BS EN ISO 5530-1:2014

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Wheat flour — Physical characteristics of doughs

Part 1: Determination of water absorption and rheological properties using a farinograph (ISO 5530-1:2013)

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National foreword

This British Standard is the UK implementation of EN ISO 5530-1:2014. It is identical to ISO 5530-1:2013.

The UK participation in its preparation was entrusted to Technical Committee AW/4, Cereals and pulses.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Farines de blé tendre - Caractéristiques physiques des pâtes - Partie 1: Détermination de l'absorption d'eau et des caractéristiques rhéologiques au moyen du farinographe (ISO 5530-1:2013)

Weizenmehl - Physikalische Eigenschaften von Teigen - Teil 1: Bestimmung der Wasserabsorption und der rheologischen Eigenschaften mittels Farinograph (ISO 5530-1:2013)

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Foreword

The text of ISO 5530-1:2013 has been prepared by Technical Committee ISO/TC 34 “Food products” of the International Organization for Standardization (ISO) and has been taken over as EN ISO 5530-1:2014 by Technical Committee CEN/TC 338 “Cereal and cereal products” the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2015, and conflicting national standards shall be withdrawn at the latest by June 2015.

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Endorsement notice

The text of ISO 5530-1:2013 has been approved by CEN as EN ISO 5530-1:2014 without any modification.

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

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ISO 5530-1 was prepared by Technical Committee ISO/TC 34, *Food products*, Subcommittee SC 4, *Cereals and pulses*.

This third edition cancels and replaces the second edition (ISO 5530-1:1997), which has been technically revised.

ISO 5530 consists of the following parts, under the general title *Wheat flour — Physical characteristics of doughs*:

— *Part 1: Determination of water absorption and rheological properties using a farinograph*

— *Part 2: Determination of rheological properties using an extensograph*

— *Part 3: Determination of water absorption and rheological properties using a valorigraph*

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*

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 a farinograph at a specified constant speed

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 twisting moment of 100 g. cm, 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
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
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
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, in general, gives some indication of 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
difference between the centre of the curve at the point where it begins to decline and the centre of the curve 12 min after that point

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 of equivalent purity.

6 Apparatus

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

6.1 Farinograph[1)] (see Annex A), with the following operating characteristics:

— slow blade rotational frequency: (63 ± 2) min^{-1} (rev/min); the ratio of the rotational frequencies of the mixing blades shall be 1,50 ± 0,01;

— torque per farinograph unit:

  — for a 300 g mixer: (9,8 ± 0,2) mN·m/FU [(100 ± 2) gf·cm/FU];

  — for a 50 g mixer: (1,96 ± 0,04) mN·m/FU [(20 ± 0,4) gf·cm/FU];

  — chart speed: (1,00 ± 0,03) cm/min.

6.1.1 Burettes.

a) for a 300 g mixer, graduated from 135 ml to 225 ml in 0,2 ml divisions.

b) for a 50 g mixer, graduated from 22,5 ml to 37,5 ml in 0,1 ml divisions.

6.1.2 Thermostat, with circulating water for constant temperature (30 °± 0,2) °C.

6.2 Balance, capable of weighing to the nearest ±0,1 g.

6.3 Spatula, thin, made of soft plastic.

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 ± 0,2) °C.

The laboratory temperature should be between 18 °C and 30 °C.

8.2.2 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.

8.2.3 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.

8.2.4 Adjust the arm of the pen so as to obtain identical readings from the pointer and the recording pen.

8.2.5 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 ± 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.

8.3 Test portion

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. Switch on the thermostatically controlled heating.

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, *m*, of flour equivalent to**	
% mass fraction	**300 g**	**50 g**
9,0	283,5	47,3
9,1	283,8	47,3

Table 1 *(continued)*

Moisture content	**Mass, *m*, of flour equivalent to**	
% mass fraction	**300 g**	**50 g**
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	289,9	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
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

Table 1 *(continued)*

Moisture content	**Mass, *m*, of flour equivalent to**	
% mass fraction	**300 g**	**50 g**
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
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

Table 1 *(continued)*

Moisture content	**Mass, *m*, of flour equivalent to**	
% mass fraction	**300 g**	**50 g**
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

$$m = \frac{25\ 800}{100 - H}$$

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

$$m = \frac{4\,300}{100 - H}$$

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

8.3.2 Constant dough mass procedure

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

$$m = \frac{C_m}{100 \pm W_\mathrm{a}} \qquad (1)$$

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):

$$V = C_V - m \qquad (2)$$

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]

8.4 Common rules of determination

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.

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,

— the maximum consistencies of which are between 480 FU and 520 FU, and

— the recording of which has been continued for sufficient time to calculate all reported terms of the selected method.

Stop mixing and clean the mixer.

9 Evaluation of the farinogram and calculation of the derived rheological characteristics

9.1 General

From each sample, two determinations shall be carried out. Read directly or calculate the values of each rheological characteristic to be determined from both farinograms. Express the results as the mean value of the relevant data.

NOTE To facilitate the calculations, a computer can be used. In that case, it would be necessary to modify the farinograph by adding an electrical output for transferring the data to the computer.

9.2 Water absorption of flour

In order to obtain the water absorption of flour (see 3.4) first from each of the mixings with maximum consistencies (see 3.3) between 480 FU and 520 FU, derive the corrected volume, V_c, in millilitres, of water corresponding to a maximum consistency of 500 FU, by means of Formulae (3) and (4):

a) for a 300 g mixer:

$$V_c = V + 0{,}096(C - 500) \quad (3)$$

b) for a 50 g mixer:

$$V_c = V + 0{,}016(C - 500) \quad (4)$$

where

V is the volume, in millilitres, of water added;

C is the maximum consistency, in farinograph units (see Figure 1), given by

$$C = \frac{c_1 + c_2}{2}$$

where

c_1 is the maximum height of the upper contour of the curve, in farinograph units;

c_2 is the maximum height of the lower contour of the curve, in farinograph units.

NOTE In the relatively infrequent case where two maxima are observed, use the height of the higher maximum.

Use for the calculation, the mean value of duplicate determinations of V_c, provided the difference between them does not exceed 2,5 ml (for a 300 g mixer) or 0,5 ml (for a 50 g mixer) of water.

The water absorption, W_a, expressed in millilitres per 100 g of flour at 14 % (mass fraction) moisture content, is equal to

— for a 300 g mixer:

$$W_a = \left(\overline{V_c} + m - 300\right) \times 0{,}333 \quad (5)$$

— for a 50 g mixer:

$$W_a = \left(\overline{V_c} + m - 50\right) \times 2 \quad (6)$$

where

$\overline{V}_c$ is the mean value of the duplicate determinations of the corrected volume, in millilitres, of water corresponding to a maximum consistency of 500 FU;

m is the mass, in grams, of the test portion derived from Table 1.

Report the result to the nearest 0,1 ml per 100 g.

9.3 Characteristics relating to the consistency of dough

Consistency (3.1) is a continuously changing characteristic of dough, which is demonstrated on the farinogram. Evaluation of the curve can be carried out in various ways. From the farinogram, the following characteristics can be derived:

— water absorption of flour (see 3.4);

— dough development time (DDT) (see 3.5);

— stability of dough (see 3.6);

— degree of softening (see 3.7);

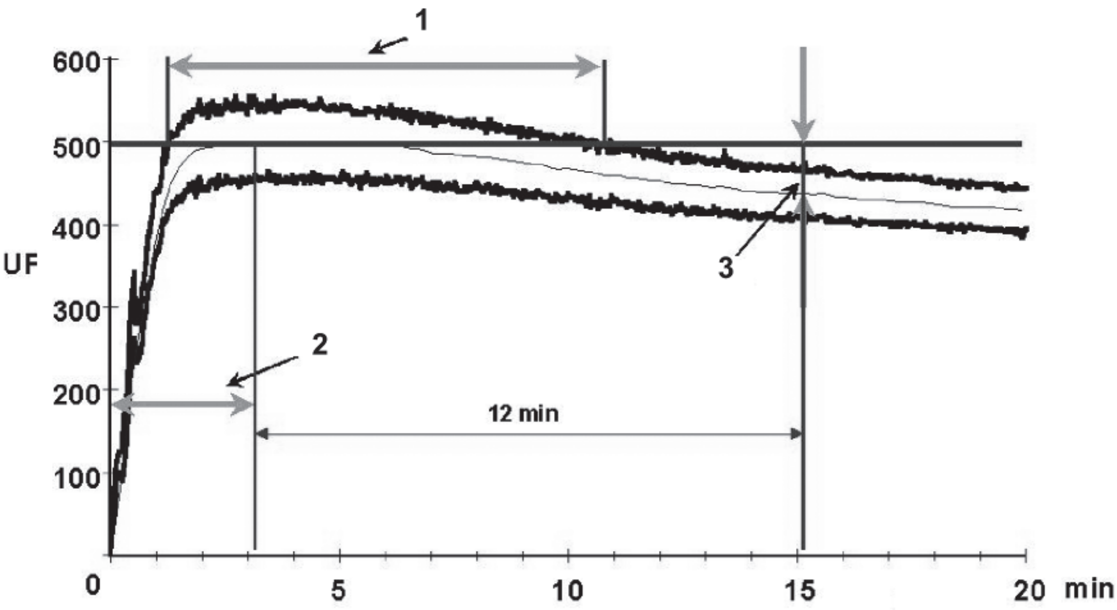
— farinograph quality number (FQN) (see 3.9).

NOTE 1 Other definitions for some of these characteristics are also known (they are reported in AACC Method 54-21.02[2] and Nieman[5]), but these cannot be compared with the characteristics defined in this part of ISO 5530.

With appropriate software, a computer can evaluate and document the most frequently required characteristics listed above.[7]

NOTE 2 The FQN can be reported together with, or instead of, the stability and the degree of softening. Using the FQN instead of the stability and the degree of softening shortens the total mixing time, especially in the case of doughs from weaker flours. There is good correlation between the quality number and the stability and the degree of softening respectively.

A representative farinogram demonstrating the commonly measured characteristics of dough consistency is shown in Figure 1. See examples of farinogram types in Annex B.



Key

1 stability

2 dough development time

3 degree of softening

Figure 1 — Representative farinogram

10 Precision

10.1 Interlaboratory tests

10.1.1 Interlaboratory tests with farinograph measurements (wheat flour with dough development time above 4 min) were conducted in 2009 by the Argentinian Institute for Standardization and Certification (IRAM), Standarization Direction, Food and Health Management (see Annex C).

10.1.2 The precision of farinograph measurements (wheat flour with dough development time up to 4 min) were extracted from interlaboratory tests conducted between 1989 and 1990 by the Department of Cereals, Feed and Bakery Technology (IGMB) of TNO Nutrition and Food Research (Netherlands).[5]

10.2 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, is in not more than 5 % of cases greater than the values given in Table 2.

Table 2 — Repeatability data obtained by using farinograph

Characteristic	Repeatability
Water absorption (ml/100 g)	0,5
Dough development time (above 4 min) (min)	0,7
Dough development time (up to 4 min)[a]	16 % of mean value
Stability of dough (min)	1,3
Degree of softening (FU)	3,6

[a] See 10.1.2.

10.3 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, is in not more than 5 % of cases greater than values given in Table 3.

Table 3 — Reproducibility data obtained by using farinograph

Characteristic	Reproducibility
Water absorption (ml/100 g)	1,0
Dough development time (above 4 min) (min)	2,1
Dough development time (up to 4 min)[a]	48 % of mean value
Stability of dough (min)	3,8
Degree of softening (FU)	31,6

[a] See 10.1.2.

11 Test report

The test report shall specify the following:

— all information necessary for the complete identification of the sample;

— the sampling method used, if known;

— the test method used indicating the procedure (constant flour mass procedure or constant dough mass procedure); with reference to this part of ISO 5530, i.e. ISO 5530-1;

— the apparatus used;

— the size of the mixer used;

— the type of flour;

— all operating details not specified in this part of ISO 5530, or regarded as optional, together with details of any incidents which might have influenced the test result(s);

— the test result(s) obtained;

— if the repeatability has been checked, the final calculated result obtained.

Annex A
(informative)

Description of the farinograph

WARNING — The safety provisions installed by the manufacturer shall be used properly. These safety provisions stop the drive if the mixer is not covered or if the front part is separated from the back wall. With earlier instruments without these safety provisions, consider the following precautions:

— **keep fingers and objects out of the running mixer;**

— **keep ties, sleeves, etc. away from the rotating driving shaft of the farinograph.**

Be careful not to damage the paddles by reaching with the spatula into the running blades at the beginning of the test or during the cleaning operation with the mixer coupled to the farinograph and the motor running at low rotational speed.

