INTERNATIONAL STANDARD

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Cereals and cereal products — Common wheat (*Triticum aestivum* L.) — Determination of alveograph properties of dough at constant hydration from commercial or test flours and test milling methodology

*Céréales et produits céréaliers — Blé tendre (*Triticum aestivum *L.) — Détermination des propriétés alvéographiques d'une pâte à hydratation constante de farine industrielle ou d'essai et méthodologie pour la mouture d'essai*

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Foreword

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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ISO 27971 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 338, *Cereal and cereal products*, in collaboration with Technical Committee ISO/TC 34, *Food products*, Subcommittee SC 4, *Cereals and pulses*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition of ISO 27971 cancels and replaces ISO 5530-4:2002, which has been technically revised to specify the preparation of a test flour, to present complete precision data, and to add one annex giving alveograph maintenance advice and another for the assessment of proteolytic activity in wheat or flour.

Introduction

The end-use value of wheat is determined by a number of properties that are useful in the manufacture of baked products such as bread, rusks, and biscuits.

Such properties include the important viscoelastic (rheological) properties of dough formed as a result of flour hydration and kneading. An alveograph is used to study the main parameters by subjecting a dough test piece to biaxial extension (producing a dough bubble) by inflating it with air which is similar to the deformation to which it is subjected during panary fermentation.

Recording the pressure generated inside the bubble throughout the deformation of the dough test piece until rupture provides information on:

— the resistance of the dough to deformation, or its strength (stiffness). It is expressed by the maximum pressure parameter, P;

— the extensibility or the possibility of inflating the dough to form a bubble. It is expressed by the parameters of extensibility, L, or swelling, G;

— the elasticity of the dough during biaxial extension. It is expressed by the elasticity index, I_e;

— the energy required to deform the dough bubble until it bursts, which is proportional to the area of the alveogram (sum of the pressures throughout the deformation process). It is expressed by the parameter, W.

The P/L ratio is a measurement of the balance between tenacity and extensibility.

Alveographs are commonly used throughout the wheat and flour industry, for the following purposes:

— selecting and assessing different varieties of wheat and marketing batches of wheat;

— blending different batches of wheat or flour to produce a batch with given values for the alveographic criteria (W, P, and L) complying with the proportional laws of blending.

Alveographs are used both on the upstream side of the industry for marketing, selecting and assessing the different varieties and on the downstream side throughout the baking industries (see Bibliography).

Cereals and cereal products — Common wheat (*Triticum aestivum* L.) — Determination of alveograph properties of dough at constant hydration from commercial or test flours and test milling methodology

1 Scope

This International Standard specifies a method of using an alveograph to determine the rheological properties of different types of dough obtained from “soft” to “hard” wheat flour (*Triticum aestivum* L.) produced by industrial milling or laboratory test milling.

It describes the alveograph test and how to use a laboratory mill to produce flour in two stages:

Stage 1: preparation of the wheat grain for milling to make it easier to separate the bran from the endosperm (see Clause 7);

Stage 2: the milling process itself, including the break system involving three fluted rollers, reduction of particle size between two smooth rollers and the use of a centrifugal sieving machine to grade the products (see Clause 8).

2 Normative references

The following referenced documents are indispensable for the application 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 385, *Laboratory glassware — Burettes*

ISO 660, *Animal and vegetable fats and oils — Determination of acid value and acidity*

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

ISO 835, *Laboratory glassware — Graduated pipettes*

ISO 1042, *Laboratory glassware — One-mark volumetric flasks*

ISO 7700-1, *Check of the calibration of moisture meters — Part 1: Moisture meters for cereals*

3 Principle

The behaviour of dough obtained from a mixture of different types of flour and salt water is evaluated during deformation. A dough disk is subjected to a constant air flow; which at first it withstands. Subsequently, it swells into a bubble, according to its extensibility, and ruptures. The change in the dough is measured and recorded in the form of a curve called an alveogram.

4 Reagents

Unless otherwise specified, use only reagents of recognized analytical grade, and only distilled or demineralized water or water of equivalent purity.

