BRITISH STANDARD

BS 5551-2.10: 1993
ISO 5308:1992

Fertilizers

Part 2: Sampling —

Section 2.10 Method of checking the performance of mechanical devices for sampling of solid fertilizer moving in bulk

UDC 631.8:620.115.2

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Chemcials Standards Policy Committee (CIC/-) to Technical Committee CIC/37, upon which the following bodies were represented:

Association of Public Analysts
British Aggregate Construction Materials Industries
British Coal Corporation
Chemical Industries Association
Consumers' Association
Department of Trade and Industry (Laboratory of the Government Chemist)
Fertiliser Manufacturers' Association Ltd.
Horticultural Trades Association
Institute of Trading Standards Administration
Ministry of Agriculture, Fisheries and Food
Ministry of Defence

This British Standard, having been prepared under the direction of the Chemicals Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 15 February 1993

The following BSI references relate to the work on this standard:
Committee reference CIC/37
Draft for comment 83/55990 DC

ISBN 0 580 21959 3

Amendments issued since publication

Amd. No.	Date	Comments

Contents

National foreword

This Section of BS 5551 has been prepared under the direction of the Chemicals Standards Policy Committee.

For some years the United Kingdom has participated in the standardization of methods of sampling fertilizers through Subcommittee 2, Sampling, of Technical Committee 134, Fertilizers and soil conditioners, of the International Organization for Standardization (ISO). As international agreement is reached on the methods, it is proposed to publish them as Sections of BS 5551.

BS 5551 is published in four Parts, each Part being subdivided into Sections and, where appropriate, Subsections. The four Parts are

— *Part 1: Terminology and labelling*;

— *Part 2: Sampling*;

— *Part 3: Physical properties*;

— *Part 4: Chemical analysis*.

This Section of Part 2 is identical with ISO 5308:1992 *Solid fertilizers — Method of checking the performance of mechanical devices for sampling of product moving in bulk*.

Cross-references

International Standard	Corresponding British Standard
	BS 2846 *Guide to statistical interpretation of data*
ISO 2602:1980	Part 2:1981 *Estimation of the mean: confidence interval* (Identical)
ISO 3301:1975	Part 6:1976 *Comparison of two means in the case of paired observations* (Identical)
	BS 5532 *Statistical terminology*
ISO 3534:1977	Part 1:1978 *Glossary of terms relating to probability and general terms relating to statistics* (Identical)
	BS 5551 *Fertilizers*
ISO 3963:1977	Section 2.3:1978 *Sampling from a conveyor by stopping the belt [reference method]* (Identical)
ISO/TR 7553:1987	Section 2.7:1988 *Recommendations for minimum mass of increment of a solid fertilizer to be taken to be representative of the total sampling unit* (Identical)
ISO 7742:1988	Section 2.5:1989 *Method for reduction of samples of solid fertilizers* (Identical)
ISO 8397:1988	Section 3.5:1988 *Method for determination of particle size distribution by test sieving* (Identical)

With reference to **4.3**, woven wire test sieves complying with BS 410:1986 are technically equivalent to, and may be used in place of, those complying with ISO 3310-1:1982. The Technical Committee has reviewed the provisions of ISO 3310-1:1982 and has decided that they are acceptable for use in conjuction with this standard.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 4, 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.

blank

1 Scope

This International Standard specifies a method of checking the performance of mechanical devices for sampling fertilizers moving in bulk by comparison of particle size distribution with that obtained by a reference method.

It is applicable to any form of mechanical sampling device installed at some point in a bulk-handling system, providing that either the fertilizer passes along a conveyor belt, before or after the device, or it is subsequently packed in bags in order that a reference collection can be made.

NOTE 1 Although the mechanical sampling may be used for the collection of samples for chemical analysis instead of or as well as for physical testing, any bias will be more easily and economically found by size analysis than by chemical analysis of the nutrients.

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 2602:1980, *Statistical interpretation of test results — Estimation of the mean — Confidence interval.*

ISO 3301:1975, *Statistical interpretation of data — Comparison of two means in the case of paired observations.*

ISO 3310-1:1990, *Test sieves — Technical requirements and testing — Part 1: Test sieves of metal wire cloth.*

ISO 3534:1977, *Statistics — Vocabulary and symbols.*

ISO 3963:1977, *Fertilizers — Sampling from a conveyor by stopping the belt.*

ISO 7742:1988, *Solid fertilizers — Reduction of samples.*

ISO 8397:1988, *Solid fertilizers and soil conditioners — Test sieving.*

3 Principle

Collection of two series of increments, one using a mechanical device and one using a reference method, from a quantity of fertilizer passing through a bulk-handling system, and comparison of the means and variances of the particle size distribution of the two samples.

4 Apparatus

4.1 *Rotary sample divider,* complying with the requirements of ISO 7742.

4.2 *Sample containers*

4.3 *Set of sieves,* complying with the requirements of ISO 3310-1, of nominal aperture sizes 4,00 mm, 3,35 mm, 2,80 mm, 2,36 mm, 2,00 mm, 1,40 mm, 1,00 mm and 0,50 mm.

4.4 *Sieve-shaking machine*

5 General conditions

The method of test specified in this International Standard should be carried out using a granular fertilizer. The use of a blended product may introduce additional sources of variation.

If only blended fertilizer is available for this test, increments of at least 200 g shall be collected (see **6.1.1**).

It may be necessary to check the variability of the product before carrying out this test method in order to decide whether to take more increments than are specified, or to be able to conduct the test over a shorter period of time. A statistician should be consulted on the most efficient and economical method of carrying out such a check.

The test shall be carried out while at least 20 t (and preferably not more than 100 t) of fertilizer passes through the mechanical sampling device.

6 Procedure

6.1 Collection of increments

Carry out the operations described in **6.1.1** and **6.1.2** concurrently.

6.1.1 Using the mechanical sampling device under test, collect at least 50 increments of a suitable size[1)] and label them from A_1 to A_{50}, etc.

[1)] Information on the minimum mass of an increment is given in ISO/TR 7553:1987, *Fertilizers — Sampling — Minimum mass of increment to be taken to be representative of the total sampling unit.*

6.1.2 Carry out one of the following reference collections.

a) If the fertilizer is conveyed by a conveyor belt feeding to, or extracting from, the mechanical sampling device, collect the same number of increments as collected in accordance with **6.1.1** by stopping the conveyor belt as specified in ISO 3963. If possible, synchronize the taking of the increments by the device under test with the taking of increments by the reference method, so that corresponding increments are taken from the same part of the fertilizer bed (see **7.2**). For example, if the reference sample is taken after the sample taken by the mechanical sampling device, it may be possible to see the gap in the fertilizer bed on the conveyor belt.

b) Collect the same number of full bags as the number of increments specified in **6.1.1**, from the same tonnage of fertilizer, at intervals corresponding as closely as possible to the time intervals at which increments are taken in accordance with **6.1.1**.

Label the reference increments or bags R_1 to R_{50}, etc.

If necessary, reduce the size of the increments, or the quantities of fertilizers taken in bags, to approximately the same size as those collected in **6.1.1**, by the method specified in ISO 7742.

6.2 Preparation of samples

Combine the increments into equal groups to give at least 10 individual samples taken by the same method (**6.1.1** and **6.1.2**). The groups shall be formed of consecutive increments, for example A_1 to A_5, A_6 to A_{10}, . . ., A_{46} to A_{50}, etc.

Mix each of the individual samples thoroughly, then, proceeding in accordance with ISO 7742 using the rotary sample divider (**4.1**), reduce each sample to a suitable mass (200 g to 250 g) for particle-size analysis.

6.3 Analysis of samples

Carry out a particle-size analysis on each of the reduced samples, obtained as described in **6.2**, by the method described in ISO 8397 using four or five sieves from the set (**4.3**), chosen to suit the fertilizer used in the test. Use the same sieves for the analysis of each reduced sample. Record the percentages of fertilizer retained on each sieve and the percentage passing through the sieve with the smallest aperture.

7 Expression of results

7.1 General case where the increments taken by the two methods do not correspond exactly to each other

For each series of n reduced samples, calculate the mean and the standard deviation for the percentage of fertilizer retained successively on each of the sieves and the percentage passing through the sieve with the smallest aperture size used.

For each successive test sieve, calculate the value of the statistic t by means of the formula

$$t = \frac{\sqrt{n(\bar{x}_A - \bar{x}_R)}}{\sqrt{s_A^2 + s_R^2}}$$

where

$\bar{x}_A$ and s_A are the mean and the standard deviation for the reduced samples obtained using the device (**6.1.1**);

$\bar{x}_R$ and s_R are the mean and the standard deviation for the reduced samples obtained using the reference method (**6.1.2**).

Refer to the statistical tables in ISO 2602 for the significance of the values of t obtained with $2(n - 1)$ degrees of freedom.

7.2 Special cases where the increments taken by the two methods correspond exactly to each other

For each pair of reduced samples, calculate the difference between the percentages of fertilizer retained on each sieve in turn and the percentage passing through the sieve of smallest aperture size used. Calculate the mean $\bar{d}$ and the standard deviation s_d of these differences for each test sieve in turn and for the undersize fraction, and calculate the value of the statistic t by means of the formula

$$t = \frac{\sqrt{n \cdot \bar{d}}}{s_d}$$

Refer to the statistical tables in ISO 3301 for the significance of the values of t obtained with $(n - 1)$ degrees of freedom.

8 Interpretation of results

The interpretation of the individual results depends on the precision that is both acceptable and practically feasible. It is to be expected that the most significant bias will be shown by the results for the percentages of fertilizer retained on the sieve of largest aperture size and passing through the sieve of smallest aperture size used for the test, and the least significant bias by the results for the intermediate sieves.

A mechanical sampling device shall be rejected if any of the values of t for the percentages of fertilizer retained on the sieve of largest aperture size and the percentages of fertilizer passing through the sieve of smallest aperture size are significant at the 95 % confidence level.

The device shall be accepted as being without bias if all the values of t are not significant at the 95 % confidence level.

In other cases, e.g. where one of the values of t is significant at the 95 % confidence level, indicating the possibility of bias, the tests should be repeated on a larger number of samples.

NOTE 2 As tests of this sort, requiring larger numbers of samples, are tedious and costly to carry out, it is recommended that a statistician be consulted before further tests are carried out.

Additional information on the performance of the tested device can be obtained by comparing the variances s_A^2 and s_R^2 obtained in **7.1** using the F-test as defined in ISO 3534.

In the special case (**7.2**), s_A^2 and s_R^2 may be calculated in the normal way from the individual results.

If a significantly larger variance is obtained for the tested mechanical device than for the reference method, this implies that the device is not reliable.

blank

List of references

See national foreword.

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: 020 8996 9000. Fax: 020 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: 020 8996 9001. Fax: 020 8996 7001.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: 020 8996 7111. Fax: 020 8996 7048.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: 020 8996 7002. Fax: 020 8996 7001.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL