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INTERNATIONAL
STANDARD

ISO
11256

First edition
1998-11-01

**Iron ore pellets — Determination of
clustering of feedstock for direct reduction
by gas reforming processes**

*Boulettes de minerais de fer — Détermination du pouvoir collant
des charges utilisées dans les procédés de reforming par réduction directe*

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 11256 was prepared by Technical Committee ISO/TC 102, *Iron ores*, Subcommittee SC 5, *Physical testing for direct reduction*.

Annex A forms an integral part of this International Standard. Annexes B and C are for information only.

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Introduction

Direct reduction processes are intended to reduce iron ores partially, or almost completely by thermal processes to form high grade feedstocks for iron- and steelmaking. Several kinds of direct reduction processes are in operation worldwide and others are still under development. The behaviour of the iron ores, as feedstock, may vary from process to process. ISO 11256 was prepared addressing specifically the direct reduction by gas reforming processes.

The obtained proportion of generated fines is a relative measure of the disintegration behaviour and the degree of metallization is a measure of the metallization behaviour of the iron ore.

The results of this test should be considered in conjunction with the results of other tests used to evaluate the quality of iron ores for direct reduction processes.

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Iron ore pellets — Determination of clustering of feedstock for direct reduction by gas reforming processes

WARNING This International Standard may involve hazardous materials, operations and equipment. This International Standard does not purport to address all of the safety problems 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 test method for evaluating the clustering behaviour of iron ore pellets under conditions that resemble the ones prevailing in direct reduction by gas reforming processes.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 2597-1:1994, *Iron ores — Determination of total iron content — Part 1: Titrimetric methods after tin(II) chloride reduction.*

ISO 3310-1:—¹⁾, *Test sieves — Requirements and tests — Part 1: Metal wire cloth sieves.*

ISO 9035:1989, *Iron ores — Determination of acid-soluble iron(II) content — Titrimetric method.*

ISO 9507:1990, *Iron ores — Determination of total iron content — Titanium(III) chloride reduction methods.*

ISO 9508:1990, *Iron ores — Determination of total iron content — Silver reduction titrimetric method.*

ISO 10836:1994, *Iron ores — Method of sampling and sample preparation for physical testing.*

ISO 11323:1996, *Iron ores — Vocabulary.*

3 Definitions

For the purposes of this International Standard the definitions given in ISO 11323 and the following apply.

3.1 cluster

Two or more particles of reduced iron ores stuck together.

¹⁾ To be published. (Revision of ISO 3310-1:1990)

3.2 clustering

The formation of clusters of iron ore particles when reduced under conditions that resemble the ones prevailing in the direct reduction processes.

4 Principle

Heating of the test portion in an inert atmosphere.

Isothermal reduction of the test portion under load in a fixed bed by reducing gas consisting of H_2 , CO , CO_2 and N_2 at a temperature of $850\text{ }^\circ\text{C}$, up to 95 % degree of reduction.

Cooling of the test portion in an inert atmosphere.

Disaggregation of the reduced test portion by tumbling, in a specified drum.

Calculation of the clustering index from the clusters accumulated after specified disaggregation operations.

5 Apparatus

The apparatus shall consist of the following (Figures 1 and 2 show examples of the arrangement).

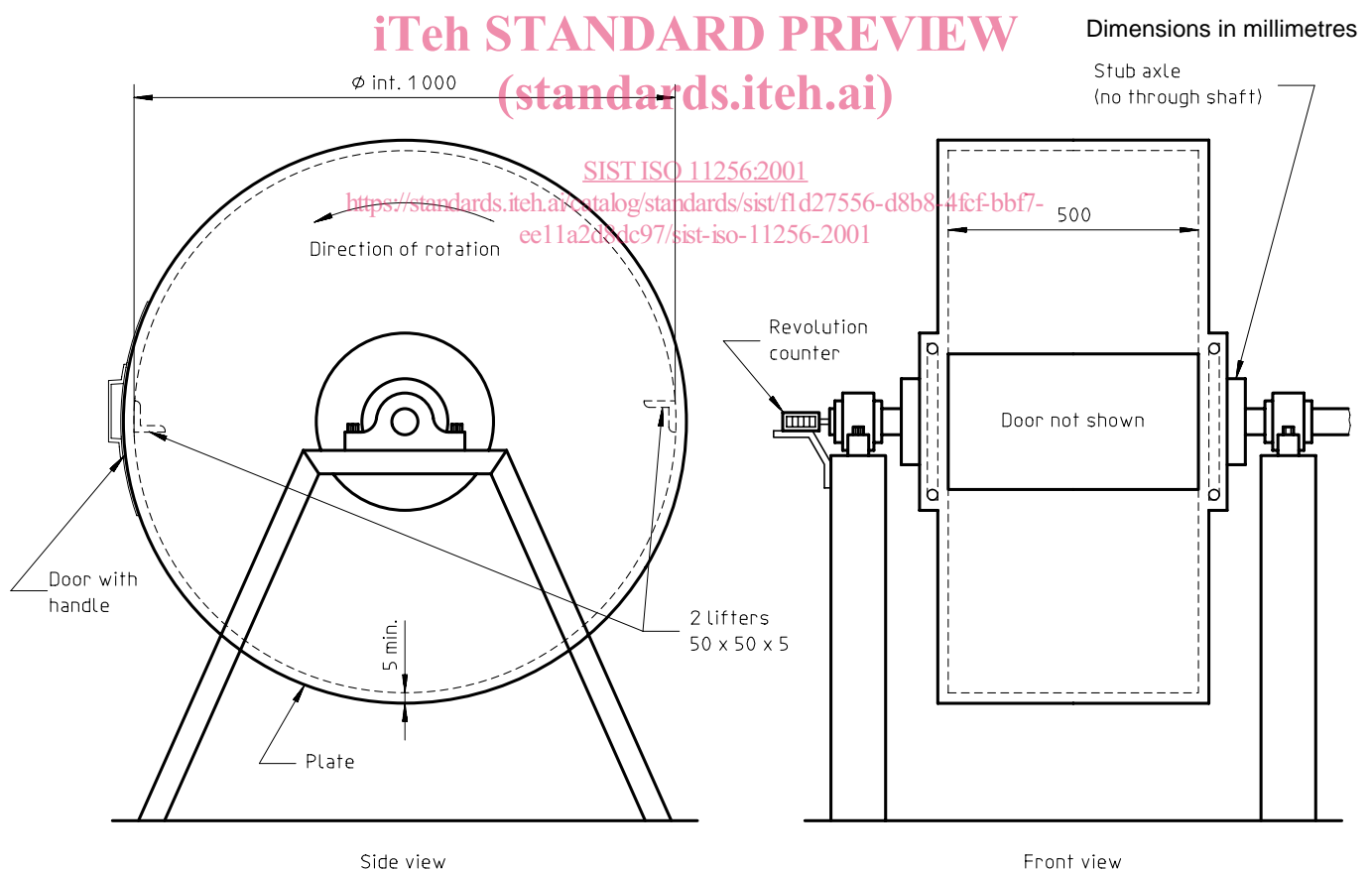


Figure 1 — Example of tumble drum for cluster disaggregation

5.1 Gas supply system, capable of supplying the gases and regulating the gas flow rates, freely suspended and connected to the tube in such a way that weighing is not affected.

5.2 Reduction tube, made of non-scaling, heat-resisting metal to withstand temperatures higher than 850 °C, having an internal diameter of 125 mm ± 1 mm. A perforated plate is mounted inside the reduction tube for supporting the test portion. This perforated plate, having a diameter of 120 mm ± 1 mm, shall be 10 mm thick; the holes shall be 3 mm to 4 mm in diameter and separated from each other by 3 mm to 5 mm.

5.3 Loading device, capable of evenly supplying a total static load of 147 kPa to the test portion. The load shall be transferred by means of a ram with rigid perforated foot plate so as to distribute it evenly over the surface of the porcelain pellets placed on top of the test portion. This perforated plate, having a diameter of 120 mm ± 1 mm, shall be 10 mm thick; the holes shall be 3 mm to 4 mm in diameter and separated from each other by 3 mm to 5 mm.

5.4 Weighing device, coupled with the furnace and capable of weighing the reduction tube assembly, including the test portion, to an accuracy of 1 g.

5.5 Weighing device, capable of weighing the test portion before and after the reduction test and the clusters to an accuracy of 1 g.

5.6 Electrically heated furnace, having a heating capacity and controls sufficient to maintain the entire test portion at 850 °C ± 5 °C.

5.7 Test sieves, conforming to ISO 3310-1, having square openings of the following nominal aperture size: 16 mm; 12,5 mm and 10 mm.

5.8 Tumble drum, as shown in Figure 1, consisting of a circular drum of internal diameter 1 000 mm and internal length 500 mm, constructed of steel plate at least 5 mm in thickness. Two equally spaced steel angle lifters, of section 50 mm × 50 mm × 5 mm, of length 500 mm shall be solidly attached longitudinally inside the drum by welding, in such a manner as to prevent accumulation of material between lifter and drum. The drum shall be replaced whenever the thickness of the plate is reduced by wear to 3 mm in any area.

5.9 Rotation equipment, to allow rotation of the tumble drum at a constant rate of 0,416 s⁻¹ ± 0,016 s⁻¹ (25 rpm ± 1 rpm).

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