is advisable to perform the two measurements on two different grain test portions, when the sample size enables it.

NOTE Repeating the measurement on the same grain test portion changes the friction coefficient which therefore makes it easier for the grains to slide; they are then more tightly packed, which increases the value of the mass per hectolitre.

6.2 Hand-operated instruments

Check that the various components of the instrument are clean and that they are working properly.

Make sure that equipment is placed on a firm, flat base, after using a spirit level to check that the base is horizontal.

Take great care to avoid any impact during filling. If the apparatus is jolted, cancel the test and start again.

Each type of apparatus is different; use each according to the manufacturer's instructions.

When using the analytical balance (5.4), weigh to the nearest 1 g for a 1 l container or the nearest 0,1 g for apparatus with a container of smaller volume.

6.3 Automatic instruments

As the operations to be performed prior to the actual measurement differ according to the type of equipment used, reference to the manufacturer's instructions is recommended.

Ensure that the instrument is placed on a horizontal surface in a room protected from extreme temperatures, humidity, dust and vibrations.

Take particular care to

a) select the correct cereal to be measured to ensure that the right calibration is used,

b) use the volume of cereals recommended for the device in question, and

c) empty the collector drawer between samples.

6.4 Expression of results

Take the arithmetic mean of the two determinations as the result if the repeatability conditions are met.

Express the result to the nearest 0,1 kg/hl.

If they are not met, take as a final result the mean of the four measurements.

Specify in the analysis report the conditions for obtaining the final result that can be attributed to sample variability.

7 Precision

7.1 Interlaboratory trial

Details of an interlaboratory test on the precision of the method are summarized in Annex C. The values derived from this interlaboratory test cannot be applied to other mass per hectolitre ranges and matrices than those given.

7.2 Repeatability

The absolute difference between two independent single test results, obtained using the same method on identical test material in the same laboratory by the same operator using the same equipment within a short interval of time, shall in not more than 5% of cases be greater than the repeatability limit

$$r = 0{,}4$$

for products where the mass per hectolitre is between 67,5 kg/hl and 84,5 kg/hl (see Tables C.1 and C.2, and Figure C.1).

7.3 Reproducibility

The absolute difference between two single test results, obtained using the same method on identical test material in different laboratories with different operators using different equipment.

In practice, it is not appropriate to compare the results from two laboratories if the test concerned imposes repeatability conditions.

The appropriate comparison tool is the critical difference as described in 7.5

7.4 Comparison of two groups of measurements in one laboratory

Critical difference, CD_r, is the difference between two averaged values obtained from two test results under repeatability conditions. As the result is a mean of two values (see 6.1), the comparison of two bulk densities shall be made with critical difference.

CD_r is given by Formula (1):

$$CD_r = 2{,}8 s_r \sqrt{\frac{1}{2n_1} + \frac{1}{2n_2}} = 2{,}8 s_r \sqrt{\frac{1}{2}} = 1{,}98 s_r = 0{,}23 \quad (1)$$

i.e. 0,2 kg/hl, after rounding, where

s_r is the standard deviation of repeatability;

n_1 and n_2 are the number of test results corresponding to each averaged value (here, $n_1 = n_2 = 2$).

7.5 Comparison of two groups of measurements in two laboratories

The critical difference, CD_R, between two averaged values obtained in two different laboratories from two test results under repeatability conditions is given by Formula (2):

$$CD_R = 2{,}8 \sqrt{s_R^2 + s_r^2 \left(1 - \frac{1}{2n_1} - \frac{1}{2n_2}\right)} = 2{,}8 \sqrt{s_R^2 - 0{,}5 s_r^2} = 1{,}18 \quad (2)$$

i.e. 1,2 kg/hl, after rounding, where

s_r is the standard deviation of repeatability;

s_R is the standard deviation of reproducibility;

n_1 and n_2 are the number of test results corresponding to each averaged value (here, $n_1 = n_2 = 2$).

7.6 Uncertainty

Uncertainty, U, is a parameter representing the distribution of the values which may reasonably be attributed to the result.

It is possible to evaluate the measurement uncertainties using data obtained from studies conducted in accordance with ISO 5725-2.

The reproducibility standard deviation obtained in a collaborative study is a valid basis for the evaluation of measurement uncertainty since, per definition, uncertainty characterizes the dispersion of the values which may be reasonably attributed to the parameter. The calculated expanded uncertainty should be ≤ +/−2 reproducibility standard deviation.

8 Test report

The test report shall contain at least the following information:

a) an indication of the method used, including a reference to this document, i.e. ISO 7971-3;

b) the result obtained;

c) all the operating details not specified in this document or those regarded as optional, in addition to any possible incidents that might have affected the result;

d) all the information necessary for a full identification of the sample.

Annex A
(informative)

Description of dimensions and use of KERN[1)]

A.1 Dimensions of the apparatus

A.1.1 General

The dimensions of the various components of the apparatus should be as specified in A.1.2 to A.1.7. See Figure A.1 for a depiction of the components.

A.1.2 Pre-filling measure

Volume to level mark:	1 350 ml ± 10 ml
Internal diameter:	86,0 mm ± 0,2 mm

A.1.3 Filling hopper

Internal diameter:	79,0 mm ± 0,1 mm
Wall thickness:	1,0 mm ± 0,2 mm
Height above piston:	280 mm ± 2 mm

A.1.4 Piston

Diameter:	87,5 mm ± 0,1 mm
Height:	40,0 mm ± 0,2 mm
Mass:	450 g ± 2 g

A.1.5 Measuring container

Internal diameter:	88,2 mm ± 0,1 mm
Internal height above piston:	163,7 mm ± 0,1 mm
Wall thickness:	1,2 mm ± 0,5 mm
External reinforcement of upper edge:	
— thickness:	2,5 mm ± 0,5 mm
— height:	6,0 mm ± 1,0 mm
Base thickness:	4,5 mm ± 0,1 mm

1) This is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

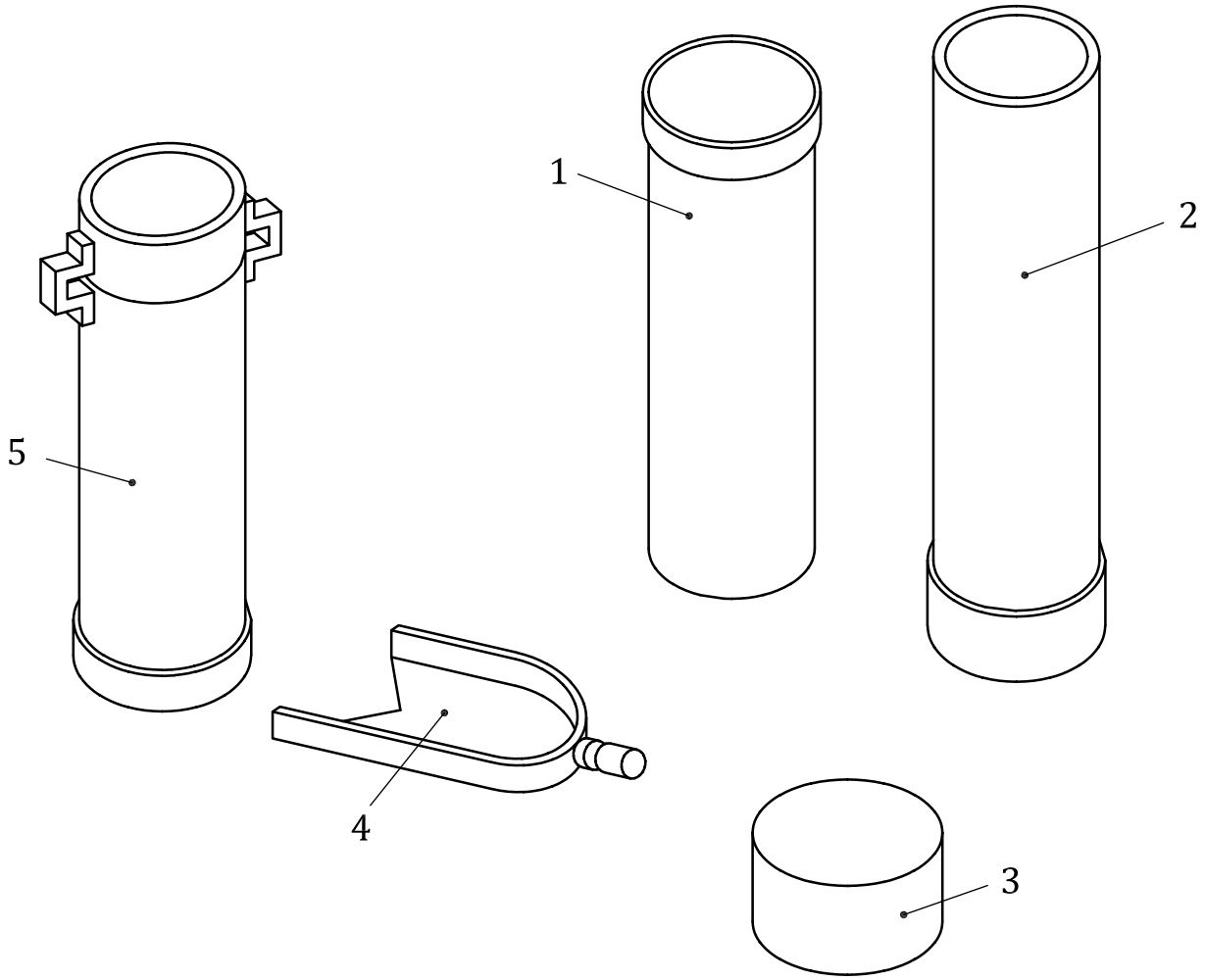
Diameter of base perforations:	3,0 mm ± 0,1 mm
Foot height:	9,0 mm ± 0,1 mm
Foot diameter:	6,0 mm ± 0,1 mm
Gap between base and base plate:	6,0 mm ± 0,1 mm
Number of perforations in base:	1 + 4 + 8 + 12 + 16 + 20 + 24 = 85
Measuring ring:	
— internal diameter:	88,2 mm ± 0,1 mm
— height:	40,5 mm ± 0,1 mm

A.1.6 Base plate

Locating circle diameter:	80,0 mm ± 0,1 mm

A.1.7 Straightedge (levelling blade)

Thickness:	1,00 mm ± 0,05 mm
Cut-out angle:	90° ± 2°
Width of cutting edge bevel:	3,0 mm ± 0,5 mm



Key

1 pre-filling measure
2 filling-tube
3 piston
4 straightedge
5 measuring container

Figure A.1 — Apparatus for the determination of mass per hectolitre of cereals using a 1 l measuring container

A.2 Specifications of the apparatus

A.2.1 Pre-filling measure. The pre-filling measure should be made of metal in the shape of a straight-sided cylinder closed at the bottom end, with a flat base plate. It should have a circular level mark on the inside wall situated no less than 10 mm and no more than 30 mm from the open end.

NOTE The pre-filling measure controls the way in which the filling hopper (A.2.2) is filled with grain and consequently reduces or eliminates possible operator errors.

A.2.2 Filling hopper. The hopper should be made of metal in the shape of a straight-sided cylinder which is open at both ends. At the bottom of the cylinder, an extended projection around the circumference of the cylinder enables the filling hopper to be pushed on to the ring at the top of the measuring container (A.2.3). The hopper receives a quantity of grain of more than 1 l from the pre-filling measure (A.2.1).

A.2.3 Measuring container with measuring ring. The 1 l volume of the measuring container is delimited by the inside surface of the container wall, the upper side of the piston (A.2.4) and the underside of the straightedge (A.2.5), once it is in position. The maximum permissible relative error in the capacity of the container is ±0,3 %. The wall of the measuring container consists of a seamless drawn brass tube or a stainless steel tube in the shape of a straight-sided cylinder that is open at the top and closed at its base, with a reinforced outer edge. The top edge should be ground flat.

A measuring ring with the same internal diameter as the measuring container should be attached to the edge of the measuring container. The gap between the edge and the measuring ring should be sufficient to allow the straightedge (A.2.5) to pass through easily, but the clearance should not be too great.

The base of the measuring container should be flat and perforated to allow air to pass through when the instrument is in use. The external reinforcement around the base of the measuring container and its three feet should be in one piece. It should be firmly welded to the wall of the measuring container.

A.2.4 Piston. The piston should be made of brass in the shape of a straight-sided cylinder with flat ends. Its inner wall should be strengthened to enable it to withstand stamping without its surface being distorted. In the event of distortion or any other damage, the piston should be replaced to ensure that the volume of grain measured is not affected.

When the straightedge (A.2.5) is withdrawn, the piston moves slowly down the measuring container (A.2.3), forcing air through the vent holes drilled in the base of the measuring container. This movement controls the speed of the falling grain and ensures an even flow into the measuring container (A.2.3) from the filling hopper (A.2.2).

A.2.5 Straightedge. The straightedge should consist of a thin but rigid, flat hardened steel blade with a handle. Its surfaces should be flat and parallel. It should be sufficiently wide to completely cover the cross-section of the measuring container at the end of its travel. The blade should be cut into a V shape which is open at the front and bevelled to ensure that the cutting line is in the middle of the thickness of the blade.

The blade slides horizontally into the slot in the measuring container (A.2.3) and, guided by this slot, it is thrust manually into the grain in a continuous, but smooth, movement. This movement separates exactly 1 l of grain (below the blade) from the excess grain (above the blade).

A.2.6 Base plate. The base plate should be made of metal and mounted in such a way that the measuring container (A.2.3) can be fitted securely to the base plate simply by rotating it. The base plate should not be perforated. It should be secured to a hardwood mounting plate or to the hardwood lid of the instrument carrying case. The mounting plate or case should be provided with vertical adjustment screws and a spirit level to ensure that the instrument remains vertical and in position after being placed on a flat, horizontal surface. Otherwise, errors are inevitable.

A.3 Determination

Fill the pre-filling measure with the sample of grain up to the level mark. Then empty it to within 30 mm or 40 mm from the upper edge of the filling hopper in such a way that the grain sample flows evenly into the middle of the filling hopper in 11 s to 13 s. After filling, quickly pull out the straightedge, but without shaking the apparatus.

When the piston and the grain have fallen into the measuring container, place the straightedge back in the slit and push it through the grain in a single stroke. If a particle becomes jammed between the slit edge and the straightedge in the process, the pouring should be repeated. Throw out excess grain lying on the straightedge. Then remove the filling hopper and straightedge.

Throughout the procedure, the apparatus should not be tapped, knocked or shaken, otherwise a falsely high result is obtained. However, once the 1 l volume has been isolated, this restriction need not be observed.

Use the balance (5.4) to weigh the content of the measuring container to the nearest 1 g. Alternatively, the grain may be poured into a separate previously tared receptacle and weighed to the nearest 1 g.

A.4 Expression of results

To calculate the mass per hectolitre, ρ, expressed in kilograms per hectolitre, with this type of device, Formulae (A.1) to (A.4) are applied:

for wheat:

$$\rho = 0{,}100\,2m + 0{,}53 \tag{A.1}$$

for barley:

$$\rho = 0{,}103\,6m - 2{,}22 \tag{A.2}$$

for rye:

$$\rho = 0{,}101\,7m - 0{,}08 \tag{A.3}$$

for oats:

$$\rho = 0{,}101\,3m - 0{,}61 \tag{A.4}$$

where m is the mass, in grams, of the cereal.

NOTE Formulae (A.1) to (A.4) provide linear mathematical conversions from grams per litre to kilograms per hectolitre. The factors are taken from data published in Reference [5].

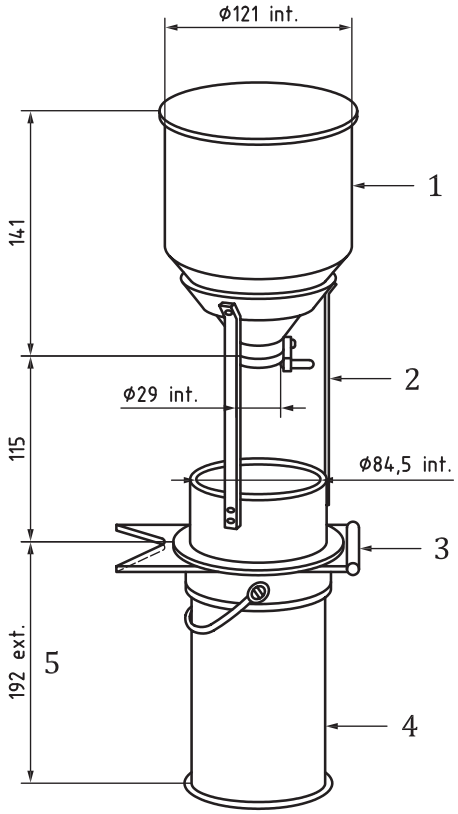
Annex B
(informative)

Description of dimensions and use of Nilema litre[2)]

B.1 Dimensions of the apparatus

See Figure B.1.

Dimensions in millimetres



Key

1 filling hopper
2 riser
3 straightedge
4 measuring container
[a] Capacity 1 l.

Figure B.1 — Nilema litre

2) Example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to give the same results.

B.2 Specifications of the apparatus

B.2.1 Filling hopper with a gate valve, designed to allow an even flow of grain. The hopper fits on to the 1 l measuring container by means of a riser sleeve with a horizontal slot at the bottom allowing the straightedge to slide horizontally.

B.2.2 Straight-sided cylindrical measuring container with a capacity of 1 l.

B.2.3 Flat straightedge ending in a sharp V-shaped cutting edge.

B.3 Determination

Use the balance (5.4) to weigh the empty measuring container to the nearest 1 g.

Pour the grain sample into the filling hopper, filling it to the rim or to the reference mark, depending on the type of equipment, without compacting the grain.

Open the shutter and allow all the grain to flow into the measuring container.

Insert the straightedge gently into the slot as far as it can go, holding the container firmly in place to minimize vibrations and compaction.

With the container full of levelled grain, use the balance (5.4) to weigh to the nearest 1 g.

B.4 Expression of results

For wheat and barley, the mass per hectolitre, ρ, expressed in kilograms per hectolitre, of the cereal is given by Formula (B.1):

$$\rho = 0{,}907\,8 \times \left(m / 1\,000 \times 100 / V \right) + 6{,}602\,5 \qquad \text{(B.1)}$$

where

m is the mass, in grams, of the cereal in the measuring container obtained from ($m_1 - m_0$);

m_0 is the mass, in grams, of the empty container,

m_1 is the mass, in grams, of the container filled with grain;

V is the volume, in litres, of the measuring container.

NOTE Formula (B.1) performs the linear conversion of grams per litre into kilograms per hectolitre. It comes from a French study conducted from 17 samples of barley and wheat (common and durum) referenced with a hopper of 20 litres and measured on 8 Nilema-litre.

For other cereals, the mass per hectolitre, ρ, expressed in kilograms per hectolitre, of the cereal is given by Formula (B.2):

$$\rho = \frac{m}{1\,000} \times \frac{100}{V} = \frac{m}{10\,V} \qquad \text{(B.2)}$$

where

m is the mass, in grams, of the cereal in the measuring container obtained from $(m_1 - m_0)$;

m_0 is the mass, in grams, of the empty container,

m_1 is the mass, in grams, of the container filled with grain;

V is the volume, in litres, of the measuring container.

NOTE Formula (B.2) performs the linear conversion of grams per litre into kilograms per hectolitre.

Annex C
(informative)

Results of interlaboratory tests

The repeatability, reproducibility and critical difference of the method were established by statistical treatment of data obtained during two interlaboratory tests organized by Foss AB (SE) in 2006 and 2007. This treatment was done in accordance with the requirements of ISO 5725-2[1], ISO 5725-3[2] and ISO 5725-6[3].

Between 13 and 16 laboratories took part in these tests on common wheat and barley. A total of 12 samples of wheat and four samples of barley were analysed.

The statistical results of the study are presented in Tables C.1 and C.2, and Figure C.1.

Table C.1 — Statistical results of the interlaboratory test on wheat

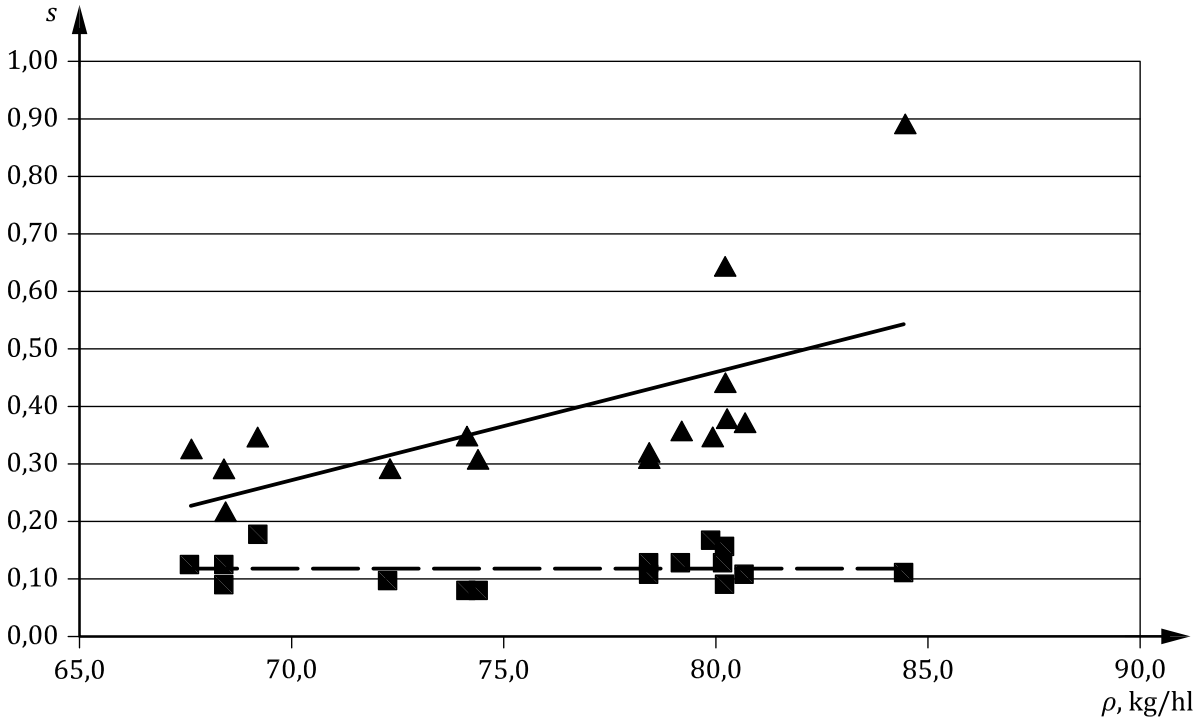
Parameter	Test sample											
	1	2	3	4	5	6	7	8	9	10	11	12
Cereal	Wheat	Wheat	Wheat	Wheat	Wheat	Wheat	Wheat	Wheat	Wheat	Wheat	Wheat	Wheat
Year	2007	2006	2007	2006	2007	2007	2007	2007	2006	2006	2006	2006
Number of laboratories	16	13	16	13	16	16	16	16	13	13	13	13
Number of laboratories retained after elimination of outliers	16	12	16	12	16	16	16	16	13	13	13	13
Test mass per hectolitre, mean values, kg/hl	72,30	74,13	74,40	78,42	78,42	79,20	79,90	80,20	80,25	80,29	80,69	84,44
Repeatability standard deviation, s_r	0,10	0,08	0,08	0,13	0,11	0,13	0,17	0,13	0,09	0,16	0,11	0,11
Coefficient of variation of repeatability, $C_{V,r}$, %	0,14	0,11	0,11	0,17	0,14	0,17	0,21	0,16	0,11	0,19	0,13	0,14
Repeatability limit ($r = 2{,}8\ s_r$)	0,28	0,22	0,22	0,36	0,31	0,36	0,48	0,36	0,25	0,45	0,31	0,31
Reproducibility standard deviation, s_R	0,29	0,35	0,31	0,31	0,32	0,36	0,35	0,64	0,44	0,38	0,37	0,89
Coefficient of variation of reproducibility, $C_{V,R}$, %	0,40	0,48	0,42	0,4	0,41	0,46	0,43	0,80	0,55	0,48	0,46	1,06
Reproducibility limit ($R = 2{,}8\ s_R$)	0,81	0,98	0,87	0,87	0,90	1,01	0,98	1,79	1,23	1,06	1,04	2,49

Table C.2 — Statistical results of the inter-laboratory test on barley

Parameter	Test sample			
	1	2	3	4
Cereal	Barley	Barley	Barley	Barley
Year	2007	2007	2007	2007
Number of laboratories	15	15	15	15
Number of laboratories retained after elimination of outliers	15	15	15	15

Table C.2 *(continued)*

Parameter	Test sample			
	1	2	3	4
Test mass per hectolitre, mean values, kg/hl	67,60	68,40	68,40	69,20
Repeatability standard deviation, s_r	0,13	0,09	0,13	0,18
Coefficient of variation of repeatability, $C_{V,r}$, %	0,20	0,13	0,19	0,26
Repeatability limit ($r = 2{,}8\ s_r$)	0,36	0,25	0,36	0,50
Reproducibility standard deviation, s_R	0,33	0,22	0,29	0,35
Coefficient of variation of reproducibility, $C_{V,R}$, %	0,50	0,32	0,43	0,51
Reproducibility limit ($R = 2{,}8\ s_R$)	0,92	0,62	0,81	0,98



Key

ρ mass per hectolitre

s standard deviation

■ repeatability standard deviation, s_r

▲ reproducibility standard deviation, s_R

Formula of the regression line for s_r: $s_r = 0{,}000\ 1\ \rho + 0{,}111\ 1$; correlation coefficient $r^2_{\rho s_r} = 0{,}000\ 5$

Formula of the regression line for s_R: $s_R = 0{,}018\ 6\ \rho - 1{,}028\ 5$; correlation coefficient $r^2_{\rho s_R} = 0{,}387\ 1$

Figure C.1 — Accuracy values for repeatability and reproducibility versus mean values

Bibliography

[1] ISO 5725-2, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*

[2] ISO 5725-3, *Accuracy (trueness and precision) of measurement methods and results — Part 3: Intermediate measures of the precision of a standard measurement method*

[3] ISO 5725-6, *Accuracy (trueness and precision) of measurement methods and results — Part 6: Use in practice of accuracy values*

[4] ISO 7971-1:2009, *Cereals — Determination of bulk density, called mass per hectolitre — Part 1: Reference method*

[5] Tables illustrating the determination of the mass per hectolitre of wheat, barley, rye and oats (data on file). Brunswick Physikalisch-Technische Bundesanstalt, 1967

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 2016 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the website-www.bis.gov.in or www.standardsbis.

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Amendments Issued Since Publication

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