4.1 Sodium chloride solution, obtained by dissolving (25 ± 0,2) g of NaCl in water and then making the volume up to 1 000 ml. This solution shall not be stored for more than 15 days and its temperature shall be (20 ± 2) °C when used.

4.2 Refined vegetable oil, low in polyunsaturates, such as peanut oil. It is possible to use olive oil if its acid index value is less than 0,4 (determined according to ISO 660). Store in a dark place in a closed container and replace regularly (at least every 3 months).

Alternatively, **liquid paraffin** (also known as "soft petroleum paraffin"), with an acid index value less than or equal to 0,05 and the lowest possible viscosity [maximum 60 mPa s (60 cP) at 20 °C].

4.3 Cold degreasing agent, optimum safety[1)].

5 Apparatus

Usual laboratory apparatus, and in particular the following.

5.1 Mechanical cleaner, fitted with sieves for wheat cleaning, in accordance with the manufacturer's requirements.

5.2 Conical or riffle sample divider.

5.3 Analytical balance, accurate to 0,01 g.

5.4 Glass burette, of capacity 50 ml, complying with the requirements of ISO 385, Class A, graduated in 0,1 ml divisions, stand-mounted.

5.5 Rotary blender[2)], for grain conditioning and flour homogenization, including the following components:

5.5.1 Constant speed stirrer.

5.5.2 Two worm screws integral with the flask, possibly via the stopper (one for wheat preparation, the other for flour homogenization).

5.5.3 Several wide-necked **plastic flasks**, of capacity 2 l.

5.6 Test mill[3)] (laboratory mill) manually operated (see Annex A).

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1) ITECMA "Securclean ER" is an example of a suitable product available commercially. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of this product.

2) The Chopin MR 2 l rotary blender is an example of a suitable product available commercially. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of this product.

3) The Chopin-Dubois CD1 test mill is an example of a suitable product available commercially. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of this product.

5.7 Complete alveograph system (see Table 1 for specifications and characteristics of the accessories) including the following devices:

5.7.1 Kneading machine [for models MA 82, MA 87 and MA 95, see Figure 1a); for model NG, see labels a in Figure 2 and Figure 3], with accurate temperature control, for dough sample preparation.

5.7.2 Hydraulic manometer or **Alveolink**[4] [for models MA 82, MA 87 and MA 95, see Figure 1 b); for model NG, see labels b in Figure 2 and Figure 3] for recording the pressure curve.

5.7.3 Alveograph[5] [for models MA 82, MA 87 and MA 95, see Figure 1 c); for model NG, see labels c in Figures 2 and Figure 3] with accurate temperature control, for test piece biaxial deformation of the dough pieces. It has two rest chambers, each containing five plates on which the dough test pieces can be arranged prior to deformation.

5.8 Burette, supplied with the apparatus, of capacity 160 ml, graduated in divisions of 0,1 % of moisture content[6] .

5.9 Timer, for use with model MA 82 only.

5.10 Planimetric scales, supplied with the apparatus where an Alveolink is not included.

5.11 System for recording the test environment conditions (temperature and relative air humidity) as specified in 8.1 and 9.1.

5.12 Volumetric flask, of capacity 1 000 ml, complying with the requirements of ISO 1042, class A.

5.13 Pipette, of capacity 25 ml, graduated in divisions of 0,1 ml, complying with the requirements of ISO 835, class A.

6 Sampling

A representative wheat or flour sample should have been sent to the laboratory. It shall not have been damaged or changed during transport or storage.

Sampling is not part of the method specified in this International Standard. Recommended sampling methods are given in ISO 2170[1], ISO 6644[6], and ISO 13690[7].

7 Preparation of the wheat for test milling

7.1 Cleaning the laboratory sample

Pass the laboratory sample through a mechanical cleaner (5.1) to ensure that all stones and metal fragments are removed and to avoid damaging the rollers during milling. A magnetic device can also be used to remove ferrous metal fragments.

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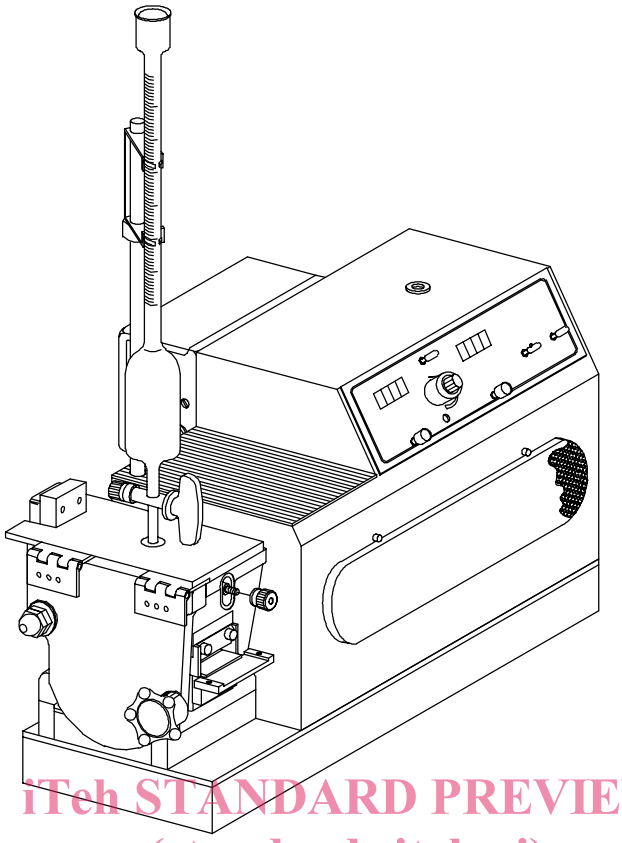
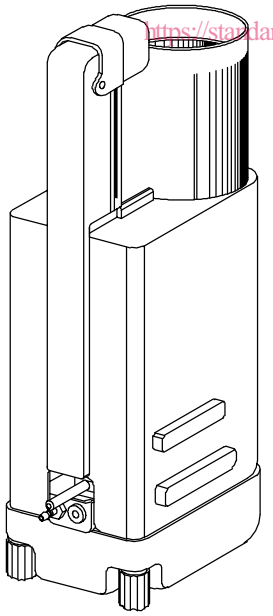
4) Example of a suitable product available commercially. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of this product.

5) The methods specified in this International Standard are based on the use of the MA 82, MA 87, MA 95 and NG models of Chopin alveograph.

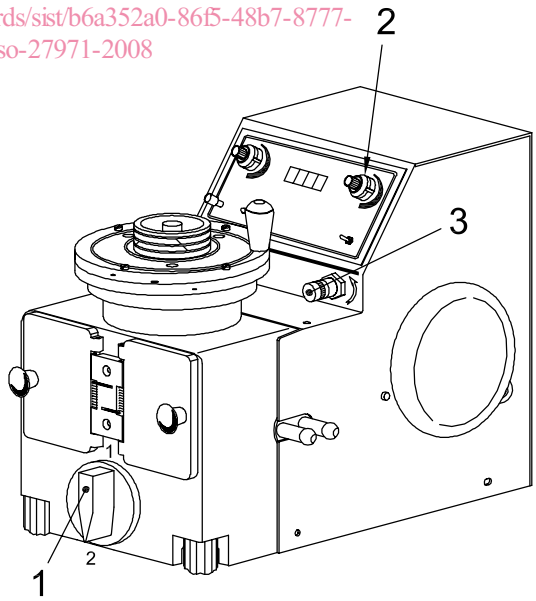
6) Throughout this International Standard, “content” is to be understood as a “mass fraction” (see ISO 80000-9:—[8], 12), i.e. the ratio of the mass of substance in a mixture to the mass of the mixture.



