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Second edition
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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*

Reference number
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Contents

Page

Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 34, *Food products*, Subcommittee SC 4, *Cereals and pulse*.

This second edition cancels and replaces the first edition (ISO 27971:2008), which has been technically revised.

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 it ruptures provides information on the following:

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

b) 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;

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

d) the work required to deform the dough bubble until it ruptures, 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 strength 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 wheat 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 determining, using an alveograph, the rheological properties of different types of dough obtained from common wheat flour (*Triticum aestivum* L.) produced by industrial milling or laboratory 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, including breaking between 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 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 660, *Animal and vegetable fats and oils — Determination of acid value and acidity*

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

ISO 12099, *Animal feeding stuffs, cereals and milled cereal products — Guidelines for the application of near infrared spectrometry*

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; at first it withstands the pressure. Subsequently, it inflates 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 sodium chloride (NaCl) in water and then making the volume up to 1 000 ml. This solution shall not be stored for more than 15 d 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 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 three months).

Alternatively, **liquid paraffin** (also known as "soft petroleum paraffin"), with an acid value of 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.

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 instructions.

5.2 Conical or riffle sample divider.

5.3 Analytical balance, accurate to 0,01 g.

5.4 Glass burette, of 50 ml in capacity, graduated in 1 ml divisions.

5.5 Rotary blender[1], 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, 2 l capacity.

5.6 Test mill (laboratory mill), manually or automatically operated (see Annex A).

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 1 a); for model NG, see label a in Figure 2 and Figure 3], with accurate temperature control, for dough sample preparation.

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

5.7.3 Alveograph[3] [for models MA 82, MA 87, and MA 95, see Figure 1 c); for model NG, see label c in Figures 2 and Figure 3] with accurate temperature control, for biaxial deformation of the dough

1) 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.

2) Alveolink 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 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 which are examples of suitable products commercially available This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of this product.

test 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 with stopcock, supplied with the apparatus, 160 ml capacity, graduated in divisions of 0,1 % of moisture content.

NOTE Throughout this International Standard, "content" is expressed as a "mass fraction" (see ISO 80000-9, 12[6]), i.e. the ratio of the mass of substance in a mixture to the total mass of the mixture.

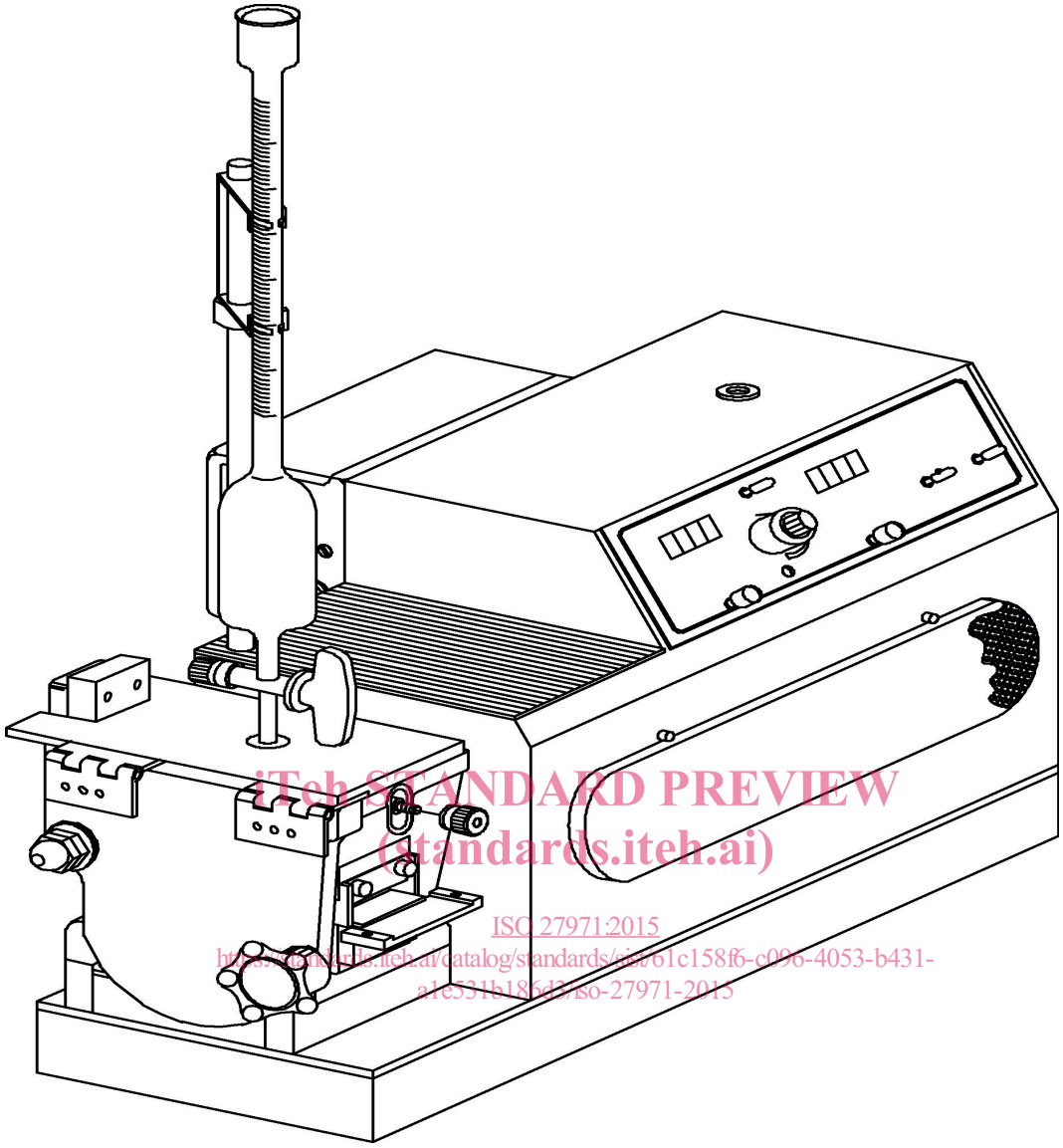
5.9 Timer, for use with model MA 82 only.

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

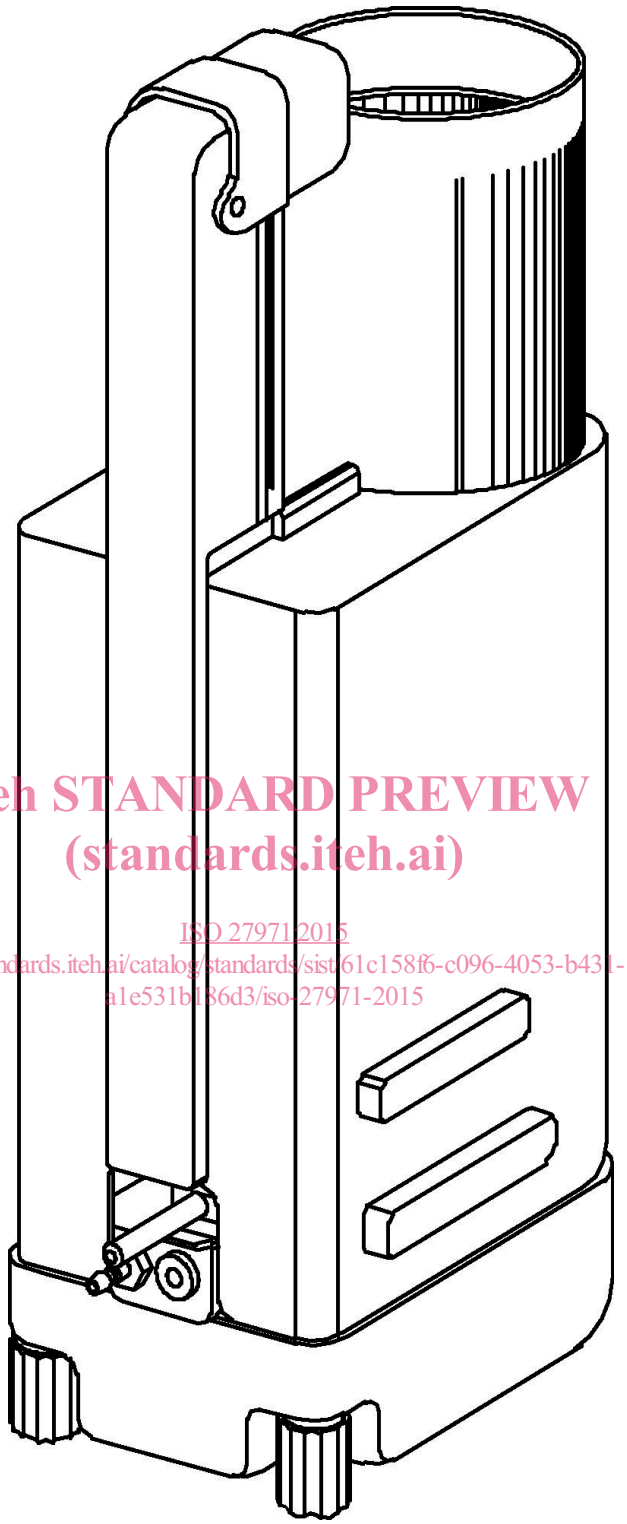
5.11 System for recording the test environment conditions (temperature and relative air humidity) as specified in 8.1 and 9.1.

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

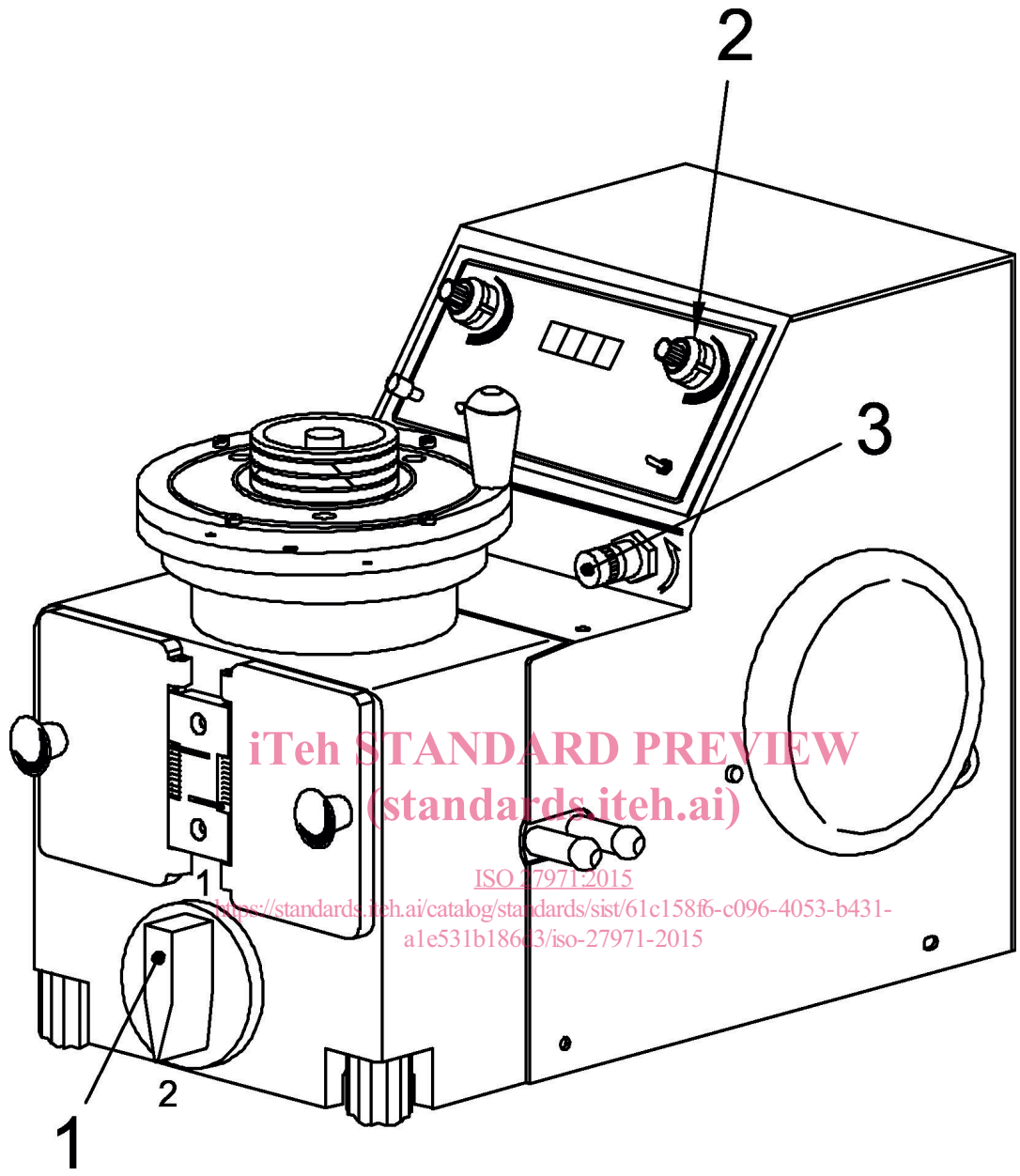
5.13 Pipette, 25 ml capacity, graduated in divisions of 0,1 ml, complying with the requirements of ISO 835, class A.



a) Kneading machine



b) Manometer

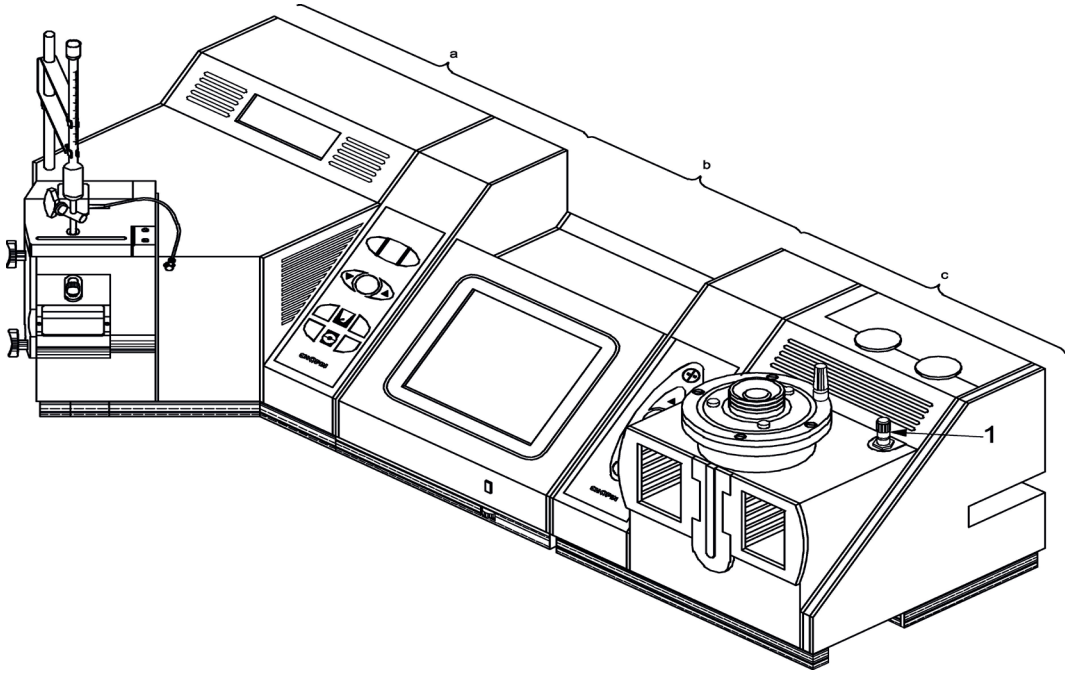


c) Alveograph

Key

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

Figure 1 — Model MA 82, MA 87, and MA 95 alveograph assemblies



Key

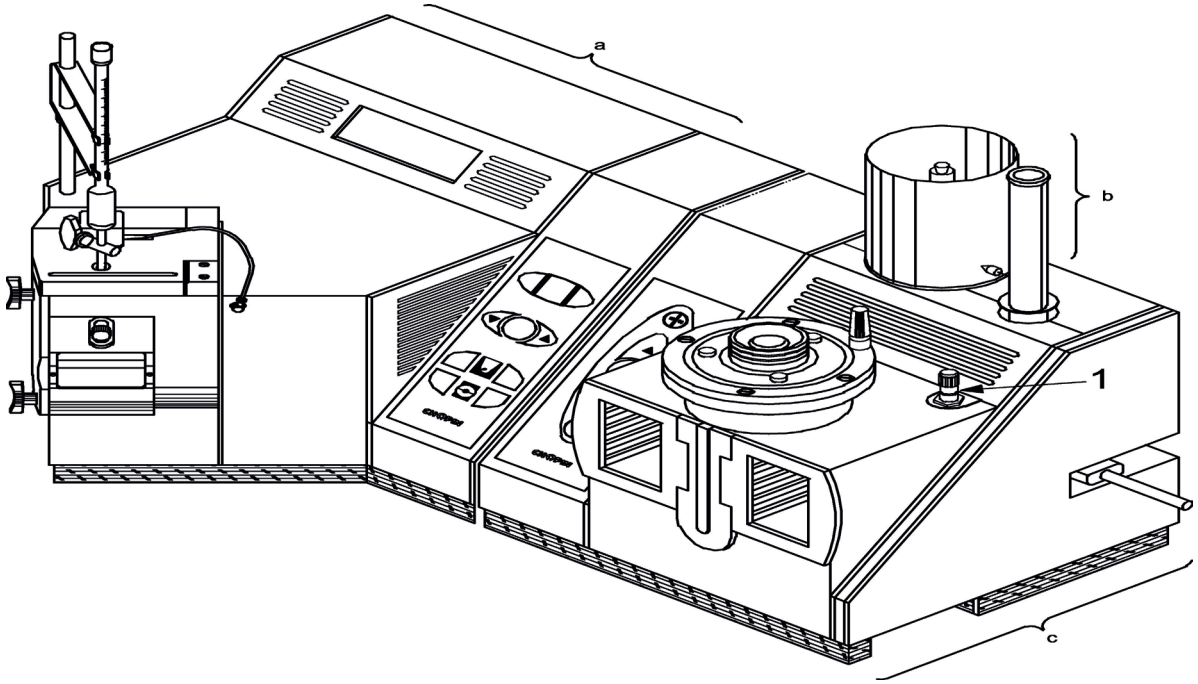
1 micrometric valve for air flow adjustment

a NG kneading machine.

b NG integrator-recorder.

c NG alveograph (with NG integrator-recorder).

Figure 2 — NG alveograph assembly with Alveolink integrator-recorder



Key

1 micrometric valve for air flow adjustment

a NG kneading machine.

b NG recording machine.

c NG alveograph (with hydraulic recording manometer).

Figure 3 — NG alveograph assembly with hydraulic recording manometer

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

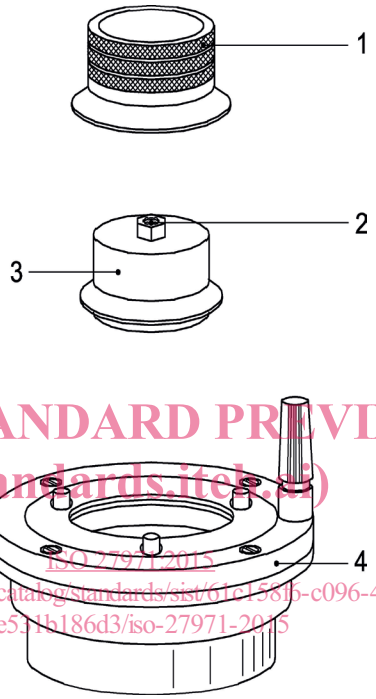
Quantity	Value and tolerance
Rotational frequency of the kneading machine blade	(60 ± 2) Hz
Height of sheeting guides	(12,0 ± 0,1) mm
Large diameter of the sheeting roller	(40,0 ± 0,1) mm
Small diameter of the sheeting roller	(33,3 ± 0,1) mm
Inside diameter of the dough cutter	(46,0 ± 0,5) mm
Diameter 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

[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 mmH2O(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 mmH2O(8,0 kPa) on the manometer chart, i.e.(96 ± 2) l/h (see Figure 4 and Figure 5).

Table 1 *(continued)*

Quantity	Value and tolerance
Rotation time 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 mmH2O(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 mmH2O(8,0 kPa) on the manometer chart, i.e.(96 ± 2) l/h (see Figure 4 and Figure 5).	



Key

1 knurled ring
2 nozzle
3 nozzle holder
4 top plate

Figure 4 — Flow control system

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 24333.[1]