ISO/DTS 17996 | IDF/RM 205:2022(E)

Date: 2022-~~09-22~~10-17

ISO TC 34/SC 5

Secretariat: NEN

Cheese — Determination of rheological properties by uniaxial compression at constant displacement rate

Fromage — Détermination des propriétés rhéologiques par compression uniaxiale à vitesse constante de translation

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Published in Switzerland.

Contents

Forewords

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This document was prepared by Technical Committee ISO/TC 34, *Food products*, Subcommittee SC 5, *Milk and milk products*, and the International Dairy Federation (IDF). It is being published jointly by ISO and IDF.

This second edition cancels and replaces the first edition (ISO/TS 17996:2006 | IDF/RM 205:2006), which has been technically revised, with the following changes:

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

IDF (the International Dairy Federation) is a non-profit private sector organization representing the interests of various stakeholders in dairying at the global level. IDF members are organized in National Committees, which are national associations composed of representatives of dairy-related national interest groups including dairy farmers, dairy processing industry, dairy suppliers, academics and governments/food control authorities.

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This document was prepared by the IDF *Standing Committee on Analytical Methods for Processing Aids and Indicators* and ISO Technical Committee ISO/TC 34, *Food products*, Subcommittee SC 5, *Milk and milk products*. It is being published jointly by ISO and IDF.

The work was carried out by the IDF/ISO Action Team on P18 of the *Standing Committee on Analytical Methods for Processing Aids and Indicators* under the aegis of its project leader Mr P. Watkinson (NZ).

Cheese — Determination of rheological properties by uniaxial compression at constant displacement rate

1 Scope

This document ~~describes~~specifies a method for the determination of rheological properties by uniaxial compression at constant displacement rate in hard and semi-hard cheeses.

The method provides standard conditions for sampling and testing, for data representation and general principles of calculation.

NOTE Sampling ~~might~~can be difficult with some cheese varieties, ~~for example~~e.g. caused by shortness, brittleness, stickiness and soft consistency. In these cases, reliable results cannot be achieved.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain ~~terminological~~terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

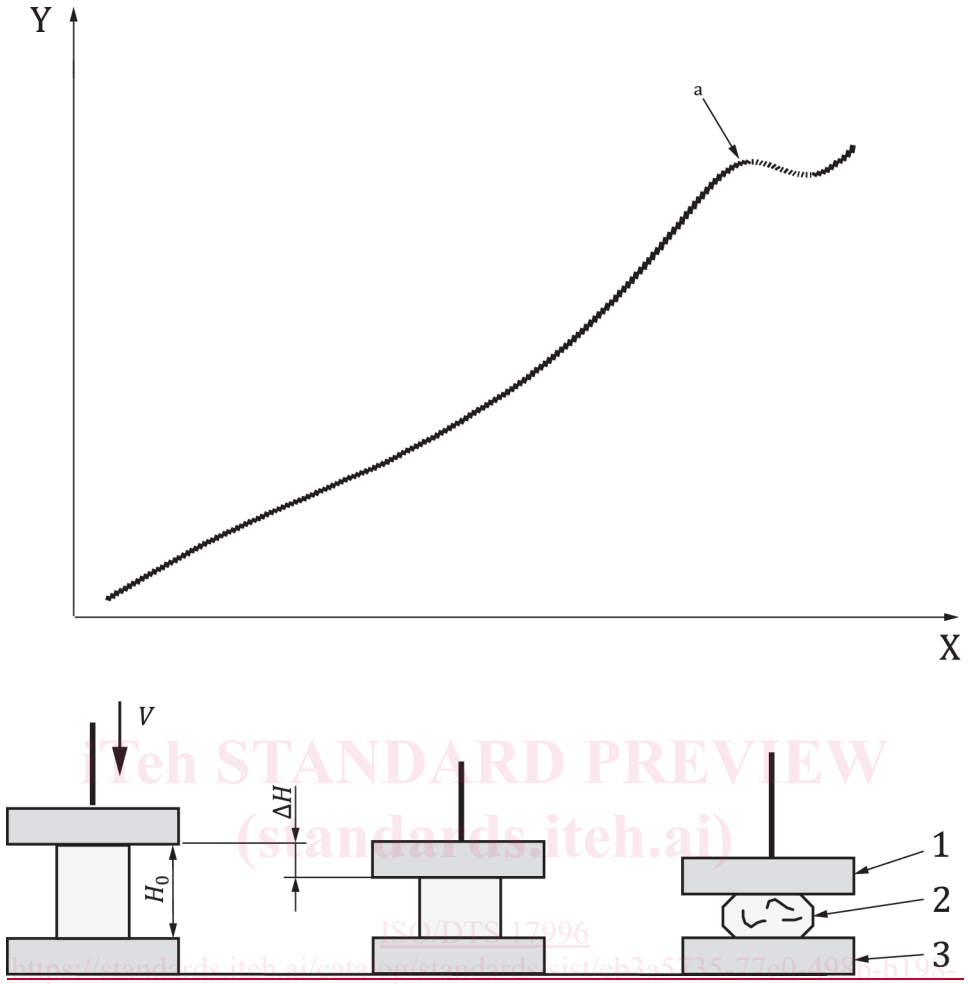
3.1
rheological properties
deformation under compression of the test sample ~~by the procedure specified in this document~~

Note 1 to entry. In accordance with the procedure specified in this document.

4 Principle

A cylindrical test sample, of defined dimensions, is compressed at a constant crosshead speed with a compression tool up to a relative deformation sufficient to determine the apparent fracture point. The force, which is the resistance of the cheese sample during compression, is measured with a load cell. The displacement may be measured either from the position of the cross head or calculated from the elapsed time multiplied by the displacement rate.

A schematic representation of the principle of the test is given in Figure ~~A.~~1.



Key

X	displacement	V	constant displacement rate of the compression tool
Y	force	H_0	initial sample height
1	compression tool	ΔH	variation in sample height
2	sample	a	Apparent fracture point.
3	fixed base		

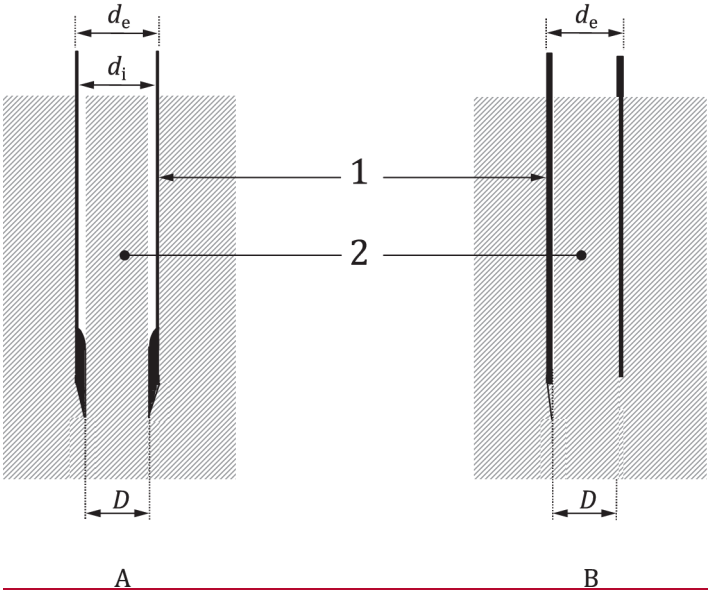
Figure 1 — Schematic principle of uniaxial compression at constant displacement rate

5 Apparatus

Usual laboratory equipment and, in particular, the following.

5.1 Cork-borer, such as that shown in Figure ~~A.4~~ 2 as an example.

It is recommended to mount the cork-borer on a drill-stand in order to drive it slowly and steadily through the test sample.



Key

1	cork borer		
2	cheese plug		
	Example A:	d_e	external diameter (d_e = 25 mm)
		d_i	internal diameter (d_i = 23 mm)
		D	cutting head diameter (D = 20 mm)
	Example B:	d_e	external diameter (d_e = 16,5 mm)
		D	cutting head diameter ($D = d_i$ is the internal diameter of 15,3 mm)

Figure 2 — Cork-borers for cutting cylindrical cheese plug

5.2 Parallel-wire cutting device, with a wire of diameter less than or equal to 0,4 mm and with a system to keep the two wires parallel to each other and perpendicular to the plug. It should also include a mechanically driven cutting system to cut the test sample to the required height.

5.3 Measuring cell, with a support and compression plate of the same stiff material, with smooth and parallel surfaces ~~(~~, e.g. stainless steel, aluminium or polytetrafluoroethylene (PTFE), of diameter larger (by 20 %) than that of the deformed test portion when at maximum compression. The load cell capacity shall have a reasonable relationship to the expected maximum force.

5.4 Compression instrument, providing ~~these~~ compression functions typically ~~consists~~consisting of two (or one) vertical columns on a platform and a crosshead connected perpendicular to these columns. This crosshead is driven vertically up and down by a motor. The load cell is typically directly connected to this crosshead and fixed to the compression tool (top plate) as shown in Figure ~~A.~~1. The fixed base in Figure ~~A.~~1 (bottom plate) is connected to the platform.

6 Sampling

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

Sampling is not part of the method specified in this document. A recommended sampling method is given in ISO 707 | IDF 50[1].

7 Procedure

7.1 Thermal equilibration of test samples

If the storage temperature of the loaf of cheese is above that of the measuring temperature, then the loaf of cheese shall be equilibrated at the measuring temperature for at least 50 h before further preparation of the test sample because of the slow crystallization of milk fat in the cheese.

If the storage temperature of the loaf of cheese is below that of the measuring temperature, before any preparation, store the loaf of cheese at the measuring temperature for at least 12 h. If there are specific difficulties that can occur during the sample preparation at the measuring temperature, then sample at the lower storage temperature and then equilibrate the test samples to the measurement temperature. In this case, the sample thermal equilibration time may be less than 12 h.

NOTE Examples of specific sampling difficulties are that the cheese is hard to cut, or a heated loaf of cheese changes the storage regime and therefore stops the use of the unsampled portions of the loaf of cheese for future measurements.

The following shall be avoided:

a) dehydration of the test sample during the period of thermal equilibration;

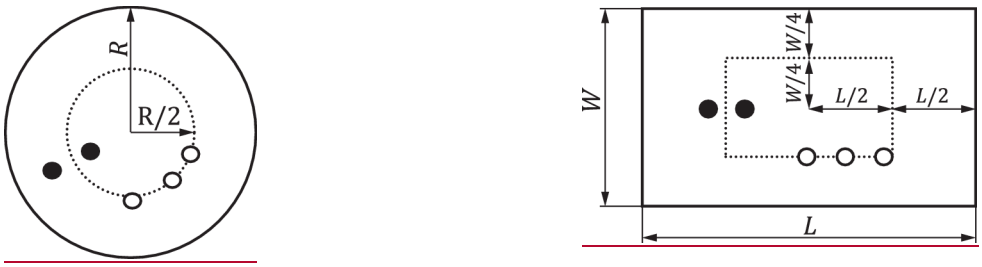
b) deformation of the test sample due to its own mass.

7.2 Test portion

7.2.1 Location

Take the test portion from the loaf of the cheese with a plug about half a radius, either along a circle of a cylindrical cheese, or along one side of a rectangular cheese (see Figure ~~A.2~~ 3).

Cut the test portion in the plug in the area representing around half of the length (see Figure ~~A.3~~ 4, plug A). If the height of cheese is sufficient, two portions can be taken as shown in Figure ~~A.3~~ 4, plug B and plug C.



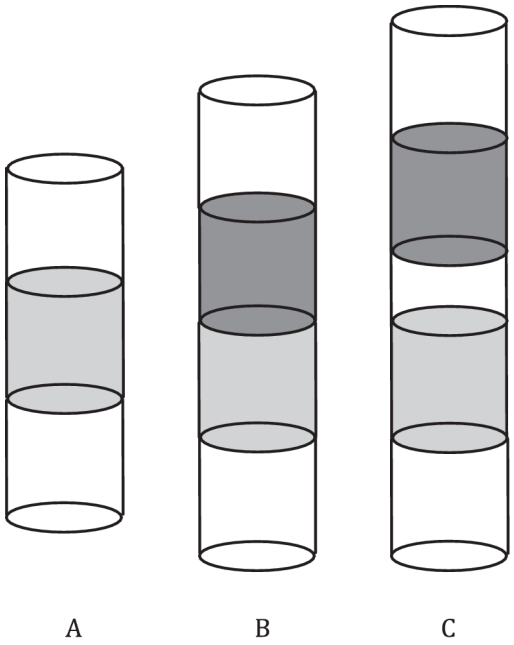
a) Cheese with cylindrical form

b) Cheese with parallelepipedal form

Key

R	radius	•	plug in case 1
W	width	°	plug in case 2
L	length		

Figure 3 — Location of plug for cheese sampling



Key

1 sample

Figure 4 — Three types of sampling in plug

7.2.2 Direction

The standard direction for taking the test portion is parallel to the pressure axis in cheese making. See Annex B for non-standard sampling conditions.

7.2.3 Geometry

The shape of the test portion shall be a cylinder with initial height/diameter ratio (h_0/d_0) of between 1,1 and 1,5.

The initial height, h_0, of the test portion shall range from 12,5 mm to 25 mm. The diameter, d_0, for a given height follows the above-mentioned ratio.

7.2.4 Cutting

Remove the rind or the plastic cover. Take a test portion using a cork-borer (5.1) with shapes shown in Figure ~~A.4~~ 2. For sticky cheeses, samples are easier to take with corer A than corer B. For cheese varieties showing shortness or brittleness, form B as shown in Figure ~~A.4~~ 2 is more appropriate than form A. It is recommended to use a cork-borer mounted on a drill-stand in order to drive it slowly and steadily through the test sample.

If it is difficult to obtain a good cylindrical form, it is recommended to use mineral oil of low viscosity (e.g. Vaseline®[1] oil) to lubricate the cork-borer. Do not test samples with cracks, holes or other visible defects.

Use a parallel-wire cutting device to cut the test sample to the required height. The wire diameter shall be less than or equal to 0,4 mm. It is essential to have a system that keeps the two wires parallel to each other and perpendicular to the plug. Preferably, use a mechanically driven cutting system. Taking these precautions into account reduces the lack in parallelism between the sample surface and the compression plate.

7.2.5 Delay

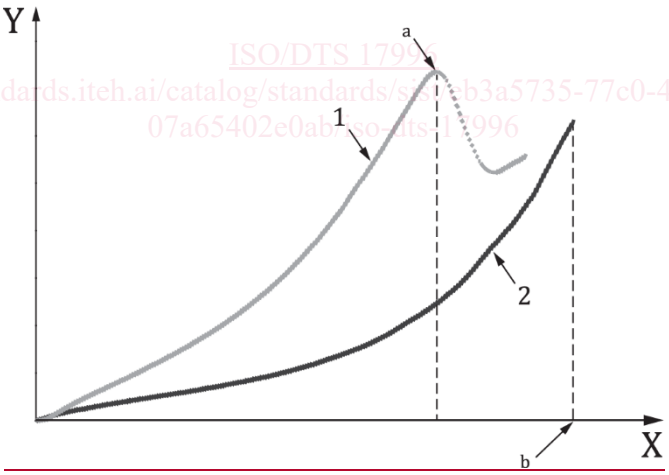
A delay between the taking of a test portion and its testing allows stress relaxation of the test portion. The recommended delay is between 10 min and 15 min. The upper limit is not strictly fixed but it should not exceed 2 h. This recommendation is not relevant when sampling is done at a lower temperature than the measuring temperature.

Store the test samples at the measuring temperature (see 7.3.5) and see Annex B for non-standard conditions. Store samples in a pill-box or wrapped in plastic film to avoid dehydration during the delay between sampling and testing.

7.3 Test conditions

7.3.1 Relative deformation

Perform the compression to just beyond the apparent fracture point (see Figure ~~A.~~5, curve 1) or to a predefined maximum deformation (see Figure ~~A.~~5, curve 2).



Key

X	deformation	a	Apparent fracture point.
Y	force	b	Maximum deformation.
1	curve 1		
2	curve 2		

Figure 5 — Examples of compression curves

[1] Vaseline®[1] is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.