BRITISH STANDARD

BS 4317-20:1999

Methods of test for
Cereals and pulses —

Part 20: Determination of water absorption of flour and rheological properties of doughs using a farinograph

Confirmed
December 2011

ICS 67.060

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee AW/4, Cereals and pulses, upon which the following bodies were represented:

Agricultural Engineers' Association
Association of Public Analysts
Campden and Chorleywood Food Research Association
Grain and Feed Trade Association
Home Grown Cereals Authority
Institute of Brewing
Institute of Food Science and Technology
Intervention Board
Maltsters Association of Great Britain
Ministry of Agriculture, Fisheries and Food
NABIM
National Farmers' Union
Natural Resources Institute
United Kingdom Agricultural Supply Trade Association Ltd.

This British Standard, having been prepared under the direction of the Consumer Products and Services Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 December 1999

Amendments issued since publication

Amd. No.	Date	Comments

The following BSI references relate to the work on this standard:
Committee reference AW/4
Draft for comment 95/502231 DC

ISBN 0 580 33054 0

Contents

Foreword

This part of BS 4317 has been prepared by Technical Committee AW/4, Cereals and pulses. It supersedes BS 4317-20:1989, which is withdrawn.

This British Standard is derived from ICC Standard Method No. 115/1, published by the International Association for Cereal Science and Technology.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 6, an inside back cover and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

1 Scope

This part of BS 4317 specifies a method, using a farinograph[1)], for determination of the water absorption of flours and the mixing behaviour of doughs made from these.

The method is applicable to white, brown and wholemeal wheat flours.

Details of an interlaboratory trial on the repeatability and reproducibility of results gained using the method specified in this British Standard are given in annex A.

2 Terms and definitions

For the purposes of this part of BS 4317, the following terms and definitions apply.

2.1

consistency

resistance of a dough to being mixed in a farinograph at a specified constant speed (expressed in farinograph units, BU)

2.2

water absorption

(of flour) volume percentage of water in a water/flour mixture required to produce a dough with a consistency of 600 BU

3 Principle

A farinograph measures and records the consistency of a dough. The consistency is adjusted to 600 BU and the water absorption calculated. The water absorption is used to determine the mixing curve, which is a guide to the strength of the flour.

4 Reagents

4.1 *Distilled water* or *deionized water* or *water of equivalent purity*.

5 Apparatus

NOTE All measuring equipment should be calibrated.

5.1 *Farinograph*, with burette and constant temperature water circulating tank. For a 300 g bowl the burette shall be graduated from 135 ml to 225 ml with an accuracy of 0.6 ml and for a 50 g bowl from 22.5 ml to 37.5 ml with an accuracy of 0.2 ml. The burette shall provide readings in percentage water added (i.e. 0 % to 75 %).

5.2 *Balance*, at least able to weigh 300 g with an accuracy of 0.01 g.

5.3 *Plastics scraper*.

5.4 *Thermometer*, graduated in intervals of 0.1 °C.

6 Procedure

6.1 Operational requirements of the farinograph

The farinograph shall be level. If the bubble in the spirit level attached to the base plate is not centred, adjust the foot screws accordingly. The time to flow from 0 ml to 225 ml or 0 ml to 37.5 ml for 300 g and 50 g bowl burettes respectively shall be 20 s $\pm$ 2 s.

Turn on the thermostat and circulate the water until the required temperature is reached prior to using the farinograph. (Warm up for a period of 1 h before conducting any test measurements.) Before and during use, check the temperature of the thermostat and mixing bowl, the latter in the hole provided for this purpose. Both temperatures shall be 30.0 °C $\pm$ 0.5 °C.

Lubricate the mixer with a drop of water between its back plate and each of the blades. Check for zero deflection of the pointer with the motor running at approximately 63 r/min (clean the bowl and recheck if required). If zero deflection is not obtained and the bowl has been thoroughly cleaned including the area behind the blades, adjust the zero point to obtain zero deflection of the pointer with the motor running at approximately 63 r/min. Adjust the position of the pen to obtain identical readings from the pointer and pen.

Ensure that the chart paper is correctly aligned on the sprockets.

NOTE When the upper lever arm is moved the pen should follow the arc on the chart paper.

6.2 Dough preparation

Allow the flour to equilibrate to 25.0 °C $\pm$ 5.0 °C.

Run the bowl empty for 1 min and ensure that the pen centres on the zero line.

