

INTERNATIONAL  
STANDARD

**ISO**  
**11051**

First edition  
1994-10-01

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**Durum wheat (*Triticum durum* Desf.) —  
Specification**

*Blé dur (Triticum durum Desf.) — Spécifications*



Reference number  
ISO 11051:1994(E)

## Foreword

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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.

International Standard ISO 11051 was prepared by Technical Committee ISO/TC 34, *Agricultural food products*, Subcommittee SC 4, *Cereals and pulses*.

Annexes A, B and C form an integral part of this International Standard. Annexes D and E are for information only.

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# Durum wheat (*Triticum durum* Desf.) — Specification

## 1 Scope

This International Standard lays down minimum specifications for durum wheat (*Triticum durum* Desf.) intended for human consumption and forming the subject of international trade.

It also gives methods for the determination of the level of impurities (annex A) and the proportion of non-wholly-vitreous grains (annex B). Annex C gives a list of typical insect pests of stored cereals. Annex D gives an informative list of harmful and toxic seeds.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 712:1985, *Cereals and cereal products — Determination of moisture content (Routine reference method)*.

ISO 950:1979, *Cereals — Sampling (as grain)*.

ISO 3093:1982, *Cereals — Determination of falling number*.

ISO 5223:1983, *Test sieves for cereals*.

ISO 7971:1986, *Cereals — Determination of bulk density, called "mass per hectolitre" (Reference method)*.

## 3 Definitions

For the purposes of this International Standard, the following definitions apply.

**3.1 impurities:** Damaged wheat grains and all organic and inorganic materials other than durum wheat grains.

NOTE 1 The impurities comprise four main categories, as follows: damaged durum wheat grains (3.2), other cereals (3.3), extraneous matter (3.4), and harmful and/or toxic seeds (3.5), bunted grains (3.6) and ergot (3.7). (See also table A.1.)

### 3.2 damaged durum wheat grains

**3.2.1 broken grains:** All grains of durum wheat in which part of the endosperm is exposed, or wheat without germ.

**3.2.2 shrivelled grains:** Shrivelled (shrunken), light, thin whole grains, in which accumulation of nutritive elements is finished owing to physiological and pathological influences, and which pass through a sieve with long rounded apertures 1,90 mm wide.

### 3.2.3 unsound grains

**3.2.3.1 mouldy grains:** Grains which have moulds visible to the naked eye on 50 % of the surface and/or in the kernel.

**3.2.3.2 heat-damaged grains:** Grains which have a chestnut to black coloration, and of which a section of the endosperm has a coloration which is between yellowish-grey and brownish-black, resulting from the effect of heat.

**3.2.4 grains attacked by pests:** Grains which show visible damage owing to attack by rodents, insects, mites or other pests.

**3.2.5 sick wheat:** Grains which show, at places other than on the germ itself, colorations between brown and brownish-black.

**3.2.6 fusaria-contaminated grains:** Grains of which the pericarp is contaminated by mycelia of *Fusarium* spp. These grains have a slightly scalded, shrivelled appearance and show diffuse spots, with badly delimited contours, of pink or white coloration.

**3.2.7 non-wholly-vitreous grains:** Grains which are partially vitreous.

**3.3 other cereals:** Cereal grains belonging to species other than *Triticum durum* Desf.

#### 3.4 extraneous matter

(1) All the components of the sample (after the removal of ergot), with the exception of grains of other cereals (3.3), grains of durum wheat, harmful and/or toxic seeds (3.5) and bunted grains (3.6), which are retained by a sieve with long rounded apertures 3,55 mm × 20,0 mm, and all the components which pass through a sieve with long rounded apertures 1,00 mm × 20,0 mm.

NOTE 2 By convention, the latter should be considered as inorganic material.

(2) All organic components (after the removal of ergot) other than grains of durum wheat, other cereals, harmful and/or toxic seeds (3.5) and bunted grains (3.6) (i.e. foreign seeds, fragments of straw, dead insects and fragments of insects, etc.) and inorganic components (i.e. stone, sand, etc.) which pass through a sieve with long rounded apertures 3,55 mm × 20,0 mm and which are retained by a sieve with long rounded apertures 1,00 mm × 20,0 mm.

**3.5 harmful and/or toxic seeds:** Seeds which if present in quantities above a certain limit may have a toxic, harmful, damaging or dangerous effect on health, organoleptic properties or technological performance.

NOTE 3 An informative list of these seeds is given in annex D.

**3.6 bunted grains:** Grains filled with a fetid-smelling dust comprising the spores of bunts, i.e. *Tilletia caries*, *Tilletia controversa*, *Tilletia foetida*, *Tilletia intermedia*, *Tilletia triticoides* and *Neovossia indica*.

**3.7 ergot:** Sclerotium of the fungus *Claviceps purpurea*.

## 4 Requirements

### 4.1 General, organoleptic and health characteristics

Durum wheat grains shall be sound, clean, have no foreign odours or odours denoting any deterioration, and shall be free of additives and toxic substances.

Pesticide residues and other contaminants shall not exceed the maximum levels laid down in the national legislation of the country of destination or, in the absence of such legislation, the maximum levels laid down by the joint FAO/WHO Codex Alimentarius Commission.

The durum wheat shall be free from any of the living insects listed in annex C visible to the naked eye upon thorough inspection.

### 4.2 Physical and chemical characteristics

#### 4.2.1 Moisture content

The moisture content of durum wheat, determined in accordance with ISO 712, shall not be greater than 14,5 %.

NOTE 4 Lower moisture contents are required for certain destinations, in relation to the climate, duration of transport and of storage. For further information see ISO 6322-1, ISO 6322-2 and ISO 6322-3.

#### 4.2.2 Bulk density

The bulk density (mass per hectolitre) of durum wheat shall be determined using instruments calibrated according to the reference method given in ISO 7971, and it shall not be less than 75 kg/hl.

#### 4.2.3 Impurities

The maximum levels of impurities, determined using the method described in annex A, shall not exceed the values specified in table 1.

The maximum content of broken grains, shrivelled grains, unsound grains, grains attacked by pests, and other cereals, determined in accordance with the method described in annex A, shall not exceed 15 % (*m/m*) in total.

#### 4.2.4 $\alpha$ -Amylase activity

The  $\alpha$ -amylase activity, determined in accordance with ISO 3093 and expressed as the falling number, shall not be less than 160.

NOTE 5 The germinated grains are not taken into consideration as such, but by the  $\alpha$ -amylase activity which results from their presence, expressed as the falling number.

#### 4.2.5 Content of non-wholly-vitreous grains

The content of non-wholly-vitreous grains, determined in accordance with the procedure described in annex B, and calculated according to B.4.1, shall not exceed 40 %.

## 5 Sampling

Sampling shall have been carried out in accordance with ISO 950.

## 6 Test methods

The tests shall be carried out using the methods specified in 4.2.

**Table 1 — Maximum levels of impurities**

Impurities	Definition given in	Maximum permissible level % (m/m)
Broken grains <sup>1)</sup>	3.2.1	7 <sup>1)</sup>
Shrivelled grains <sup>1)</sup>	3.2.2	5 <sup>1)</sup>
Unsound grains <sup>1)</sup>	3.2.3	1 <sup>1)</sup>
Grains attacked by pests <sup>1)</sup>	3.2.4	2 <sup>1)</sup>
Sick wheat	3.2.5	5,8
Fusaria-contaminated grains	3.2.6	1,5
Other cereals <sup>1)</sup>	3.3	3 <sup>1)</sup>
Extraneous matter	3.4	2
Non-organic material		0,5
Harmful and/or toxic seeds, bunted grains and ergot	3.5 to 3.7	0,5
Ergot	3.7	0,05

1) The maximum content of broken grains, shrivelled grains, unsound grains, grains attacked by pests, and other cereals shall not exceed 15 % (m/m) in total.

## Annex A (normative)

### Determination of the level of impurities

#### A.1 Principle

Separation of the impurities, by sieving and grading, into the categories shown in table A.1.

**Table A.1 — Categories of impurities**

Impurities	Corresponding main category
Broken grains Shrivelled grains Unsound grains Grains attacked by pest Fusaria-contaminated, sick grains	Damaged durum wheat grains
Other cereals	Other cereals
Organic extraneous matter Non-organic extraneous matter	Extraneous matter
Harmful and/or toxic seeds and bunted grains Ergot	Harmful and/or toxic seeds, bunted grains and ergot

#### A.2 Apparatus

**A.2.1 Set of test sieves**, with long rounded apertures, comprising sieves of 1,00 mm × 20,0 mm, 1,90 mm × 20,0 mm and 3,55 mm × 20,0 mm conforming to ISO 5223, a receiver and a lid.

**A.2.2 Sample divider**, i.e. conical sampler or multiple-slot sampler with a distributor system.

##### A.2.3 Tweezers

##### A.2.4 Dishes

**A.2.5 Shallow container**, having a surface area of at least 200 cm<sup>2</sup>.

**A.2.6 Balance**, capable of weighing to an accuracy of ± 0,01 g.

#### A.3 Sampling

See clause 5.

#### A.4 Preparation of test sample

Carefully mix the laboratory sample to make it as uniform as possible, then proceed to reduce it, if necessary, using a sample divider (A.2.2) until a quantity of approximately 1 000 g is obtained.

Weigh the test sample so obtained, to the nearest 1 g, and place it in the shallow container (A.2.5).

During the preparation of the test sample, note whether any particular odour or odour foreign to that of durum wheat is detected, and note the presence of any living insects (specified in annex C) or other anomalies.

#### A.5 Procedure (see scheme given in figure A.1)

If a grain exhibits several defects, it shall be classified in the category with the lowest maximum permissible level (see table A.1).

Any components which become lodged in the slots of a sieve shall be considered to be retained by the sieve.

##### A.5.1 Determination of ergot

Separate ergot (3.7) from the test sample (A.4) using the tweezers (A.2.3). Put it in a dish (A.2.4) and weigh it to the nearest 0,01 g.

##### A.5.2 First division

Mix thoroughly the sample from which the ergot has been removed and divide it using the divider (A.2.2) until a quantity of approximately 250 g is obtained.

Weigh the test portion so obtained, to the nearest 0,01 g, and if any husked grains are observed, separate them from their envelopes before the first sieving.

### A.5.3 First sieving

Fit together the 3,55 mm sieve, the 1,00 mm sieve and the receiver, so that the sieve apertures are positioned parallel to each other.

Place the test portion (A.5.2) on the 3,55 mm sieve and put on the lid.

Shake the sieve manually for 45 s with a forwards-and-backwards motion in the direction of the slots of the sieve, keeping the sieve in a horizontal plane.

From the material which did not pass through the 3,55 mm sieve, separate, by placing them in dishes, the other cereals (3.3), the organic and inorganic components of the extraneous matter (3.4), harmful and/or toxic seeds (3.5) and bunted grains (3.6) and any durum wheat grains which have been retained. The retained durum wheat grains shall then be added to the material which does not pass through the 1,00 mm sieve. Add the inorganic elements of the extraneous matter to the material which has passed through the 1,00 mm sieve. Weigh the fraction thus obtained to the nearest 0,01 g.

### A.5.4 Second division

Mix thoroughly the material which has not passed through the 1,00 mm sieve and divide it using the divider (A.2.2) until approximately 60 g is obtained. Weigh the portion thus obtained to the nearest 0,01 g.

Spread out the portion, then separate and classify by placing, in separate dishes, the broken grains (3.2.1), unsound grains (3.2.3), grains attacked by pests (3.2.4), sick wheat (3.2.5), fusaria-contaminated grains (3.2.6), other cereals (3.3), organic elements of foreign substances (3.4), harmful and/or toxic seeds (3.5) and bunted grains (3.6). Weigh each fraction to the nearest 0,01 g.

Verify that the sum of impurities plus the durum wheat is equal to the mass of the portion.

### A.5.5 Second sieving

Pour the portion from which the impurities specified in A.5.4 have been removed onto the 1,90 mm sieve, fitted with a receiver, and put on the lid.

Shake the sieve manually for 45 s with a forwards-and-backwards motion in the direction of the slots of the sieve, keeping the sieve in the horizontal plane.

Weigh, to the nearest 0,01 g, the undersize grain thus obtained which corresponds to the shrivelled grains (3.2.2).

Keep the grains which do not pass through the sieve for the determination of non-wholly-vitreous grains (see annex B).

## A.6 Expression of results

Express the content of each category of impurity, using the formulae given below, as a percentage by mass of the grains as received.

Give the result to one decimal place, except for harmful and toxic seeds, bunted grains and ergot, for which the results should be given to two decimal places.

Broken grains

$$C \times m_6$$

Unsound grains

$$C \times m_{10}$$

Grains attacked by pests

$$C \times m_{11}$$

Fusaria-contaminated grains

$$C \times m_{13}$$

Sick wheat

$$C \times m_{14}$$

Shrivelled grains

$$C \times m_{15}$$

Other cereals

$$\frac{100}{m_x} \times m_2 + C \times m_7$$

Extraneous matter (organic and inorganic)

$$\frac{100}{m_x} (m_3 + m_4) + C(m_8 + m_9)$$

Inorganic extraneous matter

$$\frac{100}{m_x} \times m_4 + C \times m_9$$

Harmful and/or toxic seeds, bunted grains and ergot

$$\frac{100}{m_w} \times m_1 + \frac{100}{m_x} \times m_5 + C \times m_{12}$$

Ergot		$m_7$	is the mass, in grams, of other cereals retained on the 1,00 mm sieve;
$\frac{100}{m_w} \times m_1$		$m_8$	is the mass, in grams, of organic extraneous matter retained on the 1,00 mm sieve;
where		$m_9$	is the mass, in grams, of inorganic extraneous matter retained on the 1,00 mm sieve;
$C$	is a coefficient common to the categories of impurity obtained after the second division equal to	$m_{10}$	is the mass, in grams, of unsound grains retained on the 1,00 mm sieve;
	$\frac{100}{m_z} \times \frac{m_y}{m_x}$	$m_{11}$	is the mass, in grams, of grains attacked by pests retained on the 1,00 mm sieve;
$m_w$	is the mass, in grams, of the test sample (about 1 000 g);	$m_{12}$	is the mass, in grams, of harmful and/or toxic seeds and bunted grains retained on the 1,00 mm sieve;
$m_x$	is the mass, in grams, of the test portion (about 250 g);	$m_{13}$	is the mass, in grams, of fusaria-contaminated grains retained on the 1,00 mm sieve;
$m_y$	is the mass, in grams, of the material retained on the 1,00 mm sieve, i.e. $m_y = m_x - (m_2 + m_3 + m_4 + m_5)$ ;	$m_{14}$	is the mass, in grams, of sick wheat grains retained on the 1,00 mm sieve;
$m_z$	is the mass, in grams, of the portion obtained in A.5.4 (about 60 g);	$m_{15}$	is the mass, in grams, of shrivelled grains which pass through the 1,90 mm sieve.
$m_1$	is the mass, in grams, of ergot in the test sample;		
$m_2$	is the mass, in grams, of other cereals retained on the 3,55 mm sieve;		
$m_3$	is the mass, in grams, of organic extraneous matter retained on the 3,55 mm sieve;		
$m_4$	is the mass, in grams, of inorganic extraneous matter retained on the 3,55 mm sieve and of the material which passed through the 1,00 mm sieve;		
$m_5$	is the mass, in grams, of harmful and/or toxic seeds and bunted grains retained on the 3,55 mm sieve;		
$m_6$	is the mass, in grams, of broken grains retained on the 1,00 mm sieve;		

## A.7 Test report

The test report shall specify

- the method used,
- the test results obtained, and
- if the repeatability has been checked, the final quoted result obtained.

It shall also mention all operating details not specified in this International Standard, or regarded as optional, together with details of any incidents which may have influenced the test results.

The test report shall include all information necessary for the complete identification of the sample.

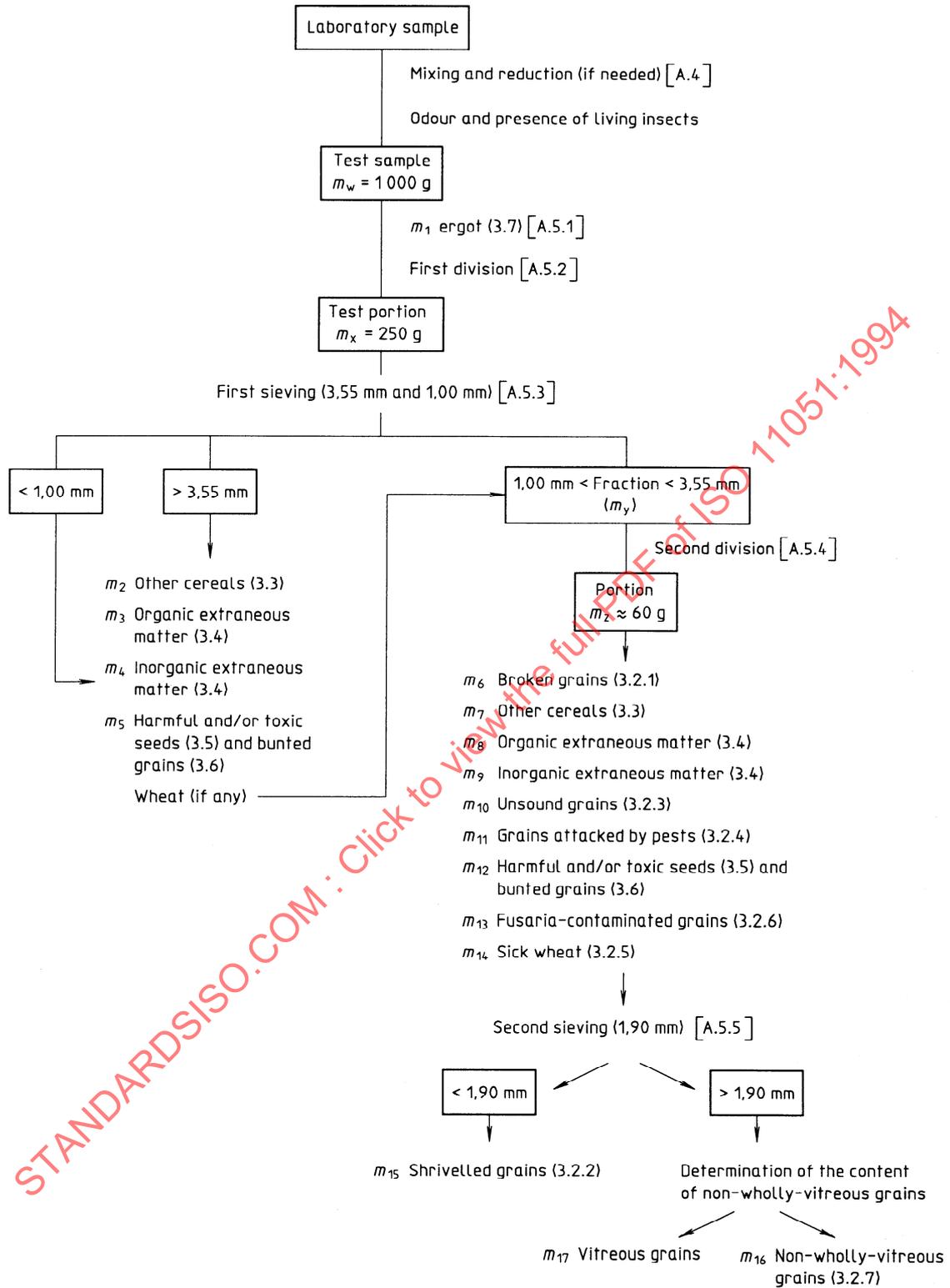


Figure A.1 — Flowchart of procedure

## Annex B (normative)

### Determination of proportion of non-wholly-vitreous grains

#### B.1 Principle

Determination of the proportion of non-wholly-vitreous grains which corresponds to the mass of partially vitreous wheat in a sample of durum wheat, by cutting the grains with a scalpel and examining the condition of the endosperm.

#### B.2 Apparatus

##### B.2.1 Tweezers

##### B.2.2 Scalpel

**B.2.3 Balance**, capable of weighing to an accuracy of  $\pm 0,1$  g.

##### B.2.4 Dishes

#### B.3 Procedure

Carry out two determinations on test portions taken from the same laboratory sample.

##### B.3.1 Test portion

The test portion is the oversize of the second sieving (A.5.5). Its mass corresponds to the mass  $m_2$  obtained in A.5.4 from which are eliminated the masses  $m_6$  to  $m_{15}$ , i.e.

$$m_2 - (m_6 + m_7 + m_8 + m_9 + m_{10} + m_{11} + m_{12} + m_{13} + m_{14} + m_{15})$$

##### B.3.2 Determination

Spread out the test portion over a flat surface. Examine each grain individually with the naked eye (corrected, if necessary, in the event of abnormal vision).

Put aside those grains which are visibly non-wholly vitreous. Do not confuse non-wholly-vitreous grains with "washed" grains, the external appearance of which is similar to that of non-wholly-vitreous grains, but which differ from the latter by their dull appear-

ance. Washed grains are not necessarily non-wholly vitreous.

Using the scalpel (B.2.2), cut the other grains cross-wise in the middle or at a suspect spot and put aside the fragments of each grain which prove to be non-wholly vitreous after cutting.

Gather together and weigh to within 0,1 g:

- a) those grains which are visibly non-wholly vitreous and the fragments of those which, once cut, prove to be non-wholly vitreous (mass  $m_{16}$ );
- b) the fragments of vitreous grains (mass  $m_{17}$ ).

The determination is considered as being valid if  $(m_{16} + m_{17})$  does not differ by more than 0,2 % from the mass of the test portion (B.3.1). Should this not be the case, carry out the determination again on a new test portion.

#### B.4 Expression of results

**B.4.1** The proportion of non-wholly-vitreous grains, expressed as a percentage relative to the clean sample, i.e. sieved and free of impurities, is equal to

$$\frac{m_{16}}{m_{16} + m_{17}} \times 100$$

where

$m_{16}$  is the mass, in grams, of the non-wholly-vitreous wheat;

$m_{17}$  is the mass, in grams, of the vitreous wheat grains.

**B.4.2** The proportion of non-wholly-vitreous grains, expressed as a percentage by mass of the grains as received (prior to sieving and elimination of impurities), is equal to

$$m_{16} \times C$$

where

$C$  is the coefficient calculated in A.6;

$m_{16}$  is the mass, in grams, of the non-wholly-vitreous wheat.

## B.5 Repeatability

The absolute difference between two single test results, obtained using the same method on identical test material in the same laboratory by the same operator using the same equipment within a short interval of time, should not be greater than 20 % of the arithmetic mean of the two results for a content of non-wholly-vitreous grains of less than 12,5 %, or 2,5 (absolute value) for a content of non-wholly-vitreous grains greater than 12,5 %.

## B.6 Test report

The test report shall specify

- the method used,
- the test result(s) obtained, and
- if the repeatability has been checked, the final quoted result obtained.

It shall also mention all operating details not specified in this International Standard, or regarded as optional, together with details of any incidents which may have influenced the test result(s).

The test report shall include all information necessary for the complete identification of the sample.

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## Annex C

(normative)

### Typical insect pests of stored cereals

The durum wheat shall not contain the following insects:

*Anagasta (Ephestia) kuehniella* Zell.

*Cryptolestes* spp.

*Ephestia* spp.

*Nemapogon granella* L.

*Oryzaephilus* spp.

*Plodia interpunctella* Hübn.

*Prostephanus truncatus* Horn.

*Rhizopertha dominica* F.

*Sitophilus* spp.

*Sitotroga cerealella* Oliv.

*Tenebroides mauritanicus* L.

*Tribolium* spp.

*Trogoderma granarium* Everts

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