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

A.1 The main unit of the apparatus

A.1.1 The main unit of the apparatus consists of a water-jacketed mixer, a means for recording dough consistency in the form of farinograms. It is mounted on a heavy cast-iron base plate, having four levelling screws, and consists of:

a) a detachable, water-jacketed mixer (A.1.2);

b) an electric motor, driving the mixer (A.1.3);

c) a gear and lever system, acting as a dynamometer to measure the torque on the driving shaft between the gear and the mixer (A.1.3);

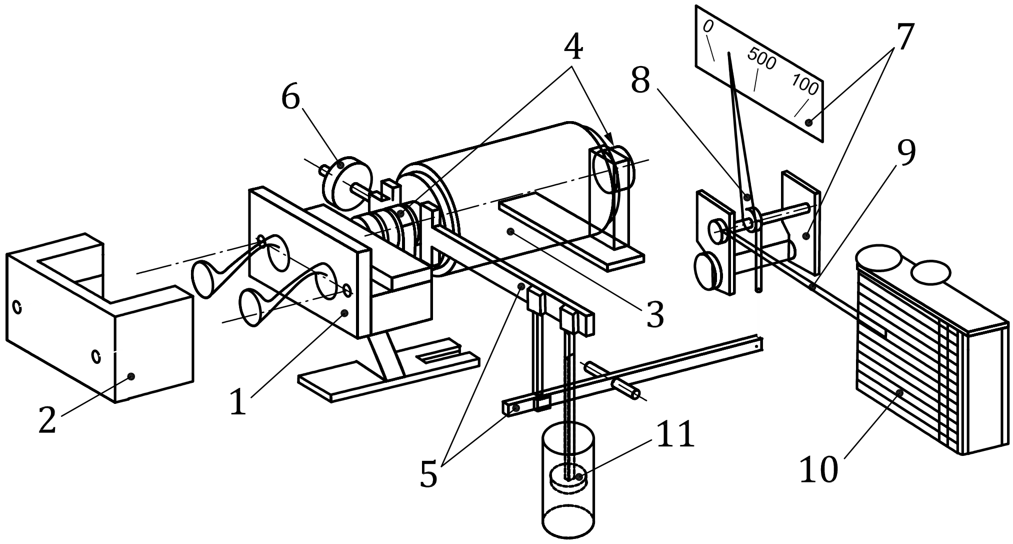
d) a dash-pot to dampen the movements of the dynamometer (A.1.3);

e) a scale, the pointer of which is actuated by movements of the dynamometer (A.1.3);

f) a recorder, the pen of which is actuated by the movements of the dynamometer (A.1.4);

g) burettes, to measure the volume of water added to the flour (6.1.1).

The parts of the farinograph are illustrated in Figure A.1.



Key

1 back wall of mixer with mixing blades
2 remainder of mixer
3 housing of motor and gears
4 ball-race bearings
5 levers
6 counterweight
7 scale head
8 pointer
9 pen arm
10 recorder
11 dash-pot damper

Figure A.1 — Diagram of farinograph

A.1.2 The mixer is two-bladed and is designed to mix doughs from either 300 g or 50 g of flour. It is in two parts:

a) a hollow back-plate, through which water from the thermostat circulates and, at the back, a gear-box driving the two mixer blades that project forward through this back-plate;

b) the remainder of the mixer, i.e. two sides, front and bottom in one piece, through which water from the thermostat circulates.

The two parts are held together by means of two bolts and wing nuts, and can be dismantled for cleaning.

The slower mixing blade is driven directly by the shaft from the gear; it rotates at a frequency of 63 min^{-1} in recent (at the time of publication) farinographs. The faster mixing blade is geared, by cog-wheels, to rotate at a frequency that is 1,5 times that of the slower blade.

NOTE Previous farinographs were made with rotational frequencies of the driving shaft, which differ from the standardized value of 63 min^{-1}. The effect of the rotational frequency on the determination can be neglected if it is within the range of 61 min^{-1} to 65 min^{-1}. If it is outside this range, approximately correct water absorption can be obtained by substituting a consistency, C, for the standard consistency of 500 FU. The value of C can be calculated from the actual rotational frequency, n, in reciprocal minutes, of the driving shaft or slower mixing blade, by means of Formula (A.1):

$$C = 500 + 200\ \ln\left(\frac{n}{63}\right) \quad \text{(A.1)}$$

If a consistency, C, has to be substituted for the standard consistency, the dough development time varies according to Formula (A.2):

$$t_0 = t - 320\left(\frac{1}{n} - \frac{n}{63}\right) \quad \text{(A.2)}$$

where

t_0 is the dough development time, in minutes, that would be measured with a farinograph that is in accordance with 6.1;

t is the dough development time, in minutes, which is read on the curve actually recorded. Insufficient data are available to make a similar correction for the degree of softening. The mixer can be closed by a lid which, in farinographs at the time of publication, consists of two parts:

a) a bottom part, to be opened only to place the flour into the mixer. When it is opened, the security system switches off the instrument. This part has slots, to allow dough to be scraped down from the sides of the bowl with a spatula. The water shall be added through the front end of the slot at the right-hand side of the mixer;

b) a top part, to be placed on the bottom part to close its slots. It shall be opened only for adding water or scraping the dough down.

In older farinographs, the mixer is closed by a flat plastic plate, which is laid on top of the mixer. It is removed to add water and scrape the dough down.

A.1.3 The motor and its reduction and dynamometer gears are placed together in a housing. From the front and rear ends of this housing, shafts that protrude are supported by ball-race bearings; the housing can pivot on these shafts.

The shaft from the front end drives the mixing blades. The resistance of the dough to being mixed causes a torque on this shaft, which, if not balanced, would cause rotation of the motor housing.

The motor housing carries an arm, one end of which is connected by the lever system to the scale and recorder pen. This causes a counter-torque on the motor housing, which is linearly related to the deflection of the scale pointer and recorder pen. As a result, the deflections of the scale pointer and recorder pen are, if the two torques balance one another, proportional to the torque on the driving shaft, i.e. to the resistance of the dough to being mixed. The operator can choose the correct torque for each unit deflection (6.1) by selecting:

— the appropriate effective counterweight in the scale head; this is done by a handle that can lift a counterweight, and so make it ineffective;

— the appropriate effective length of the front part of the lower lever arm; this is done by varying the position of the link between the lower lever arm and the motor housing lever arm.

In instruments, at the time of publication, both possibilities for adjustment are used. In older instruments, there is only the second possibility.

Movements of the motor housing, lever system, scale and recorder pen are damped by a piston immersed in oil; the piston is connected to the right-hand end of the arm of the motor housing. The extent of damping can be adjusted; more damping results in a narrower curve.

A.1.4 The paper for the recorder is supplied in the form of a roll. It is moved by an electric clock-type motor at a rate of 1,00 cm/min. Along its length, it bears a printed scale in minutes. Across its width, it bears a circular scale (radius 200 mm) with arbitrary units, running from 0 FU to 1 000 FU.