a) kneading machine



b) manometer

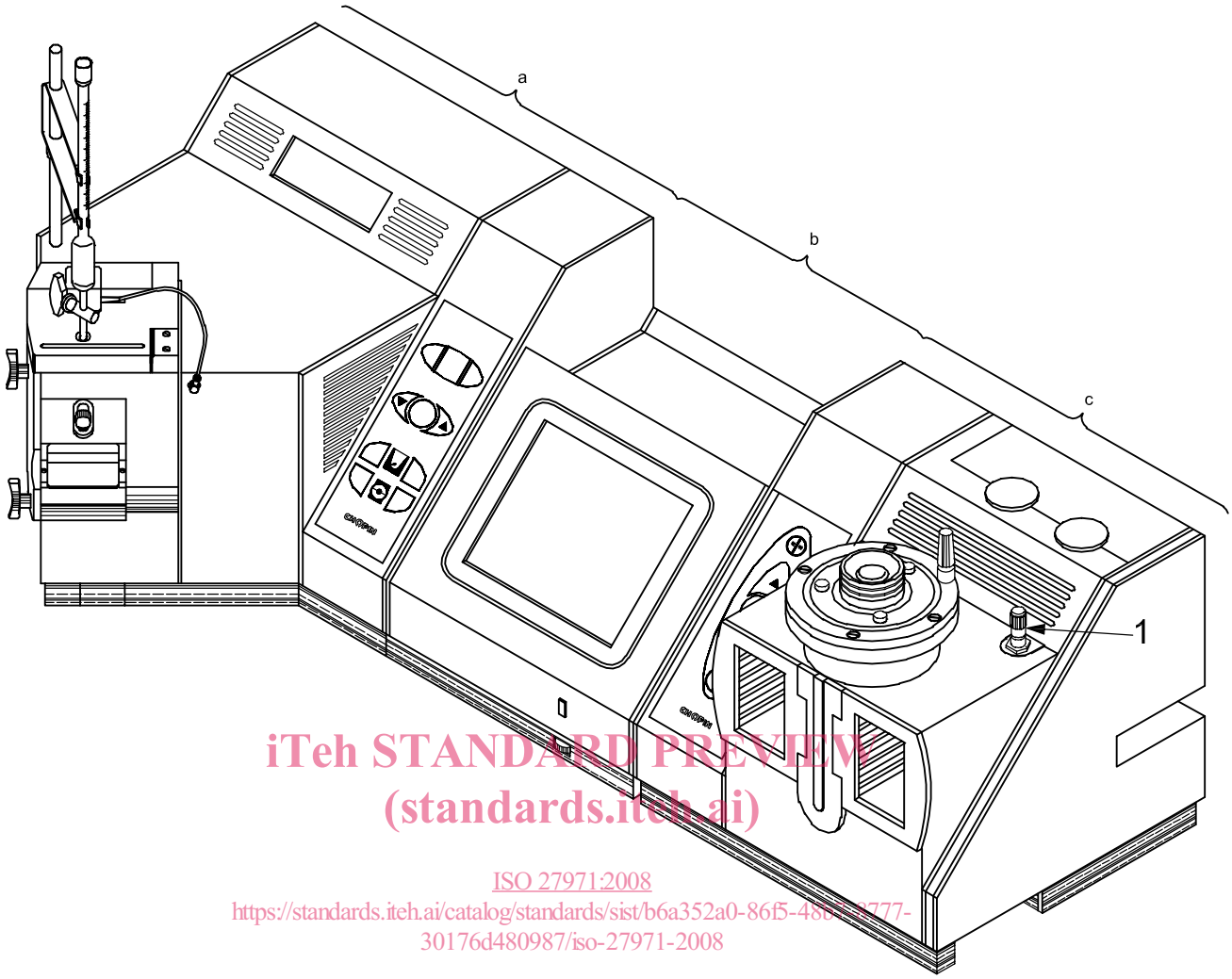


Key

1 handle A in position 2
2 pump potentiometer
3 micrometric valve for air flow adjustment

c) alveograph

Figure 1 — Alveograph model MA 82, MA 87 and MA 95 assemblies

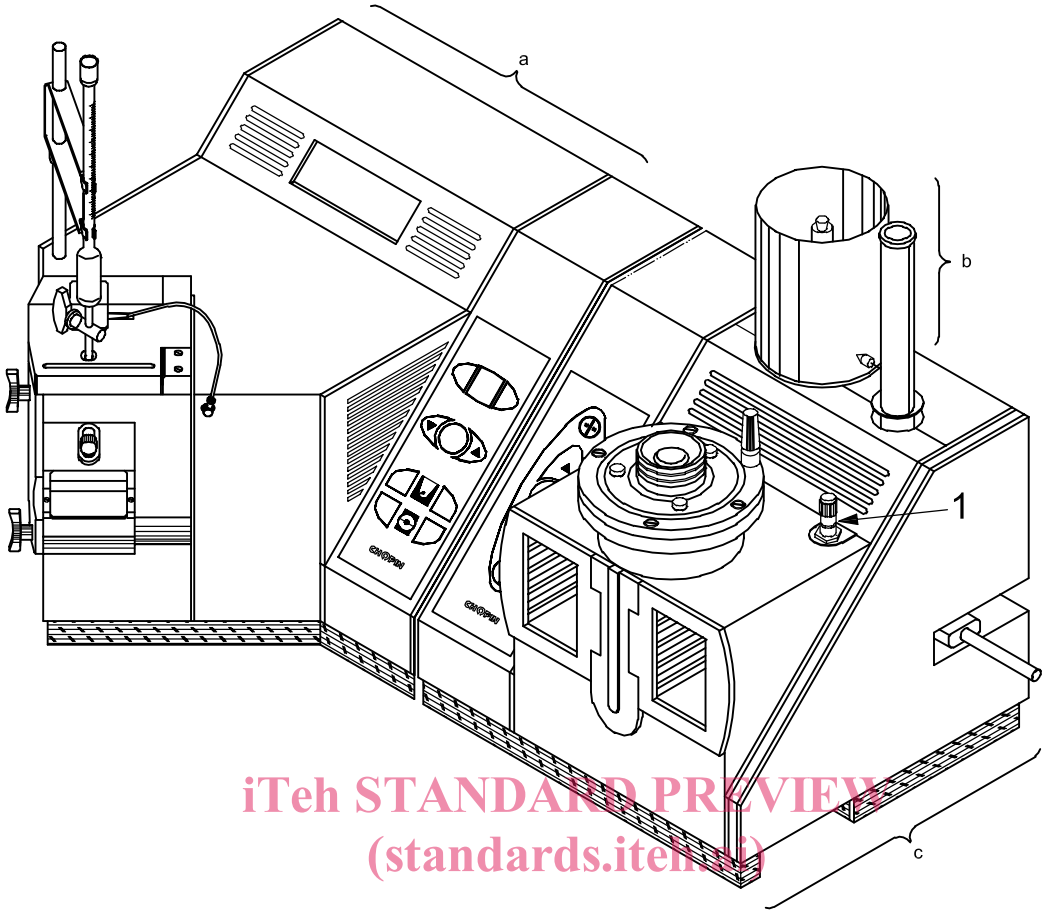


Key

1 micrometric valve for air flow adjustment

a kneading machine
b integrator-recorder
c alveograph (with Alveolink integrator-recorder)

Figure 2 — Alveograph model NG assembly with an Alveolink integrator-recorder



Key

1 micrometric valve for air flow adjustment

a kneading machine

b recording manometer

c alveograph (with hydraulic recording manometer)

Figure 3 — Alveograph model NG assembly with a hydraulic recording manometer

Table 1 — Specifications and characteristics of the accessories required for the test

Quantity	Value and tolerance
Rotational frequency of the kneading machine blade	(60 ± 2) Hz
Height of sheeting guides	(12,0 ± 0,1) mm
Large diameter of the sheeting roller	(40,0 ± 0,1) mm
Small diameter of the sheeting roller	(33,3 ± 0,1) mm
Inside diameter of the dough cutter	(46,0 ± 0,5) mm
Diameter of the aperture created when the moving plate opens (which determines the effective diameter of the test piece)	(55,0 ± 0,1) mm
Theoretical distance between the fixed and moving plates after clamping (equal to the thickness of the test piece before inflation)	(2,67 ± 0,01) mm
Volume of air automatically injected to detach the test piece prior to inflating the bubble[a]	(18 ± 2) ml
Linear speed of the periphery of the recording drum	(5,5 ± 0,1) mm/s
Air flow[b] ensuring inflation	(96 ± 2) l/h
Rotation of the manometer drum (from stop to stop)	(55 ± 1) s

[a] Some older devices are fitted with a pear-shaped rubber bulb for manual injection of the 18 ml required to detach the test piece.