Before carrying out any tests mix a scrap dough.

Place 300.0 g or 50.0 g of flour in the bowl as appropriate for the size of bowl. Close the lid to engage the safety switch.

Set the pen on the chart paper on a 9 min line. Start mixing the dry flour with the motor running at approximately 63 r/min. The pen shall read 20 BU or less.

Fill the burette including the tip with water at 30.0 °C $\pm$ 2.0 °C.

As the pen crosses the 0 min line, start adding water from the burette through the front end of the right hand slot in the lid. Add a volume of water expected to bring the curve to a consistency of 600 BU.

When the dough forms, carefully use the plastics scraper to push any flour particles or dough adhering to the mixing bowl walls down into the mixture.

[1)] This part of BS 4317 has been prepared based on work with the Brabender Farinograph. This information is given for the convenience of users of this part of BS 4317 and does not constitute an endorsement by BSI of this product.

If the consistency is too high add more water to centre the curve on 600 BU ± 20 BU. (If the water is not added in a single titration, the sample shall not be used to determine the farinograph characteristics.)

NOTE Remove the dough and clean the bowl as follows. Stop the mixer, set the pen away from the paper, add a little flour and mix for a short time to stiffen the dough. Take care to avoid exceeding a consistency of about 800 BU. Remove the dough, clean the bowl and blades thoroughly with warm water and dry with a clean cloth.

Make further mixing(s) if required until the correct water addition is made within 30 s and continue mixing for at least 12 min after the curve first shows signs of weakening or until the required features of the curve are revealed.

The maximum band width obtained during any test shall lie in the range 70 BU to 90 BU. If the band width falls beyond this range, adjust the damping accordingly and repeat the test.

7 Expression of results

7.1 Water absorption

Read the water absorption (%) directly from the burette.

7.2 Farinogram characteristics

Measure the farinogram relative to the line on which the curve centres (e.g. if the curve centres at 610 BU, make the measurement along this line).

7.3 Development time

Report the development time (the time from the start of mixing to the point on the curve immediately before the first signs of weakening) to the nearest 0.5 min. If two peaks are observed, use the second peak to measure development time.

NOTE See example farinogram in Figure 1.

7.4 Stability

Report the stability (the difference in time between the point where the top of the curve first intercepts the line equivalent to a consistency of 600 BU and the point where the top of the curve leaves this line) to the nearest 0.5 min.

NOTE See example farinogram in Figure 1.

7.5 Degree of softening

Report the degree of softening (the difference in height between the centre of the curve immediately before the first signs of weakening and the centre of the curve 12 min afterwards) to the nearest 5 BU.

NOTE See example farinogram in Figure 1.

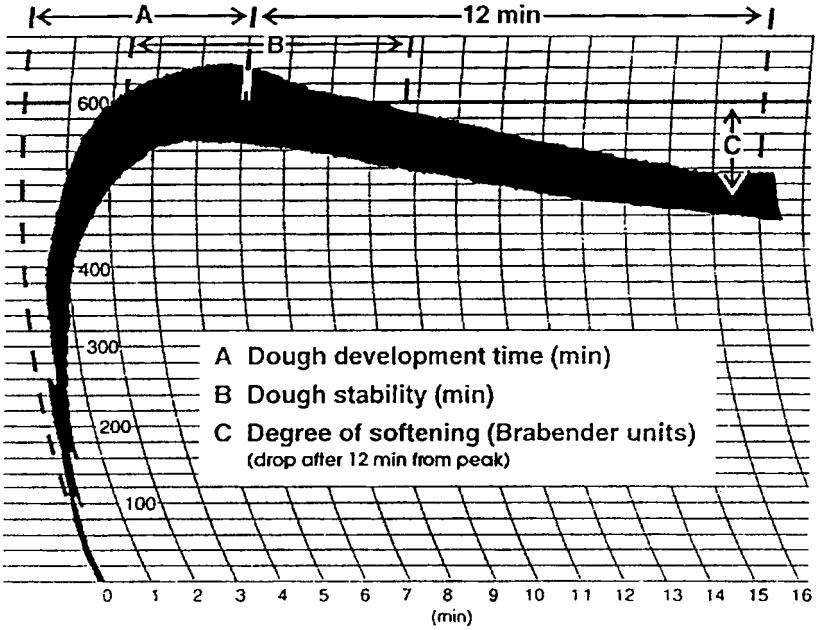

Figure 1 — Farinogram

Annex A (informative)
Repeatability and reproducibility

A.1 Repeatability r

Values for the difference between two independent single test results obtained by the method specified in this British Standard, from examination of identical test material in the same laboratory by the same operator using the same equipment and within a short interval of time, are given in Table A.1.

