BRITISH STANDARD

BS 4317-26: 1991
ISO 4112:1990

Methods of test for

Cereals and pulses —

Part 26: Measurement of temperature of grain during bulk storage

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Agriculture and Food Standards Policy Committee (AFC/-) to Technical Committee AFC/4, upon which the following bodies were represented:

AFRC Institute of Engineering Research
Agricultural Engineers' Association
Association of Public Analysts
British Edible Pulse Association
Flour Milling and Baking Research Association
Food and Drink Federation
Grain and Feed Trade Association
Home Grown Cereals Authority
Institute of Brewing
Institute of Food Science and Technology
Intervention Board for Agricultural Produce
Ministry of Agriculture, Fisheries and Food
NABIM
National Association of Commodity Cargo Superintendents and Surveyors
National Farmers' Union
Natural Resources Institute
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United Kingdom Agricultural Supply Trade Association Ltd.

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Contents

National foreword

This Part of BS 4317 has been prepared under the direction of the Agriculture and Food Standards Policy Committee. It is identical with ISO 4112:1990 "*Cereals and pulses — Guidance on measurement of the temperature of grain stored in bulk*", published by the International Organization for Standardization (ISO), and in the preparation of which the United Kingdom played a full part.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 and 2, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This International Standard gives guidance on the measurement of the temperature of grain stored in silos or any other bulk store.

2 Definitions

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

2.1
grain

cereal grains and/or seeds of pulses

2.2
bulk store

large store in which grain is stored unpackaged in large quantities

3 Principle

Placing a series of thermometric probes throughout the mass of stored grain to detect or monitor changes in temperature.

4 Apparatus

The type of apparatus or installation shall be suitable for the size and shape of the store. For example, use

— a portable apparatus, for small stores;

— a semi-fixed or retractable apparatus, for horizontal stores, i.e. stores with extensive floor areas and limited height;

— a permanent installation, for vertical stores (silos).

The apparatus shall comprise the following parts.

4.1 *Thermometric probes,* one or more, usually consisting of a rigid tube or flexible cable (**4.1.1**) with one or more temperature-sensing devices (**4.1.2**), together with their respective output conductors, which are housed in the tube or cable. When the probe is buried in the mass of grain, its response time to reach a steady temperature reading shall not exceed 3 min.

The materials used to fabricate the thermometric probes shall be resistant to products employed for fumigation and to damage by rodents.

Horizontal stores, emptied by means of a scraper, shall be equipped with retractable thermometric probes.

NOTE 1 Flexible cables suspended in vertical stores should be anchored at the bottom of the store to prevent dislocation during loading.

4.1.1 *Rigid tubes* or *flexible cables*, of appropriate length and diameter, made of glass fibre, metal or other suitable material and, particularly for vertical stores, having the strength and rigidity to resist the very high tensile and compressive forces which occur when the store is filled and emptied.

NOTE 2 Forces on the tubes or cables increase with their diameter, depth of burial and with movement of the grain during loading and unloading. Tensile forces of up to 50 kN may occur. A small diameter has the effect of reducing the strain at fastening points and simplifying the anchorage system. Conversely, larger diameters give greater rigidity which is particularly important for very deep, stores.

4.1.2 *Temperature-sensing device* (thermosensitive element), consisting of a thermistor, or thermocouple, or a resistance thermometer, or any other electrical temperature-sensing device capable of detecting changes in temperature of the order of 0,5 °C, with a working range up to 70 °C and a lower limit appropriate for the local ambient temperatures.

4.2 *Temperature-reading device*, which may be supplemented by a recording instrument (see Annex A for further information).

4.3 *Thermometric apparatus* (for ventilated stores), placed at the air inlet to measure the temperature of the ventilation air.

5 Procedure

5.1 Positioning the apparatus

Owing to the low thermal diffusivity in stored grain and the fact that measuring points shall be sufficiently close to each other to detect localized temperature changes within a short time of their occurring, the measuring points should be no more than 3 m apart from each other in any direction.

If for economic or other reasons, however, measurements are made at spacings of more than 3 m, this shall be recorded in the temperature records.

For horizontal stores, the upper measuring points shall be 1 m to 2 m below the surface of the grain.

It is essential that several probes or cables be positioned in the plane of symmetry of the store.

NOTE 3 In stores of limited height, it may be sufficient that the temperature be determined 0,3 m below the surface of the grain, 0,5 m above the floor, and mid-way between these points.

For vertical stores, the measuring points shall be spaced at regular intervals along vertical probes or cables in the immediate proximity of the walls and of the top and bottom.

It is essential also that one probe or cable be positioned on the axis of symmetry of the store.

5.2 Temperature readings

5.2.1 *Frequency of readings*

If the grain is in unfavourable storage conditions (high temperature and moisture content), read the temperatures at the measuring points in the mass of stored grain at frequent time intervals, for instance every 24 h. For favourable storage conditions (dry and cold grain), the frequency of readings may be reduced (for example, to once a week).

Persons responsible for storage facilities shall determine the frequency of temperature readings, taking into account the nature of the stored product, the moisture content of the product, the season of the year, the degree of insect infestation of the product, etc.

5.2.2 *Particular requirements for ventilated stores*

Read and record the temperatures at the various measuring points in the mass of stored grain using the following procedure.

If the ventilation is not in operation, carry out an initial temperature reading and then ventilate the grain for 30 min to 45 min, depending on the height of the store. Measure the temperature of the ventilation air at the inlet.

NOTE 4 During this short period of ventilation, the air at any hot spot present rises, thus heating the upper probe(s).

Carry out a second temperature reading after ventilation, correcting the value obtained where necessary to take account of the temperature of the ventilation air. If the result obtained between the initial and second temperature readings is approximately 5 °C or above, a hot spot may be presumed to be present and there is a risk of damage.

Provisions shall be made (service contracts, reserves of spare parts) to ensure that the upper probes are never out of commission for longer than 24 h.

6 Temperature records

The temperature records shall indicate the apparatus used, the temperatures recorded at the various measuring points, and the times at which the temperatures were measured. They shall also mention all operating conditions not specified in this International Standard, or regarded as optional, as well as any circumstances that may have influenced the readings. They shall include, if necessary, all information relating to the store in question and to the nature of the product stored.

Annex A (informative)
Temperature-reading devices

Reading devices differ according to the size of the installation.

In small installations, the reading device may be an electrical or electronic measuring appliance, graduated in degrees Celsius, giving the temperature reading and fitted with a thermometric probe which is pushed into the mass of grain at the required measuring points.

In larger installations, a control cabinet may be used.

The control cabinet may simply hold the reading instruments and indicators. However, it may be more complex and include.

— an analog or digital indicator for either manual or automatic reading and recording of temperatures;

— a variation indicator showing any fluctuation in the temperature in relation to a set value;

— pre-set controls which, when the temperature rises above a pre-set value, automatically activate visual or audible alarm signals and possibly ventilation:

— a synoptic panel of the storage facility and its various storage compartments;

— automated temperature control whereby the measuring points are scanned according to a predetermined programme (for example, every 6 h, 12 h or 24 h), the various measurements being printed on paper.

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