[b] To adjust the flow rate of the air generator used to inflate the bubble, fit the nozzle (Figure 4) to create a specified pressure drop (and obtain a pressure corresponding to a height of 92 mmHg (12,3 kPa) on the manometer chart). The air flow rate is set with the standardized pressure drop to obtain a pressure corresponding to a height of 60 mmHg (8,0 kPa) on the manometer chart, i.e. (96 ± 2) l/h (see Figure 4 and Figure 5).

7.2 Test portion

The test portion shall be representative of the initial wheat mass. Use the sample divider (5.2) to homogenize and divide the laboratory sample until the mass required for test milling plus moisture content determination is obtained. The minimum wheat mass of the test portion for milling shall be 800 g.

7.3 Wheat moisture content determination

Determine the moisture content of the test portion as specified in ISO 712, or using a rapid device whose measurement does not differ from the reference value by ± 0,4 g water per 100 g of sample (see ISO 7700-1).

7.4 Wheat conditioning

7.4.1 General

Conditioning the wheat for milling makes it easier to separate the bran from the endosperm. The target moisture content is (16 ± 0,5) %.

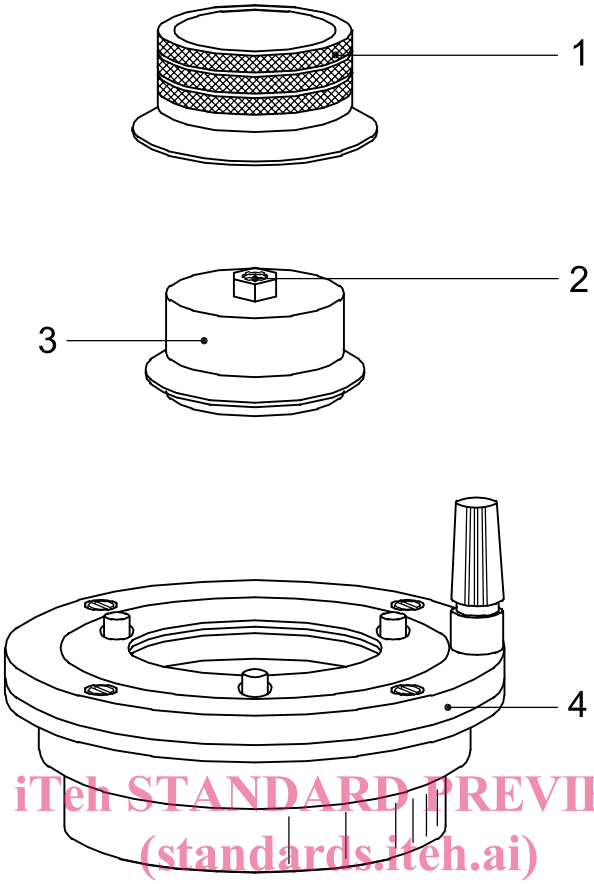
7.4.2 Wheat with initial moisture content between 13 % and 15 % (one-stage moistening)

Weigh, using the balance (5.3), a test portion of (800 ± 1) g of wheat and pour it into the blender.

Add the required amount of water (see Table B.1) to the grain from the burette (5.4) directly, or after weighing it to the nearest 0,1 g.

Immediately after adding the water, insert the stopper fitted with the worm screw provided for use with wheat into the flask, shake vigorously for a few seconds and place on the rotary blender (5.5).

