INTERNATIONAL STANDARD

ISO 4700

Fourth edition
2015-08-01

Iron ore pellets for blast furnace and direct reduction feedstocks — Determination of the crushing strength

Boulettes de minerais de fer pour charges de hauts fourneaux et réduction directe — Détermination de la résistance à l'écrasement

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 102, *Iron ore and direct reduced iron*, Subcommittee SC 3, *Physical testing*.

This fourth edition cancels and replaces the third edition (ISO 4700:2007) which has been technically revised to provide clarification in 7.2 when using automatic equipment.

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Introduction

This International Standard concerns one of a number of physical test methods that have been developed to measure various physical parameters and characteristics and to evaluate the behaviour of iron ores, including reducibility, disintegration, crushing strength, apparent density, etc. This method was developed to provide a uniform procedure, validated by collaborative testing, to facilitate comparisons of tests made in different laboratories.

The results of this test have to be considered in conjunction with other tests used to evaluate the quality of iron ores as feedstocks for blast furnace and direct reduction processes.

This International Standard can be used to provide test results as part of a production quality-control system, as a basis of a contract, or as part of a research project.

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Iron ore pellets for blast furnace and direct reduction feedstocks — Determination of the crushing strength

CAUTION — This International Standard may involve hazardous operations and equipment. This International Standard does not purport to address all of the safety issues associated with its use. It is the responsibility of the user of this International Standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to its use.

1 Scope

This International Standard specifies a method to provide a measure of the compressive load attained to cause breakage of pellets.

This International Standard is applicable to hot bonded pellets.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3082, *Iron ores — Sampling and sample preparation procedures*

ISO 11323, *Iron ore and direct reduced iron — Vocabulary*

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3 Terms and definitions

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For the purposes of this document, the terms and definitions given in ISO 11323 apply.

4 Principle

A single pellet of a specific size range is compressed at a specific speed. The procedure is repeated on all pellets in the test portion. The crushing strength is calculated as the arithmetic mean of all the measurements obtained.

5 Sampling, sample preparation and preparation of test portions

5.1 Sampling and sample preparation

Sampling of a lot and preparation of a test sample shall be in accordance with ISO 3082.

The size range for pellets shall be –12,5 mm +10,0 mm.

A test sample of at least 1 kg, on a dry basis, of sized pellets shall be obtained.

Oven-dry the test sample to constant mass at 105 °C ± 5 °C and cool it to room temperature before testing.

NOTE Constant mass is achieved when the difference in mass between two subsequent measurements becomes less than 0,05 % of the initial mass of the test sample.

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5.2 Preparation of test portions

One test portion comprising at least 60 pellets, as agreed upon at the time of order, shall be taken from the test sample by random selection.

NOTE A method of determining the exact number of pellets to obtain a specific precision in the test results is to use the following equation:

$$n = \left(\frac{2\sigma}{\beta}\right)^2$$

where

n is the number of pellets;

σ is the standard deviation, in newtons, derived from several experiments;

β is the required precision, in newtons, for 95 % confidence levels.

6 Apparatus

6.1 General

The test apparatus shall comprise the following:

a) ordinary laboratory equipment, such as an oven, hand tools and safety equipment;

b) loading unit;

c) load transmission system;

d) load indicator or recorder.

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6.2 Loading unit, formed by two compressive flat platens made of steel, installed in mutual parallel planes. The surface of the platens that will be in contact with the sample shall be made of surface-hardened steel. A device capable of setting the speed of the compressive platen between 10 mm/min and 20 mm/min over the entire test period shall be used.

NOTE If the platen speed is not constant during the test cycle, results may differ depending upon the test machine used. More uniform results may be obtained using a test machine that applies a constant load increase.

6.3 Load transmission system, which shall be either a load cell or a lever. The capacity of the load cell for transmission of the applied load to the indicating unit shall be at least 10 kN.

6.4 Load indicator or recorder, which shall be either an electric indicator (digital read-out device, recording chart, meter with needle rider or other suitable device) for the load-cell type, or a mechanical indicator (gauge equipped with a needle rider or other suitable device) for the lever type. When using a load cell, the chart-recorder pen-response time shall be 1,0 s or less for a full-scale deflection. The minimum graduation shall be 1/100 of the full scale. The compression device shall be calibrated regularly.

7 Procedure

7.1 Number of determinations for the test

Carry out the test on 60 or more single pellets (see the Note in 5.2).

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7.2 Load application

Place a test piece (single pellet) at the approximate centre of the surface-hardened portion of the lower platen. Apply the load at a constant platen speed between 10 mm/min and 20 mm/min throughout the test period.

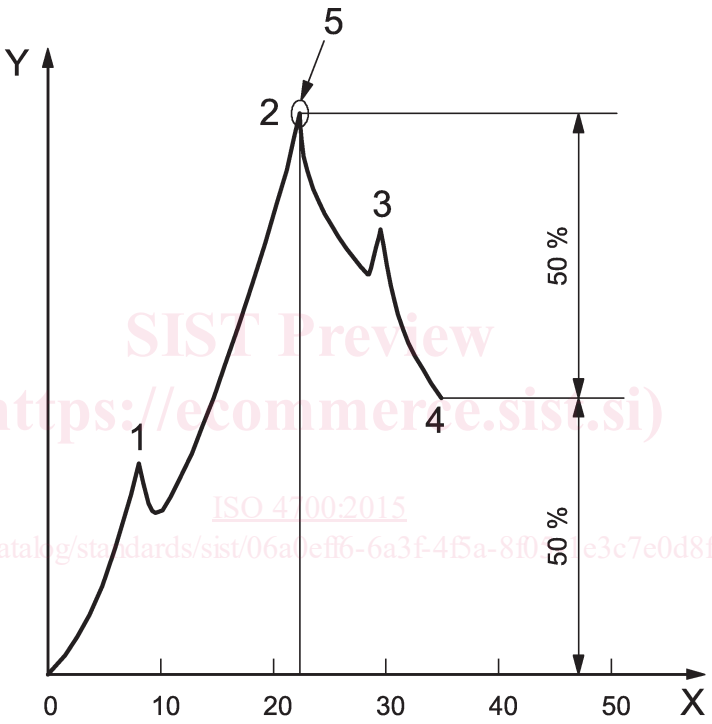
The test is complete when

— either the load falls to a value of 50 % or more of the maximum load recorded (see Figure 1),

— or the platen gap has reduced to 50 % of the initial mean test-piece diameter (see Figure 2).

In either case, the crushing strength is the maximum load attained in the test.

For automatic equipment, individual pellet strength values lower than 10 daN shall be excluded from the calculation of results.



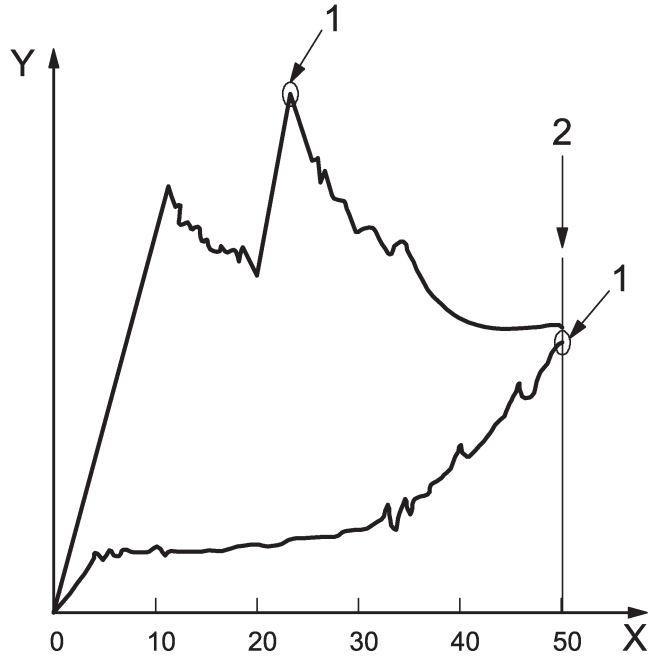
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Key

X contraction, %
Y load
1 1st peak
2 2nd peak
3 3rd peak
4 stop
5 strength

Figure 1 — Measurement of crushing strength as explained in Example 1 in the procedure

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Key

X contraction, %
Y load
1 1st peak
2 2nd peak

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Figure 2 — Measurement of crushing strength as explained in Example 2 in the procedure

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8 Expression of results

The crushing strength, CS, is the arithmetic mean of all the measurements obtained.

Express the result, in decanewtons per pellet, to one decimal place.

9 Test report

The test report shall include the following information:

a) a reference to this International Standard, i.e. ISO 4700;

b) all details necessary for the identification of the sample;

c) the name and address of the test laboratory;

d) the date of the test;

e) the date of the test report;

f) the signature of the person responsible for the test;

g) the details of any operation and any test conditions not specified in this International Standard or regarded as optional, as well as any incident which may have had an influence on the results;

h) the crushing strength, CS;

i) the standard deviation of the measurements;

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