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Wheat flour — Physical characteristics of doughs —

Part 1:

Determination of water absorption and rheological properties using a farinograph

Farines de blé tendre — Caractéristiques physiques des pâtes —

Partie 1: Détermination de l'absorption d'eau et des caractéristiques rhéologiques au moyen du farinographe

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 34, Food products, Subcommittee SC 4, Cereals and pulses.

This fourth edition cancels and replaces the third edition (ISO 5530-1:2013), which has been technically revised.

The main changes compared to the previous edition are as follows:

- Wheat flour interlaboratory test 2015 described in this annex (see [Tables C.1](#) to C.6) in order to evaluate the repeatability and reproducibility of the test method specified in this part of ISO 5530.

A list of all parts in the ISO 5530 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Wheat flour — Physical characteristics of doughs —

Part 1:

Determination of water absorption and rheological properties using a farinograph

1 Scope

This part of ISO 5530 specifies a method, using a Farinograph, for the determination of the water absorption of flours and the mixing behaviour of doughs made from them by a constant flour mass procedure, or by a constant dough mass procedure.

The method is applicable to experimental and commercial flour from wheat (*Triticum aestivum* L.).

NOTE This part of ISO 5530 is based on ICC 115/1^[1] and AACC Method 54-21.2^[2].

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 712, *Cereals and cereal products — Determination of moisture content — Reference method*

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3 Terms and definitions

For the purposes of this part of ISO 5530, the following terms and definitions apply.

3.1

consistency

resistance of a dough to being mixed in specific conditions (mixing conditions, temperature, hydration, ...). In this document it will refer to resistance of dough being mixed in a Farinograph under the conditions specified in the following methodology

Note 1 to entry: It is expressed in Farinograph arbitrary units (see 3.2).

3.2

Farinograph unit

FU

arbitrary unit for consistency on the Farinogram

Note 1 to entry: For the mathematical expression of Farinograph units, see 6.1.

Note 2 to entry: It is also possible to define “Farinograph unit (FU)” as a torque expressed in Nm, measured in the axis of the mixer.

3.3

maximum consistency

consistency measured at the end of dough development time

Note 1 to entry: For the mathematical expression of maximum consistency, see 9.2.

Note 2 to entry: It is expressed in Farinograph units (FU).

Note 3 to entry: See [3.7](#).

3.4

water absorption of flour (WA)

volume of water required to produce a dough with a maximum consistency of 500 FU, under the specified operating conditions

Note 1 to entry: Water absorption is expressed in millilitres per 100 g of flour at 14 % (mass fraction) moisture content to an accuracy of 0,1 ml.

3.5

dough development time (DDT, former wordings also use 'peak time')

time from the beginning of the addition of water to the point on the curve immediately before the first sign of the decrease of maximum consistency

Note 1 to entry: In those cases where two maxima are observed, use the second maximum to measure the dough development time.

Note 2 to entry: See [Figure 1](#) and 9.3 .

Note 3 to entry: It is expressed in minutes to the nearest 0,1 min.

3.6

Stability (S)

difference in time between the point where the top part of the curve intercepts, for the first time, the line of 500 FU and the last point where leaves this line

Note 1 to entry: This value measures the tolerance of the flour to mixing.

Note 2 to entry: When the maximum consistency deviates from the (500 ± 20) FU line, the line of this consistency should be used to read the interceptions.

Note 3 to entry: The stability is expressed in minutes, to an accuracy of 0,5 min.

3.7

degree of softening (DS)

Two definitions: First one the difference between the height of the centre of the curve at the point where it begins to decline (DDT) and the height of the centre of the curve 12 min after that point (ICC method). Secondly the difference between the height of the centre of the curve at DDT and the height of the centre of the curve 10 min after beginning of the measurement

Note 1 to entry: It is expressed in Farinograph units (FU).

Note 2 to entry: In the case where two peaks appear, the second peak is considered.

Note 3 to entry: The degree of softening should be expressed to the nearest 5 FU.

Note 4 to entry: If another time is used to carry out this method, this has to be detailed in the report along with information on the reference standard applied. The definite time is usually 12 min.

3.8

mixing tolerance index (MTI)

difference from the top of the curve at peak (DDT) to the top of the curve measured at 5 min after peak is reached

Note 1 to entry: It is expressed in Farinograph units (FU).

3.9

Farinograph quality number (FQN)

length, along the time axis, between the point of the addition of water and the point where the height of the centre of the curve has decreased by 30 FU, compared to the height of the centre of the curve at DDT

Note 1 to entry: It is expressed in millimetres to an accuracy of 1 mm.

4 Principle

Measuring and recording, by means of a Farinograph, the consistency of a dough as it is formed from flour and water, as it is developed, and as it changes with time.

NOTE The maximum consistency of the dough is adjusted to a fixed value by adapting the quantity of water added. The correct water addition, which is called the water absorption, is used to obtain a complete mixing curve, the various features of which are a guide to the rheological properties (strength) of the dough.

5 Reagent

Use only distilled or demineralized water or water complying with grade 3, ISO 3696.

6 Apparatus

The usual laboratory apparatus and, in particular, the following:

6.1 Farinograph¹⁾ (see [Annex A](#)), with the following operating characteristics:

- slow blade rotational frequency: $(63 \pm 2) \text{ min}^{-1}$ (rev/min); the ratio of the rotational frequencies of the mixing blades shall be $1,50 \pm 0,01$;
- torque per Farinograph unit:
 - for a 300 g mixer: $(9,8 \pm 0,2) \text{ mN}\cdot\text{m}/\text{FU}$ [$(100 \pm 2) \text{ gf}\cdot\text{cm}/\text{FU}$];
 - for a 50 g mixer: $(1,96 \pm 0,04) \text{ mN}\cdot\text{m}/\text{FU}$ [$(20 \pm 0,4) \text{ gf}\cdot\text{cm}/\text{FU}$];
 - chart speed: $(1,00 \pm 0,03) \text{ cm}/\text{min}$, for the chart recording devices;
 - for the electronic devices chart speed is not applicable, but time is measured.

6.1.1 Water dosing

6.1.2 Thermostat, with circulating water for constant temperature $(30^\circ \pm 0,2)^\circ\text{C}$.

6.2 Balance, capable of weighing to the nearest $\pm 0,1 \text{ g}$.

6.3 Spatula, thin, made of non metal material.

7 Sampling

Sampling is not part of the method specified in this part of ISO 5530. A recommended sampling method is given in ISO 24333^[3].

It is important that the laboratory receive a sample which is truly representative and which has not been damaged or changed during transport and storage.

1) This part of ISO 5530 has been drawn up on the basis of the Brabender Farinograph, which is an example of a suitable product available commercially. This information is given for the convenience of users of this part of ISO 5530 and does not constitute an endorsement by ISO of this product. Other equipment may be used if it can be shown to give comparable results.

8 Procedure

8.1 Determination of the moisture content of the flour

Determine the moisture content of the flour using the method specified in ISO 712.

8.2 Preparation of Farinograph

NOTE See details of electronic Farinograph characteristics and procedure in [A.4](#).

8.2.1 Turn on the thermostat of the Farinograph ([6.1.2](#)) and circulate the water, until the required temperature is reached, prior to using the instrument. Before and during use, check the temperatures of the thermostat and of the mixing bowl, the latter in the hole provided for this purpose. The temperature of the mixing bowl shall be $(30 \pm 0,2)$ °C.

The laboratory temperature should be between 20 °C and 30 °C.

8.2.2 For the mechanical devices uncouple the mixer from the driving shaft and adjust the position of the counterweight(s) so as to obtain zero deflection of the pointer with the motor running at the specified rotational frequency (see [6.1](#)). Switch off the motor and then couple the mixer. For the electronic devices the zero adjustment is programmed to be done automatically at the start of each measurement.

8.2.3 For the mechanical devices lubricate the mixer with a drop of water between the back-plate and each of the blades. Check that the deflection of the pointer is within the range (0 ± 5) FU with the mixing blades rotating at the specified rotational frequency in the empty, clean bowl. If the deflection exceeds 5 FU, clean the mixer more thoroughly or eliminate other causes of friction. For the electronic controlled devices lubrication of the blades is done with silicon fat.

8.2.4 For the mechanical devices adjust the arm of the pen so as to obtain identical readings from the pointer and the recording pen.

8.2.5 For the mechanical devices adjust the damper so that, with the motor running, the time required for the pointer to go from 1 000 FU to 100 FU is $(1,0 \pm 0,2)$ s. This should result in a bandwidth of approximately 60 FU to 90 FU.

8.2.6 Fill the burette ([6.1.1](#)) with water at 30 °C. The time to flow from 0 ml to 225 ml or from 0 ml to 37,5 ml, respectively, shall be not more than 20 s. For the electronic Farinograph's the time for the water flow by means of the dosing system is the same.

8.3 Test portion

NOTE If necessary, bring the flour to a temperature of between 25 °C and 30 °C.

8.3.1 Constant flour mass procedure

Weigh ([6.2](#)), to the nearest 0,1 g, the equivalent of 300 g (for a 300 g mixer) or 50 g (for a 50 g mixer) of flour having a moisture content of 14 % mass fraction. Let this mass, in grams, be m ; see [Table 1](#) for m as a function of moisture content.

Place the test portion in the mixer. Cover the mixer, and keep it covered until the end of mixing except, for the shortest possible time, when water has to be added and the dough has to be scraped down. Temperature of the measurement is defined in note [8.2.1](#).

Table 1 — Mass of flour, in grams, equivalent to 300 g and 50 g at a moisture content of 14 % mass fraction

Moisture content % mass fraction	Mass, <i>m</i> , of flour equivalent to	
	300 g	50 g
9,0	283,5	47,3
9,1	283,8	47,3
9,2	284,1	47,4
9,3	284,5	47,4
9,4	284,8	47,5
9,5	285,1	47,5
9,6	285,4	47,6
9,7	285,7	47,6
9,8	286,0	47,7
9,9	286,3	47,7
10,0	286,7	47,8
10,1	287,0	47,8
10,2	287,3	47,9
10,3	287,6	47,9
10,4	287,9	48,0
10,5	288,3	48,0
10,6	288,6	48,1
10,7	288,9	48,2
10,8	289,2	48,2
10,9	289,6	48,3
11,0	290,0	48,3
11,1	290,2	48,4
11,2	290,5	48,4
11,3	290,9	48,5
11,4	291,2	48,5
11,5	291,5	48,6
11,6	291,9	48,6
11,7	292,2	48,7
11,8	292,5	48,8
11,9	292,8	48,8
12,0	293,2	48,9
12,1	293,5	48,9

NOTE The values in this table are calculated using the following formulae:

a) for the mass, in grams, equivalent to 300 g at 14 % mass fraction moisture content

$$m = \frac{25800}{100 - H}$$

b) for the mass, in grams, equivalent to 50 g at 14 % mass fraction moisture content:

$$m = \frac{4300}{100 - H}$$

where *H* is the moisture content of the sample, as a percentage by mass.

Calculation example: Mass of flour to be added, e.g. having 13 % moisture:

$$m(13\%) = 300\text{g} * (100\% - 14\%) / (100\% - 13\%) = 296,55\text{g}$$

Table 1 (continued)

Moisture content	Mass, <i>m</i> , of flour equivalent to	
12,2	293,8	49,0
12,3	294,2	49,0
12,4	294,5	49,1
12,5	294,9	49,1
12,6	295,2	49,2
12,7	295,5	49,3
12,8	295,9	49,3
12,9	296,2	49,4
13,0	296,6	49,4
13,1	296,9	49,5
13,2	297,2	49,5
13,3	297,6	49,6
13,4	297,9	49,7
13,5	298,3	49,7
13,6	298,6	49,8
13,7	299,0	49,8
13,8	299,3	49,9
13,9	299,7	49,9
14,0	300,0	50,0
14,1	300,3	50,1
14,2	300,7	50,1
14,3	301,1	50,2
14,4	301,4	50,2
14,5	301,8	50,3
14,6	302,1	50,4
14,7	302,5	50,4
14,8	302,8	50,5
14,9	303,2	50,5
15,0	303,5	50,6
15,1	303,9	50,6
15,2	304,2	50,7
15,3	304,6	50,8
15,4	305,0	50,8
15,5	305,3	50,9

NOTE The values in this table are calculated using the following formulae:

a) for the mass, in grams, equivalent to 300 g at 14 % mass fraction moisture content

$$m = \frac{25800}{100 - H}$$

b) for the mass, in grams, equivalent to 50 g at 14 % mass fraction moisture content:

$$m = \frac{4300}{100 - H}$$

where *H* is the moisture content of the sample, as a percentage by mass.

Calculation example: Mass of flour to be added, e.g. having 13 % moisture:

$$m(13\%) = 300\text{g} * (100\% - 14\%) / (100\% - 13\%) = 296,55\text{g}$$

Table 1 (continued)

Moisture content	Mass, <i>m</i> , of flour equivalent to	
15,6	305,7	50,9
15,7	306,0	51,0
15,8	306,4	51,1
15,9	306,8	51,1
16,0	307,1	51,2
16,1	307,5	51,3
16,2	307,9	51,3
16,3	308,2	51,4
16,4	308,6	51,4
16,5	309,0	51,5
16,6	309,4	51,6
16,7	309,7	51,6
16,8	310,1	51,7
16,9	310,5	51,7
17,0	310,8	51,8
17,1	311,2	51,9
17,2	311,6	51,9
17,3	312,0	52,0
17,4	312,3	52,1
17,5	312,7	52,1
17,6	313,1	52,2
17,7	313,5	52,2
17,8	313,9	52,3
17,9	314,3	52,4
18,0	314,6	52,4

NOTE The values in this table are calculated using the following formulae:

a) for the mass, in grams, equivalent to 300 g at 14 % mass fraction moisture content

$$m = \frac{25800}{100 - H}$$

b) for the mass, in grams, equivalent to 50 g at 14 % mass fraction moisture content:

$$m = \frac{4300}{100 - H}$$

where *H* is the moisture content of the sample, as a percentage by mass.

Calculation example: Mass of flour to be added, e.g. having 13 % moisture:

$m(13\%) = 300\text{g} * (100\% - 14\%) / (100\% - 13\%) = 296,55\text{g}$

8.3.2 Constant dough mass procedure

Calculate the necessary mass of flour, m , in grams, according to [Formula \(1\)](#):

$$m = \frac{C_m}{100 \pm W_a} \quad (1)$$

where

C_m is a constant number, which is 48 000 using a large bowl and 8 000 using a small bowl;

W_a is the water absorption of the flour, expressed in millilitres per 100 g of flour at 14 % (mass fraction) moisture content (determined by [9.2](#)).

Calculate the necessary volume of water, V , in millilitres, according to [Formula \(2\)](#):

$$V = C_v - m \quad (2)$$

where C_v is a constant number, which is 480 using a large bowl and 80 using a small bowl.

Weigh ([6.2](#)), to the nearest 0,1 g the calculated mass of flour, m , and place the test portion in the bowl.

Fill the burette ([6.1.1](#)) with water of room temperature. Start the mixer and recording mechanism, and 1 min later, add the calculated volume of water to the flour. In this case, the maximum consistency of the dough will be (500 ± 20) FU.

NOTE W_a Versus m , calculated by [Formula \(1\)](#) using the large or small bowl, respectively (in the water absorption range from 54 % to 77 %), is given^[1]. [ISO/DIS 5530-1](#)

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8.4 Common rules of determination

NOTE For the steps of the operation not specified in this part of ISO 5530, follow the manufacturer's instructions.

8.4.1 Mix at the specified rotational frequency for 1 min or slightly longer. Start adding water from the burette into the right-hand front corner of the mixer within 25 s, when a whole-minute line on the recorder paper passes by the pen.

NOTE In order to reduce the waiting time, the recorder paper can be moved forward during the mixing of the flour. Do not move it backwards.

Add a volume of water close to that expected to produce a maximum consistency ([9.2](#)) of 500 FU. When the dough forms, scrape down the sides of the bowl with the spatula ([6.3](#)) adding any adhering particles to the dough, without stopping the mixer. If the consistency is too high, add a little more water to obtain a maximum consistency of approximately 500 FU. Stop mixing and clean the mixer.

When using the electronic devices, the measurement also starts after a mixing time of 1 min, but the starting point on the diagram is independent from certain lines on the chart paper.

Depending on the flour quality and evaluations one wants to make, e.g. when using very strong flours with a long stability, then the measurement time has to be extended when you would like to record all evaluation points.

See also point [8.4.2](#).

8.4.2 Carry out additional mixings as necessary, until two mixings are available

— in which the water addition has been completed within 25 s,