A.2 Circulating thermostat

The circulating thermostat normally consists of a tank with water, and contains the following parts.

a) An electric heating element.

b) A thermoregulator to control the heating element, capable of maintaining the temperature of the mixing bowl at (30 ± 0,2) °C.

c) A thermometer.

d) A motor-driven pump and stirrer. The pump is connected to the water jackets of the mixing bowl by means of flexible tubing. It shall have sufficient capacity to maintain the temperature of the walls of the mixing bowl at (30 ± 0,2) °C. For a 300 g mixer, the flow of water through the jackets shall be at least 2,5 l/min (preferably 5 l/min or more), and for a 50 g mixer, at least 1 l/min. Except in some earlier models of the farinograph, the dash-pot damper can also be connected to the pump; however, temperature control of the dash-pot damper is not really necessary if the viscosity of the oil in it is only slightly sensitive to temperature.

e) One or two coils of metal tubing. At the time of publication, thermostats supplied by the manufacturer of the farinograph have two coils. One of them is used to cool the thermostat bath by a flow of tap water. The distilled water can be pumped through the other one into the burette to adjust its temperature (8.2.6). If there is only one coil, it shall be used to cool the thermostat bath, except under exceptional conditions. If cooling of the bath by tap water is not necessary, the distilled water can be pumped through the only coil to adjust its temperature.

A.3 Calibration of farinographs

The reproducibility of the determination with farinographs is influenced by the calibration status of the farinograph and the mixers used in conjunction with the farinograph.

The dynamometer, lever system and scale of the farinograph can be adjusted to give correct results. Also, the burette can be calibrated. However, there is no method for absolute adjustment of the mixer. Each mixer (or instrument) shall be compared with another mixer (or instrument) using a range of flours.

It is possible to have the mixer adjusted by the manufacturer to their standard. With old or badly worn instruments, this will be impossible. It is likely that the results from a given mixer will change with increasing usage of the mixer. If good agreement between instruments is to be maintained, frequent checks are required.

A.4 Electronic farinograph

A.4.1 Application

Farinograph (or any compatible) software is a computer-controlled system for measuring the mixing characteristics of wheat or dough for determining the flour quality and the processing characteristics of the dough.

The farinograph can be operated with infinitely variable speed controlled by the PC. This allows for use of the instrument not only for the standard farinograph test with the prescribed speed of 63 min^{-1}, but also with other speeds.

The test results are recorded by a computer and can be represented graphically and/or numerically on the monitor already during the running test. The measured data are evaluated automatically in compliance with International Standards and can be printed in the form of tables and diagrams (farinogram).

A.4.2 Features and operating principle

The farinograph consists of:

— drive unit (dynamometer), and

— farinograph (or any compatible) software and cable.

The following parts may be or need to be ordered separately (see Figure A.2):

— measuring mixer;

— thermostat;

— burette;

— computer with printer and monitor;

— additional evaluation software (e.g. to carry out farinograph data correlation).

A.4.3 Drive unit with torque measurement

Measuring principle: the basic farinograph unit is a drive unit with torque measurement (dynamometer), which provides a variable speed of 2 min^{-1} to 200 min^{-1} (software-controlled). The dynamometer unit with its modern, high-precision electronic torque measuring system is mounted on sturdy and distortion-free base plate. The torque of the linear dynamometer is measured directly without any intermediate member.

The measuring principle is based on making visible the resistance put up by the sample material (dough) against the rotating blades or rotors in the measuring head. The torque proportional to this resistance is recorded as a measure of viscosity and consistency. The measuring signal is digitized in the farinograph and transmitted to the computer via USB port.

The result are represented graphically on the monitor during the running test. The results can be stored and printed on a separate printer.

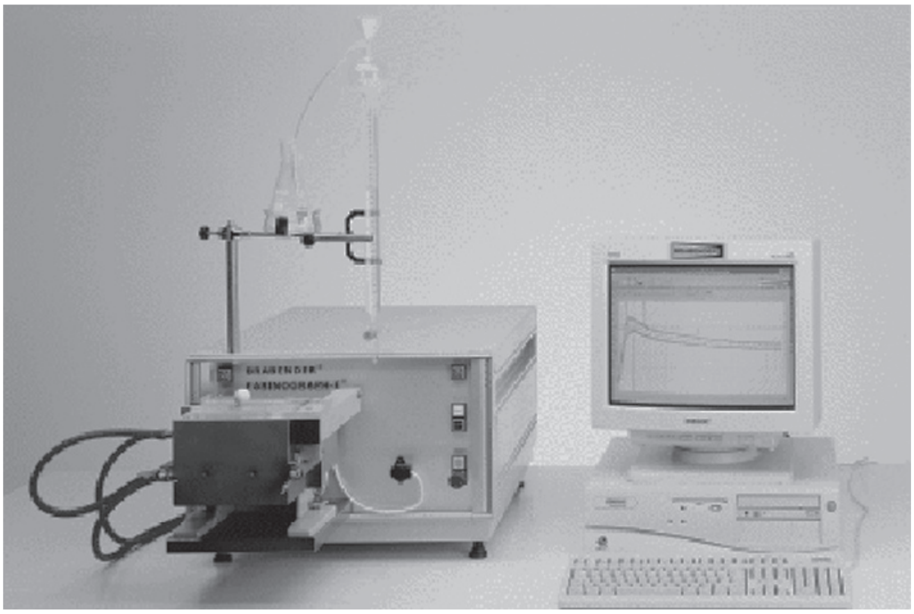
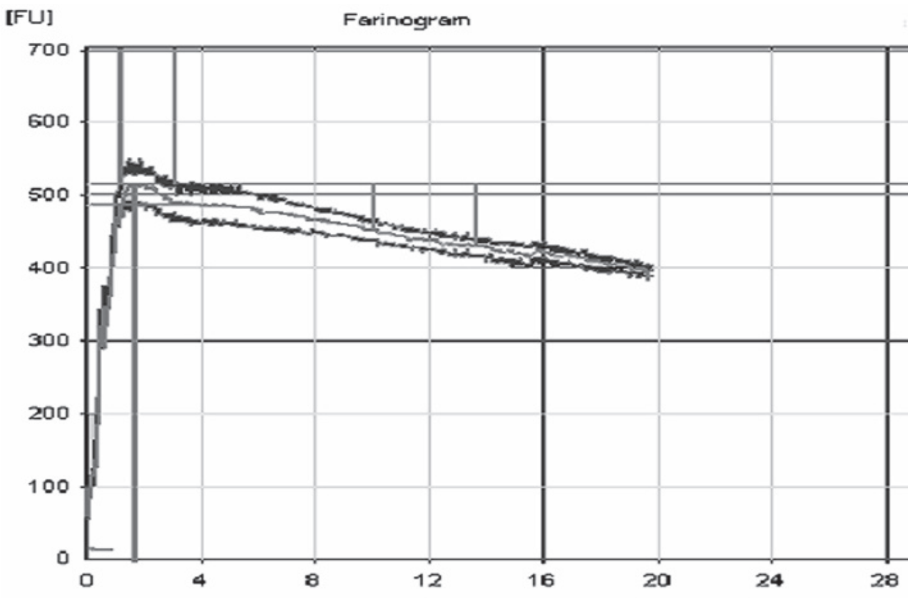