Table A.1 — Repeatability: limits of result differences

Measurement	Difference
Water absorption	0.5 %
Development time	0.5 min
Stability	1.0 min
Degree of softening	20 BU

A.2 Reproducibility R

Values for the difference between two single test results obtained by the method specified in this British Standard, from examination of identical test material in different laboratories with different operators using different equipment, are given in Table A.2.

Table A.2 — Reproducibility: limits of result differences

Measurement	Difference
Water absorption	1.6 %
Stability	2.0 min
Development time	1.0 min
Degree of softening	45 BU

A.3 Water absorption

The results of interlaboratory trials to determine water absorption are given in Table A.3.

Table A.3 — Water absorption

Measurement	Sample A	Sample B	Sample C	Total
Number of laboratories	12	12	12	12
Number of results	24	24	24	72
Number of laboratories retained after deletion of outliers	12	12	12	12
Number of accepted results	24	24	24	72
Mean	66.2	56.8	59.4	60.8
Repeatability standard deviation $S(r)$	0.22	0.18	0.15	0.19
Repeatability coefficient of variation $CV(r)$ %	0.34	0.32	0.26	0.31
Reproducibility standard deviation $S(R)$	0.81	0.46	0.39	0.55
Reproducibility coefficient of variation $CV(R)$ %	1.23	0.80	0.65	0.91
Repeatability r 95 % [$2.83 \times S(r)$]	0.63	0.52	0.44	0.53
Reproducibility R 95 % [$2.83 \times S(R)$]	2.30	1.29	1.09	1.56

The reported results of the interlaboratory trials for water absorption are given in Table A.4 (expressed as percentage of flour mass). No outliers or stragglers were identified.

Table A.4 — Results of interlaboratory tests for water absorption

Laboratory no.	Sample A		Sample B		Sample C	
1	66.9	66.9	57.3	57.3	59.8	59.8
2	65.8	66.0	56.5	56.4	59.4	59.3
3	66.1	65.8	57.0	56.5	59.2	59.1
4	67.0	66.6	56.7	57.0	59.0	59.4
7	66.4	66.3	56.9	56.6	59.7	60.0
9	64.8	65.5	56.5	56.0	58.8	59.0
10	66.2	66.0	57.2	57.2	59.7	59.7
11	66.9	67.0	56.5	56.6	59.5	59.5
12	66.0	66.0	57.0	57.0	59.0	59.5
13	64.5	64.2	56.0	56.3	58.8	58.8
14	66.3	66.8	57.1	57.2	59.7	59.7
15	67.0	67.1	57.5	57.65	59.8	59.9

A.4 Development time

The results of interlaboratory trials to determine development time are given in Table A.5.

Table A.5 — Development time

Measurement	Sample A	Sample B	Sample C	Total
Number of laboratories	12	12	12	12
Number of results	24	24	24	72
Number of laboratories retained after deletion of outliers	12	12	12	12
Number of accepted results	24	24	24	72
Mean	3.4	1.8	2.1	2.4
Repeatability standard deviation $S(r)$	0.28	0.11	0.17	0.19
Repeatability coefficient of variation $CV(r)$ %	8.18	6.19	7.93	7.92
Reproducibility standard deviation $S(R)$	0.46	0.13	0.33	0.30
Reproducibility coefficient of variation $CV(R)$ %	13.43	6.80	15.29	12.27
Repeatability r 95 % [$2.83 \times S(r)$]	0.79	0.32	0.48	0.53
Reproducibility R 95 % [$2.83 \times S(R)$]	1.30	0.37	0.92	0.86

The reported results are given in Table A.6 (expressed in minutes). No outliers or stragglers were identified.