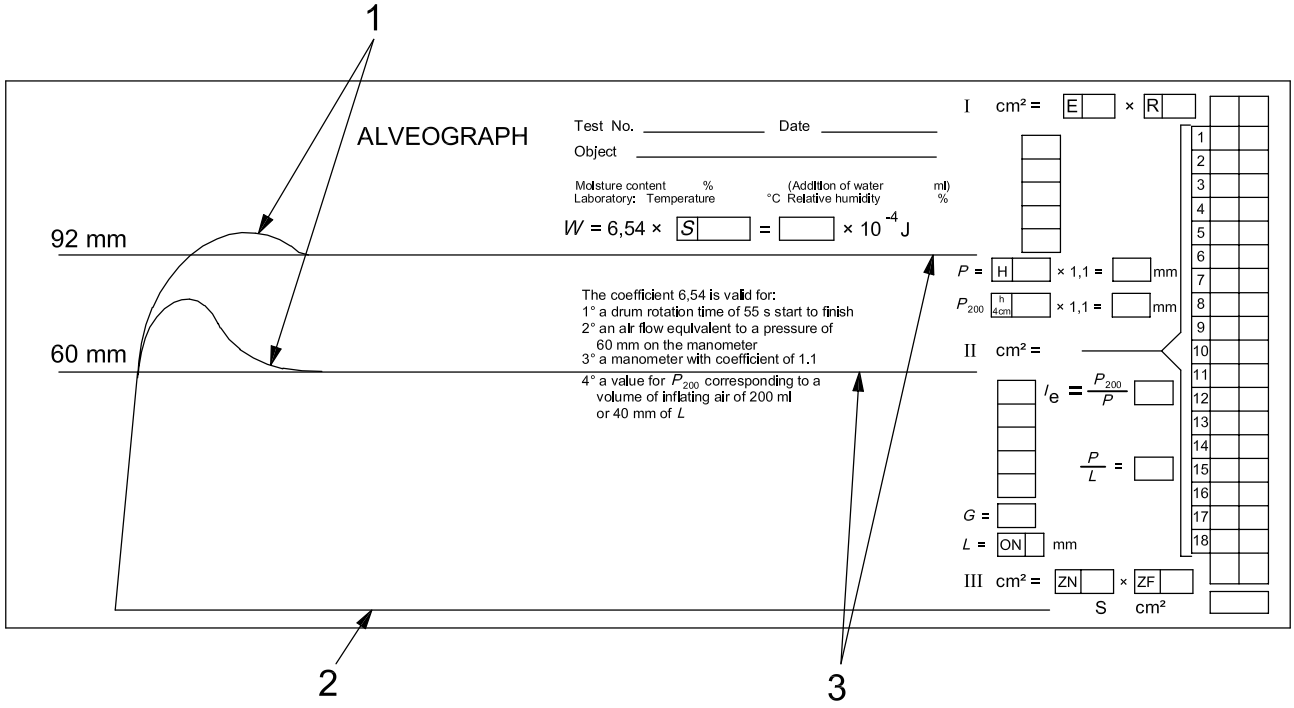
Run the rotary blender for (30 ± 5) min (time required to distribute the water evenly across the surface of the grains).



Key

1 knurled ring
2 nozzle
3 nozzle holder
4 top plate

Figure 4 — Flow control system



Key

1 floater curve
2 zero pressure baseline
3 parallel lines

Figure 5 — Measurement pressure adjustment

Allow the flask to rest for a period that brings the total time of operations of moistening, shaking and resting to (24 ± 1) h.

7.4.3 **Wheat with a moisture content less than 13 %** (two-stage moistening)

As a larger volume of water is required, divide it into two halves and add in two stages during the conditioning period.

Proceed as described in 7.4.2, using only half the total quantity of water required (see Table B.1).

Shake the flask as described in 7.4.2 and allow it to rest for at least 6 h.

Then add the second half of the total quantity of water between the 6th hour and the 7th hour.

After adding the second half, shake the flask again for (30 ± 5) min, then allow it to rest for a period that brings the total time of operations of moistening, shaking and resting to (24 ± 1) h.

7.4.4 **Wheat with a moisture content greater than 15 %** (preliminary drying followed by conditioning, as described above)

The wheat shall be dried to produce a moisture content lower than 15 %.

Spread the laboratory sample in a thin layer to optimize the exchange between the grain and the air. Allow to dry in the open air in a dry place for at least 15 h.

Proceed to a new moisture determination (7.3).

Then condition the wheat as specified in 7.4.2 or 7.4.3, depending on the new moisture content.