Figure A.2 — Example of a farinograph

Annex B
(informative)

Examples of farinograms

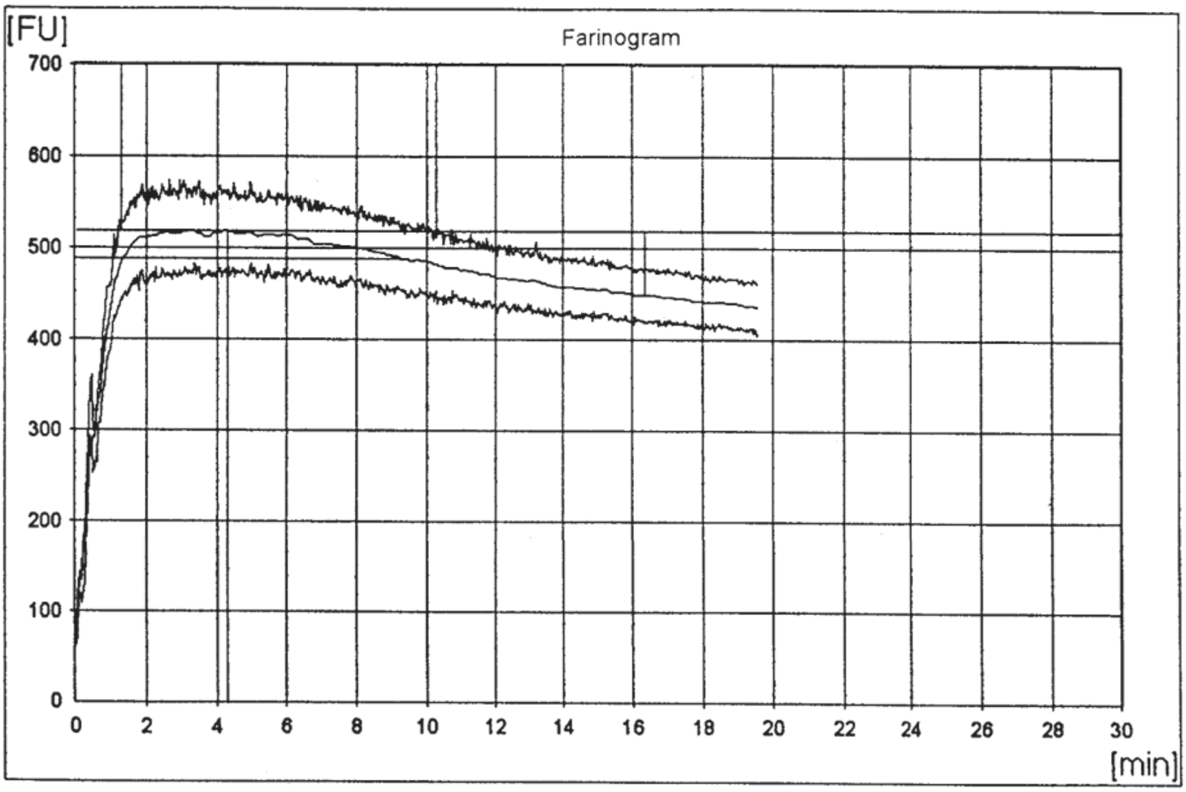
B.1 Low dough development time and low stability flour



Evaluation of:	Date:
Method:	Operator:
Mixer:	300 g
Moisture of flour:	13,4 %
Consistency:	515 FU with water absorption: 65,5 %
Water absorption:	65,9 % (corrected for 500,0 FU)
Water absorption:	65,2 % (corrected to 14,0 %)
Dough development time:	1,7 min
Stability:	1,9 min
Degree of softening (ICC):	87 FU
Farinograph quality number (FQN):	41
Remarks:	

Figure B.1 — Low dough development time and low stability flour

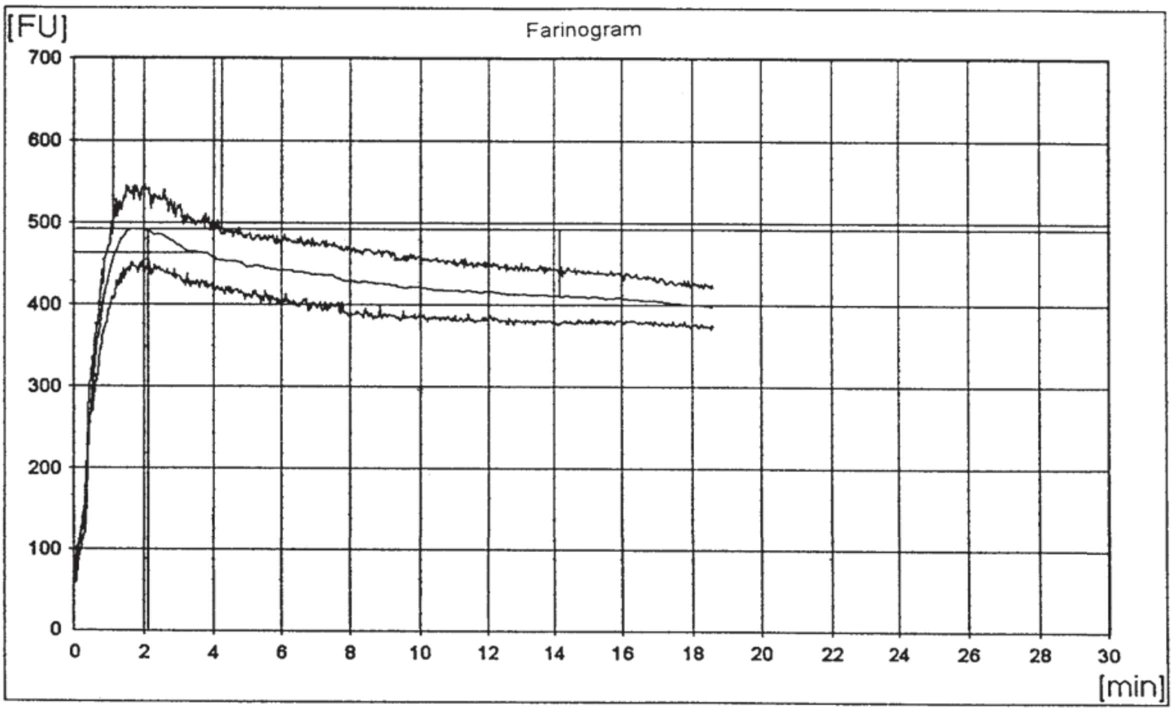
B.2 Standard flour



Evaluation of:	Date:
Method:	Operator:
Mixer:	300 g
Moisture of flour:	13,0 %
Consistency:	519 FU with water absorption: 57,5 %
Water absorption:	58,0 % (corrected for 500,0 FU)
Water absorption:	56,8 % (corrected to 14,0 %)
Dough development time:	4,3 min
Stability:	9,0 min
Degree of softening (ICC):	70 FU
Farinograph quality number (FQN):	94
Remarks:	

Figure B.2 — Standard flour

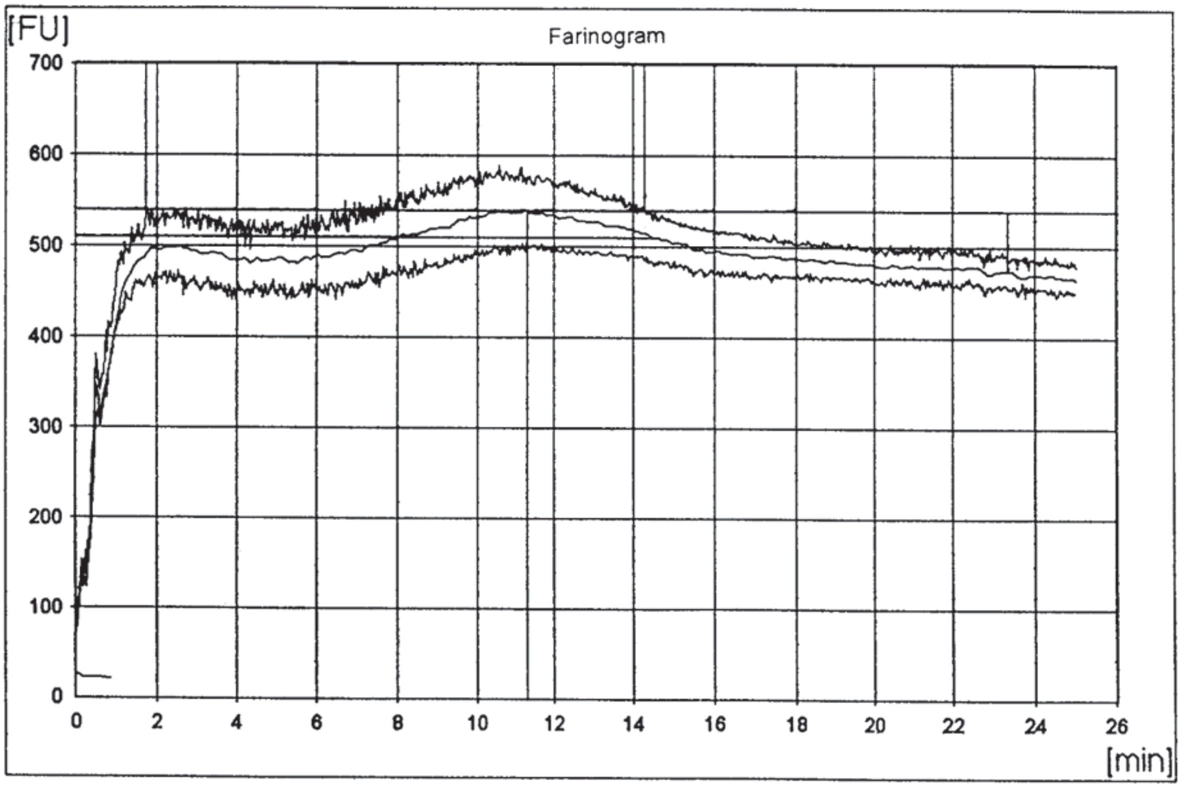
B.3 Low stability flour



Evaluation of:	Date:
Method:	Operator:
Mixer:	300 g
Moisture of flour:	14,0 %
Consistency:	493 FU with water absorption: 56,3 %
Water absorption:	56,1 % (corrected for 500,0 FU)
Water absorption:	56,1 % (corrected to 14,0 %)
Dough development time:	2,1 min
Stability:	3,1 min
Degree of softening (ICC):	82 FU
Farinograph quality number (FQN):	37
Remarks:	

Figure B.3 — Low stability flour

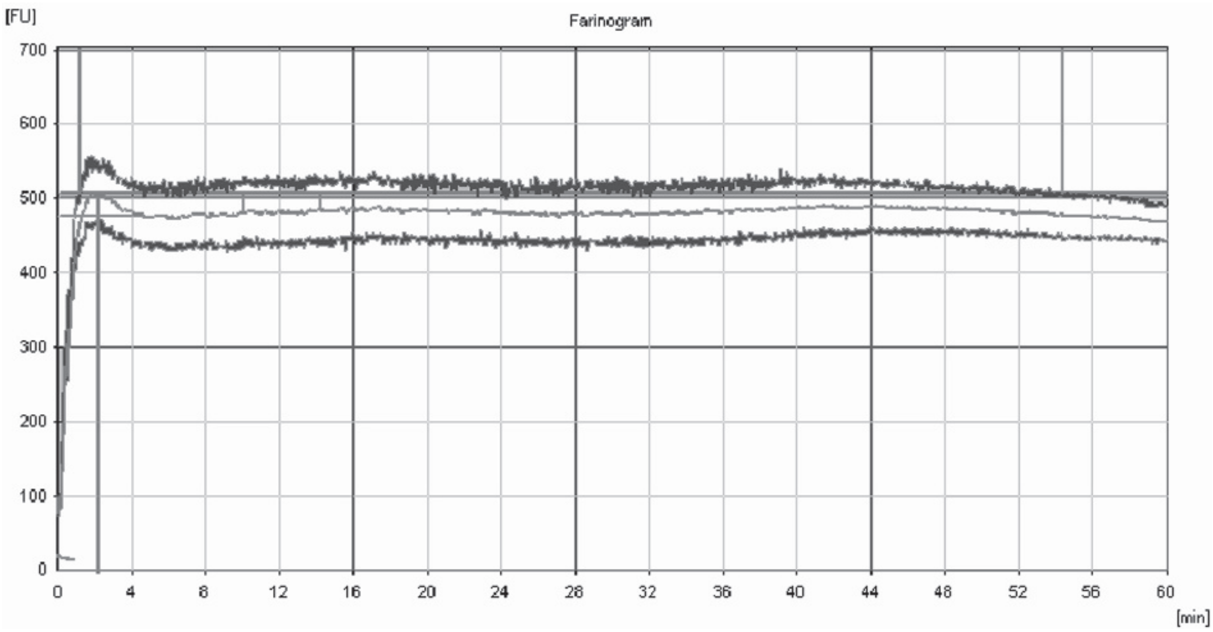
B.4 Two peaks flour



Evaluation of:	Date:
Method:	Operator:
Mixer:	300 g
Moisture of flour:	14,3 %
Consistency:	519 FU with water absorption: 57,5 %
Water absorption:	62,0 % (corrected for 500,0 FU)
Water absorption:	62,3 % (corrected to 14,0 %)
Dough development time:	11,3 min
Stability:	12,5 min
Degree of softening (ICC):	6 FU
Farinograph quality number (FQN):	146
Remarks:	

Figure B.4 — Two peaks flour

B.5 High stability flour



Evaluation of:	Date:
Method:	Operator:
Mixer:	300 g
Moisture of flour:	14,9 %
Consistency:	506 FU with water absorption: 56,0 %
Water absorption:	56,1 % (corrected for 500,0 FU)
Water absorption:	57,1 % (corrected to 14,0 %)
Dough development time:	2,2 min
Stability:	53,2 min
Degree of softening (ICC):	22 FU
Farinograph quality number (FQN):	46
Remarks:	Conditioned grain at 15 % of moisture. Flour with 24 h of rest.

Figure B.5 — High stability flour

Annex C
(informative)

Results of interlaboratory tests

C.1 Wheat flour interlaboratory test 2009

IRAM organized the interlaboratory test described in this annex (see Table C.1) in order to evaluate the repeatability and reproducibility of the test method specified in this part of ISO 5530.2) The scope of this method is to determine the water absorption and the rheological characteristics of wheat flour using a farinograph apparatus.

Each participant received a homogenized and standarized sample, prepared and packed by Molino Argentino S.A. (Argentinian mill factory) and the samples distribution and delivery was in charge of IRAM. The test samples were sent to 34 national and foreign laboratories, and 28 laboratories results were recieved. To sum up, the 82 % of laboratories participated actively in this interlaboratory test.

The calculation of repeatability and reproducibility values obtained for each analytical parametres rises from the application of an statistical analysis according to ISO 5725-1[7] and ISO 5725-2.[8] This analysis was prepared by Complejo Laboratorios of Bolsa de Comercio de Rosario (Argentina).

Table C.1 — Results of interlaboratory test 2009

Parameter	Robust media	S_r	S_R	r (2,8 x S_r)	R (2,8 x S_R)
Water absorption	58,94	0,17	0,37	0,48	1,04
Dough development time	8,84	0,23	0,74	0,65	2,08
Stability of dough	14,35	0,46	1,34	1,28	3,76
Degree of softening 12 min	58,92	1,29	11,30	3,61	31,63

C.2 Information about Argentinian wheat flour interlaboratory tests

The following data were prepared from Argentinian interlaboratory test results conducted between January 2004 and December 2010(see Table C.2 and Figures C.1 to C.4).

2) For additional information, see INTI-SAI (Servicio Argentino de Interlaboratorios), *Ensayo de aptitud. Determinación de parámetros de calidad en harinas de trigo*. Informe final. Available at: http://www.inti.gov.ar/interlaboratorios/informes.htm [Viewed 2012-11-15].

Table C.2 — Repeatibility and reproducibility of Argentinian Interlaboratories tests

Parameter	Period	Robust media	S_r	S_R	r (2,8 x S_r)	R (2,8 x S_R)	Number of laboratories
Water absorption	2004	61,0	0,2	1,1	0,6	3,1	8
	2005	61,5	0,2	1,1	0,5	3,1	9
	2006	60,1	0,1	0,8	0,2	2,3	8
	2007	57,7	0,1	1,3	0,4	3,8	12
	2008	61,2	0,2	1,5	0,5	4,2	13
	2010 to 2011	56,7	0,2	1,1	0,5	3,1	11
	2010 to 2012	57,9	0,2	1,2	0,6	3,5	14
Dough development time	2004	9,3	0,2	4,8	0,5	13,7	7
	2005	8,4	0,5	4,0	1,5	11,3	8
	2006	14	0,4	1,5	1,1	4,4	7
	2007	7	0,2	4,2	0,5	11,9	11
	2008	10	0,4	3,9	1,2	11,1	13
	2010 to 2011	11,4	0,4	5,9	1,3	16,7	10
	2010 to 2012	13	0,3	0,9	1,0	2,6	12
Stability of dough	2004	15,5	0,4	4,7	1,2	13,4	8
	2005	19,4	0,7	6,3	2,0	17,9	8
	2006	19,7	0,2	7,9	0,7	22,5	8
	2007	10,6	0,2	4,5	0,7	12,8	11
	2008	18,8	0,5	2,4	1,4	6,7	13
	2010 to 2011	23,7	1,2	3,0	3,5	8,4	11
	2010 to 2012	16,7	0,5	1,9	1,3	5,3	14
Degree of softening 12 min	2004	39,4	2,5	7,5	7,1	21,1	8
	2005	23,6	2,5	12,0	7,0	34,0	9
	2006	28,4	1,0	10,0	2,9	28,4	8
	2007	69,9	3,8	16,0	10,8	45,3	12
	2008	35,0	3,1	12,0	8,8	34,0	13
	2010 to 2011	24,9	3,9	11,2	11,0	31,6	11
	2010 to 2012	71,8	5,8	10,6	16,5	30,0	11