Table A.6 — Results of interlaboratory tests for development time

Laboratory no.	Sample A		Sample B		Sample C	
1	3.0	3.0	2.0	2.0	2.0	2.0
2	3.5	3.5	2.0	2.0	2.5	2.5
3	3.5	3.5	2.0	2.0	2.0	2.0
4	4.0	4.5	1.5	2.0	2.0	2.0
7	3.5	3.5	1.75	1.75	2.25	2.0
9	3.0	3.5	1.75	1.75	2.0	2.0
10	3.0	3.0	1.75	1.75	1.75	2.0
11	3.0	3.5	2.0	2.0	2.0	2.5
12	4.0	3.75	2.0	2.0	3.0	2.5
13	3.75	3.0	1.5	1.25	2.0	1.75
14	2.5	3.0	1.75	1.75	1.75	1.75
15	4.0	3.5	2.0	2.0	2.5	2.5

A.5 Stability

The results of interlaboratory trials to determine stability are given in Table A.7.

Table A.7 — Stability

Measurement	Sample A	Sample B	Sample C	Total
Number of laboratories	12	12	12	12
Number of results	24	24	24	72
Number of laboratories retained after deletion of outliers	12	12	12	12
Number of accepted results	24	24	24	72
Mean	6.4	1.7	3.6	3.9
Repeatability standard deviation $S(r)$	0.56	0.15	0.28	0.33
Repeatability coefficient of variation $CV(r)$ %	8.78	9.13	7.56	8.46
Reproducibility standard deviation $S(R)$	0.93	0.22	1.07	0.74
Reproducibility coefficient of variation $CV(R)$ %	14.44	12.94	29.5	18.89
Repeatability r 95 % [2.83 × $S(r)$]	1.60	0.43	0.78	0.94
Reproducibility R 95 % [2.83 × $S(R)$]	2.62	0.61	3.04	2.09

The reported results are given in Table A.8 (expressed in minutes). Stragglers are marked * and are excluded from the final statistical analysis.

Table A.8 — Results of interlaboratory tests for stability

Laboratory no.	Sample A		Sample B		Sample C	
1	5.0	6.0	1.5	2.0	4.0	4.0
2	7.0	6.5	1.5	1.5	4.0	3.5
3	7.0	5.0	2.0	2.0	3.5	3.0
4	7.0	7.0	1.5	2.0	3.5	3.0
7	6.0	6.25	1.75	1.75	3.5	3.0
9	5.5	6.0	1.5	1.5	2.5	2.5
10	5.5	5.5	1.5	1.5	2.5	2.25
11	6.0	6.0	2.0	2.0	4.0	4.5
12	8.5	8.5*	1.5	1.5	6.5	6.0
13	7.5	6.25	1.75	1.5	3.5	3.0
14	6.5	7.0	1.75	1.75	2.5	3.0
15	6.5	6.0	1.5	1.5	4.5	4.5

A.6 Degree of softening

The results of interlaboratory trials to determine the degree of softening are given in Table A.9.

Table A.9 — Degree of softening

Measurement	Sample A	Sample B	Sample C	Total
Number of laboratories	12	12	12	12
Number of results	24	24	24	72
Number of laboratories retained after deletion of outliers	12	12	11	12 (max.)
Number of accepted results	24	24	22	70
Mean	92.3	148.8	132.0	124.4
Repeatability standard deviation $S(r)$	8.60	8.90	4.13	7.21
Repeatability coefficient of variation $CV(r)$ %	9.32	5.98	3.13	5.80
Reproducibility standard deviation $S(R)$	11.82	19.75	13.813	15.13
Reproducibility coefficient of variation $CV(R)$ %	12.81	13.28	10.46	12.17
Repeatability r 95 % [$2.83 \times S(r)$]	24.34	25.18	11.68	20.40
Reproducibility R 95 % [$2.83 \times S(R)$]	33.46	55.90	39.09	42.82

The reported results are given in Table A.10 [expressed in Brabender units (BU)]. Outliers are marked ** and excluded from the final statistical analysis.

Table A.10 — Results of interlaboratory tests for degree of softening

Laboratory no.	Sample A		Sample B		Sample C	
1	110	105	150	150	135	135
2	80	90	130	140	130	130
3	70	90	130	145	130	135
4	80	80	160	140	120	120
7	85	85	115	140	140	130
9	100	80	130	110	100	130**
10	115	105	175	175	155	160
11	100	100	180	180	120	130
12	90	80	160	160	130	120
13	80	100	135	145	115	115
14	105	90	145	140	125	120
15	95	100	165	170	155	155

blank

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: 020 8996 9000. Fax: 020 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: 020 8996 9001. Fax: 020 8996 7001.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: 020 8996 7111. Fax: 020 8996 7048.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: 020 8996 7002. Fax: 020 8996 7001.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL