
**Wheat, rye and respective flours, durum
wheat and durum wheat semolina —
Determination of the Falling Number
according to Hagberg-Perten**

*Blés tendres, seigles et leurs farines, blés durs et leurs semoules —
Détermination de l'Indice de Chute selon Hagberg-Perten*

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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.

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.

ISO draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning the Falling Number apparatus given in 6.1.

ISO takes no position concerning the evidence, validity and scope of this patent right.

The holder of this patent right has assured the ISO that he is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with the ISO. Information may be obtained from:

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Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 3093 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 3093:1982), which has been technically revised.

Wheat, rye and respective flours, durum wheat and durum wheat semolina — Determination of the Falling Number according to Hagberg-Perten

1 Scope

1.1 This International Standard describes the determination of the α -amylase activity of cereals by the Falling Number method according to Hagberg-Perten.

This method is applicable to cereal grains, in particular to wheat and rye and their respective flours, durum wheat and its semolina. For the purposes of this International Standard the term "flour" includes semolina and ground grain (wholemeal), the particle sizes of which are defined.

This method is not applicable for the determination of low levels of α -amylase activity, which can be carried out in accordance with ISO 7973.

1.2 By converting the Falling Number into a Liquefaction Number (LN), it is possible to use this method to estimate the composition of mixtures of grain, flour or semolina with known Falling Number values necessary to produce a sample of a required Falling Number.

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 565, *Test sieves — Woven metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings*

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

ISO 3310-1, *Test sieves — Technical requirements and testing — Part 1: Test sieves of metal wire cloth*

ISO 3696, *Water for analytical laboratory use — Specification and test methods*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

Falling Number

FN

total time, in seconds, required to activate a viscometer stirrer and allow it to fall a predetermined distance through an aqueous gel prepared from heating a mixture of flour or semolina and water in a viscometer tube, and which is undergoing liquefaction due to attack by the enzyme α -amylase

NOTE Time is counted from immersion in the water bath.

3.2

Liquefaction Number

LN

result of a simple calculation to convert the Falling Number into a value used to estimate the composition of mixtures of grain, flour or semolina necessary to produce a sample of the required Falling Number

NOTE LN values, unlike Falling Numbers are additive.

4 Principle

The α -amylase activity is estimated using the starch present in the sample as a substrate. The determination is based on the ability of an aqueous suspension of flour, semolina or wholemeal cereal product to gelatinize rapidly in a boiling water bath, and on the measurement of starch liquefaction by the α -amylase present in the sample.

Liquefaction affects the thickness of the starch gel and, hence, the resistance to the viscometer stirrer and the time taken for it to fall a defined distance.

5 Reagents

5.1 Water, produced by distillation or demineralization, complying with grade 3 in accordance with ISO 3696.

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6 Apparatus

Usual laboratory apparatus and, in particular, the following <https://standards.iteh.ai/catalog/standards/sist/4a8f5b7b-2a92-4055-9b1e-357163022746-iso-3093-2004>

6.1 Apparatus for the determination of Falling Number¹⁾, comprising the following components.

6.1.1 Water bath, with integral heating unit, cooling system and water level indicator.

6.1.2 Electronic timer.

6.1.3 Viscometer stirrer, metallic, able to move freely within the ebonite stopper.

Its rods shall be straight, without ring and the wheels free from distortion and wear.

6.1.4 Precision viscometer tubes, manufactured from special glass, with the following dimensions:

- inner diameter of 21,00 mm \pm 0,02 mm;
- outer diameter of 23,80 mm \pm 0,25 mm;
- inner height of 220,0 mm \pm 0,3 mm.

6.1.5 Rubber stoppers, to fit the viscometer tubes.

6.2 Automatic dispenser or pipette, allowing a volume of 25,0 ml \pm 0,2 ml to be delivered.

1) The "Falling Number" apparatus having a specifically designed viscometer stirrer produced by Perten Instruments is an example of suitable device available commercially. This device forms the subject of a patent.

This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of this product.

6.3 Analytical balance, capable of weighing to the nearest 0,01 g.

6.4 Laboratory mill²⁾, hammer type, and fitted with a 0,8 mm screen allowing the production of a wholemeal product meeting the particle size specification shown in 8.1.3.

The performance of the mill should be checked periodically using a well-mixed sample of ground grain (as produced in 8.1.2).

The mill should be equipped with an automatic feeding device, particularly for the grinding of high moisture content grain.

6.5 Laboratory sieve, of aperture 800 µm, and conforming to ISO 565 and ISO 3310-1.

7 Sampling

Sampling is not part of the method specified in this International Standard. A recommended sampling method is given in ISO 13690.

It is important the laboratory receive a sample which is truly representative and has not been damaged or changed during transport or storage. Storage time and storage conditions of the sample in the laboratory may have a significant effect on Falling Number values.

8 Preparation of test sample

8.1 Whole grain

8.1.1 Elimination of impurities

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If necessary, the sample should be cleaned to eliminate impurities (e.g. stones, dust, husks and other cereal grains). A 300 g of representatively sampled grain shall be taken from the laboratory sample.

A smaller sample of about 200 g, although it provides less reproducible results, may be used for routine inspections. If the sample is less than 200 g, the results risk being marred by errors.

8.1.2 Grinding of grain samples

Feed the laboratory mill (6.4) carefully with grain to avoid heating and overloading. The feed to the mill may be controlled automatically with an automatic feeding device. Grinding should be continued for 30 s to 40 s after the last of the sample has entered the mill. Discard the bran particles remaining inside the mill, provided these do not represent more than 1 % of the quantity of grain sampled for grinding. Thoroughly mix all of the milled product before use.

It is recommended (especially in the case of successive grindings) to allow the meal to cool for 1 h before proceeding with the test.

8.1.3 Ground sample specification

WARNING — The Falling Number values can be affected by the particle size of the ground grain.

2) The LM 3100 and LM 120 mills from Perten Instruments are examples of suitable devices available commercially.

This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of these products.

The milled product shall comply with the specification given in Table 1.

Table 1 — Ground sample specification

Aperture of sieve µm	Amount of ground sample passing through sieve %
710	100
500	95 to 100
210 to 200	80 or less

The particle size distribution of the ground material should be checked regularly using a well-mixed sample of ground grain as produced in 8.1.2.

The following method may be used to do this. Select the appropriate sieves, as specified in Table 1, and arrange in order of decreasing aperture size with a suitable sieving aid in each sieve and a receiver pan on the bottom. Weigh out a representative sample of 50,0 g and place on the top sieve. Sieve in a horizontal plane, manually for at least 5 min until nothing passes through the sieve, or mechanically for a period of 10 min. Weigh the material retained on each sieve and that contained in the receiver pan. Calculate the percentage of ground grain which passes through each sieve.

8.2 Flour and semolina samples

Flour samples shall not contain lumps. If necessary, sift the flour using the laboratory sieve (6.5) in order to remove lumps or foreign bodies.

In the case of coarse commercial wholemeal flours or semolina, a sample shall be ground using the laboratory mill (6.4) in order to produce a test sample which conforms to the particle size specification shown in Table 1. The ground sample shall be mixed thoroughly before use.

9 Procedure

9.1 Determination of the moisture content

The Falling Number should be determined on flour or ground material with a moisture content of 15%.

Therefore, determine the moisture content of the prepared test material (8.1 and 8.2) using the method described in ISO 712.

Alternatively, a rapid instrumental procedure may be used (e.g. near infrared reflectance) provided this has been calibrated using ISO 712.

9.2 Test portion

Carry out the determination on two test portions simultaneously or rapidly one after the other.

Refer to Table 2, column (2) which shows the required mass of sample to be taken, at different moisture contents, in order to ensure that a constant ratio of dry matter is used for the Falling Number determination.

If greater differentiation of the Falling Number values is required for samples with very high α -amylase activity, as is normally the case for rye, refer to column (3).

Weigh the test portion to the nearest 0,05 g.

Table 2 — Test portion as a function of moisture content of the sample

Moisture content %	Test portion, g		Moisture content %	Test portion, g	
	for a nominal mass of 7 g at 15 % moisture content	for a nominal mass of 9 g at 15 % moisture content		for a nominal mass of 7 g at 15 % moisture content	for a nominal mass of 9 g at 15 % moisture content
(1)	(2)	(3)	(1)	(2)	(3)
9,0	6,40	8,20	13,6	6,85	8,80
9,2	6,45	8,25	13,8	6,90	8,85
9,4	6,45	8,25	14,0	6,90	8,85
9,6	6,45	8,30	14,2	6,90	8,90
9,8	6,50	8,30	14,4	6,95	8,90
10,0	6,50	8,35	14,6	6,95	8,95
10,2	6,55	8,35	14,8	7,00	8,95
10,4	6,55	8,40	15,0	7,00	9,00
10,6	6,55	8,40	15,2	7,00	9,05
10,8	6,60	8,45	15,4	7,05	9,05
11,0	6,60	8,45	15,6	7,05	9,10
11,2	6,60	8,50	15,8	7,10	9,10
11,4	6,65	8,50	16,0	7,10	9,15
11,6	6,65	8,55	16,2	7,15	9,20
11,8	6,70	8,55	16,4	7,15	9,20
12,0	6,70	8,60	16,6	7,15	9,25
12,2	6,70	8,60	16,8	7,20	9,25
12,4	6,75	8,65	17,0	7,20	9,30
12,6	6,75	8,65	17,2	7,25	9,35
12,8	6,80	8,70	17,4	7,25	9,35
13,0	6,80	8,70	17,6	7,30	9,40
13,2	6,80	8,75	17,8	7,30	9,40
13,4	6,85	8,80	18,0	7,30	9,45

9.3 Determination of Falling Number

9.3.1 Fill the water bath (6.1.1) with water to the level dictated by the overflow. Turn on the cooling system and ensure that cold water is flowing through the cooling lid. Switch on the Falling Number apparatus and bring the water to the boil. The water bath shall be boiling vigorously before any determinations are carried out and during the entire test period.

9.3.2 Transfer the weighed test portion (9.2) to a clean, dry viscometer tube (6.1.4). Add 25 ml ± 0,2 ml of water (5.1) at 22 °C ± 2 °C using the automatic dispenser or pipette (6.2).

9.3.3 Immediately stopper (6.1.5) the viscometer tube (6.1.4) and shake it vigorously up and down 20 to 30 times in order to obtain a uniform suspension³⁾. Ensure that dry flour or ground material is not trapped at the top of the tube against the stopper. If necessary, this can be freed by easing the stoppers slightly upwards and reshaking as necessary.

3) The "SHAKE-MATIC" apparatus from Perten Instruments is convenient for the homogenization of the suspension.

This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of this product.