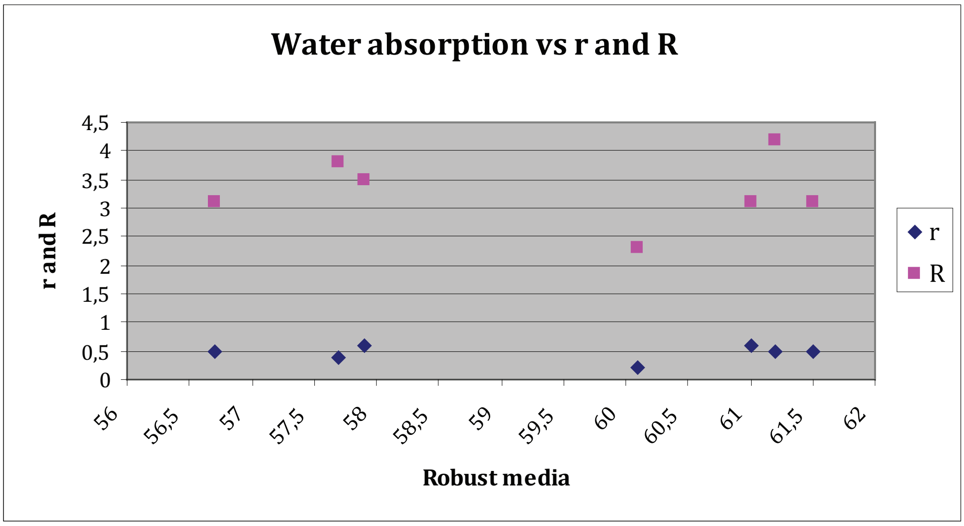


Figure C.1 — Water absorption

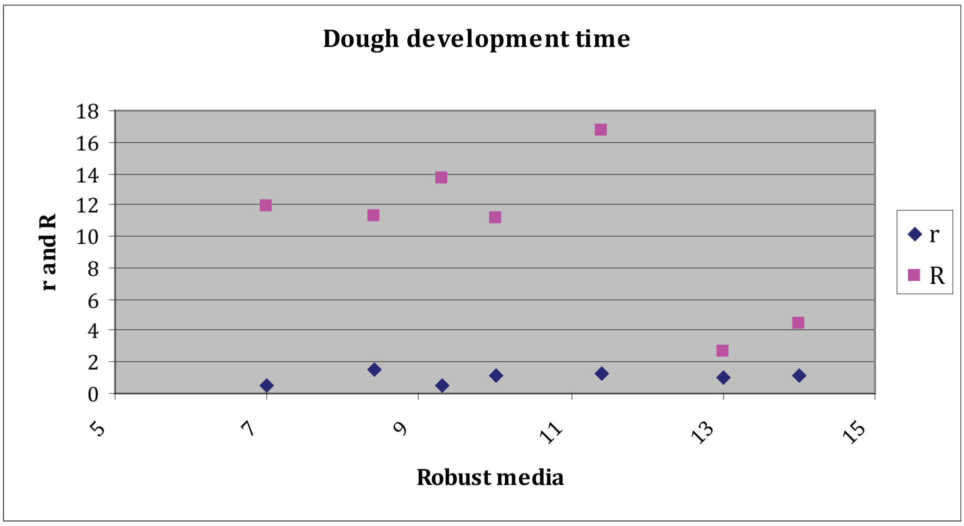


Figure C.2 — Dough development time

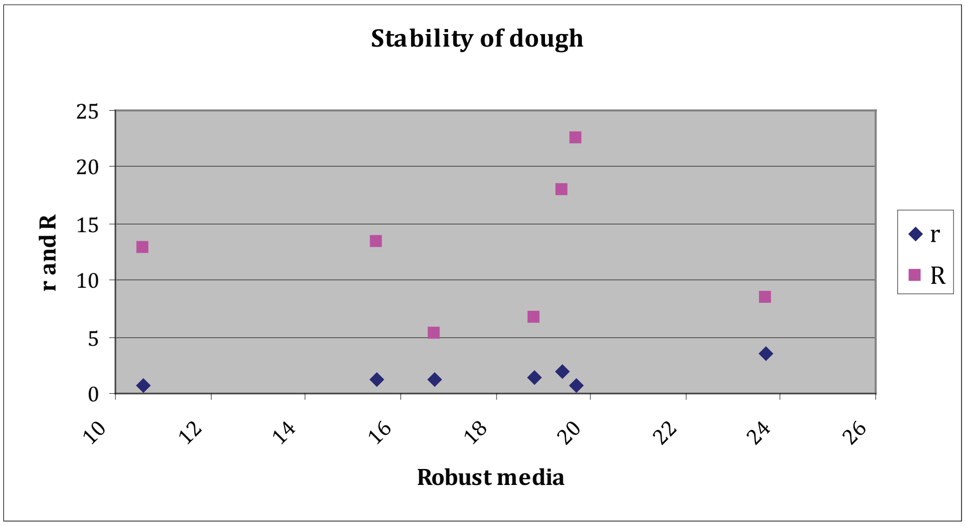


Figure C.3 — Stability of dough

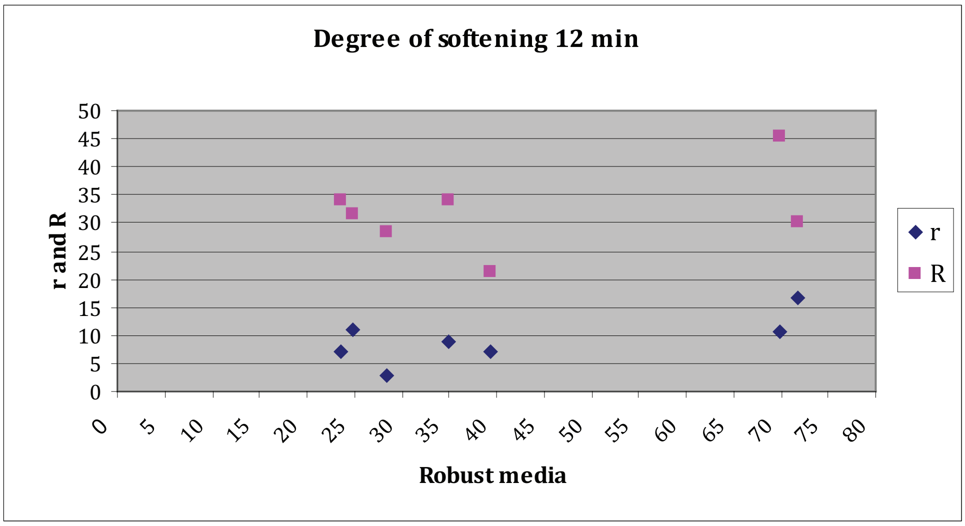


Figure C.4 — Degree of softening 12 min

Bibliography

[1] ICC 115/1, *Method for using the Brabender Farinograph*

[2] AACC Method 54-21.02, *Rheological Behavior of Flour by Farinograph: Constant Flour Weight Procedure*

[3] ISO 24333, *Cereals and cereal products — Sampling*

[4] D'Appolonia B.L., & Kunerth W.H.eds. *The Farinograph Handbook*. AACC, St. Paul, MN, 1984

[5] Nieman Ir.W. Report No. T 91-31, *The reproducibility of farinograph results.* IGMB - TNO, Wageningen, The Netherlands, March 1991

[6] Sietz W.: *Computer evaluation at dough rheological measurements.* Mühle und Mischfuttertechnik, **130** (34), 1993

[7] ISO 5725-1, *Accuracy (trueness and precision) of measurement methods and results — Part 1: General principles and definitions*

[8] 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*

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