SLOVENSKI STANDARD
SIST ISO 11258:2001

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Železove rude – Ugotavljanje stisljivosti in metalizacije vhodne surovine za direktno redukcijo s procesi transformacije plinov

Iron ores -- Determination of reducibility and metallization of feedstock for direct reduction by gas reforming processes

Minerais de fer -- Détermination de la réductibilité et de la métallisation des charges utilisées dans les procédés de reforming par réduction directe

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INTERNATIONAL STANDARD

ISO 11258

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Iron ores — Determination of reducibility and metallization of feedstock for direct reduction by gas reforming processes

Minerais de fer — Détermination de la réductibilité et de la métallisation des charges utilisées dans les procédés de reforming par réduction directe

Reference number
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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 11258 was prepared by Technical Committee ISO/TC 102, *Iron ores and direct reduced iron*, Subcommittee SC 5, *Physical testing of direct reduction feedstock and DRI*.

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

Introduction

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

The obtained reducibility index is a relative measure of the reducibility behaviour, and the degree of metallization is a relative 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 as feedstock for direct reduction processes.

Iron ores — Determination of reducibility and metallization 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 describes a test method for evaluating the reducibility and metallization behaviour of iron ore pellets and lumps under conditions which 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 5416:1997, *Direct reduced iron — Determination of metallic iron content — Bromine-methanol titrimetric method.*

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.*

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

3 Terms and definitions

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

3.1
degree of reduction
extent to which oxygen has been removed from iron oxides, expressed as the ratio of oxygen removed to oxygen originally combined with iron, relative to the iron (III)-state

4 Principle

Heating of the test portion in an inert atmosphere.

Isothermal reduction of the test portion at a specified size range in a fixed bed, at a temperature of 800 °C, using a reducing gas consisting of H_2, CO, CO_2 and N_2.

Continuous weighing or intermittent weighing of the test portion at specified time intervals for 90 min reduction in total.

Cooling of the test portion in an inert atmosphere.

Calculation of the degree of reduction, after reduction for 90 min, relative to the iron (III)-state and the reducibility index at the oxygen:iron ratio of 0,9.

Calculation of the degree of metallization from the chemical analysis of the reduced test portion or from the final degree of reduction (R_{90}).

5 Apparatus

The apparatus shall consist of the following (Figure 1 and Figure 2 show an example of the arrangement).

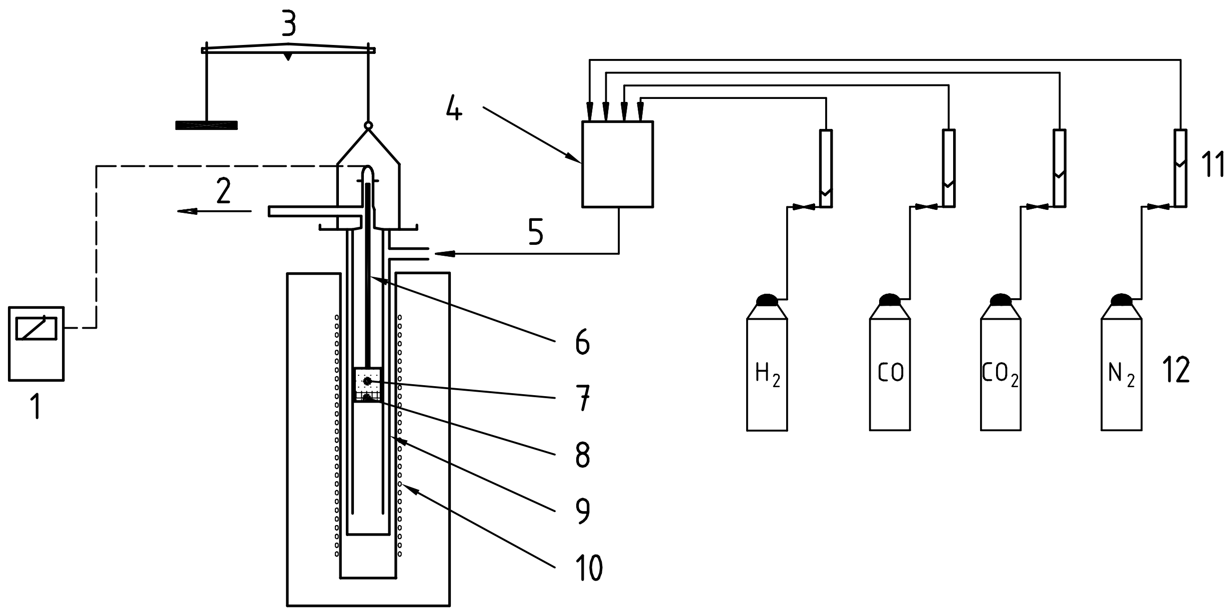
5.1 Gas supply system, capable of supplying the gases and regulating the gas flow rates, freely suspended and connected to the tube in such a way that weighing is not affected.

5.2 Reduction tube, made of non-scaling, heat-resisting metal to withstand temperatures greater than 800 °C and having an internal diameter of 75 mm ± 1 mm. A perforated plate is mounted inside the reduction tube to support the test portion.

5.3 Weighing device, capable of weighing the reduction tube, including the test portion, to an accuracy of 1 g.

5.4 Electrically heated furnace, having a heating capacity and controls sufficient to maintain the entire test portion and the gas entering the bed at 800 °C ± 5 °C.

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

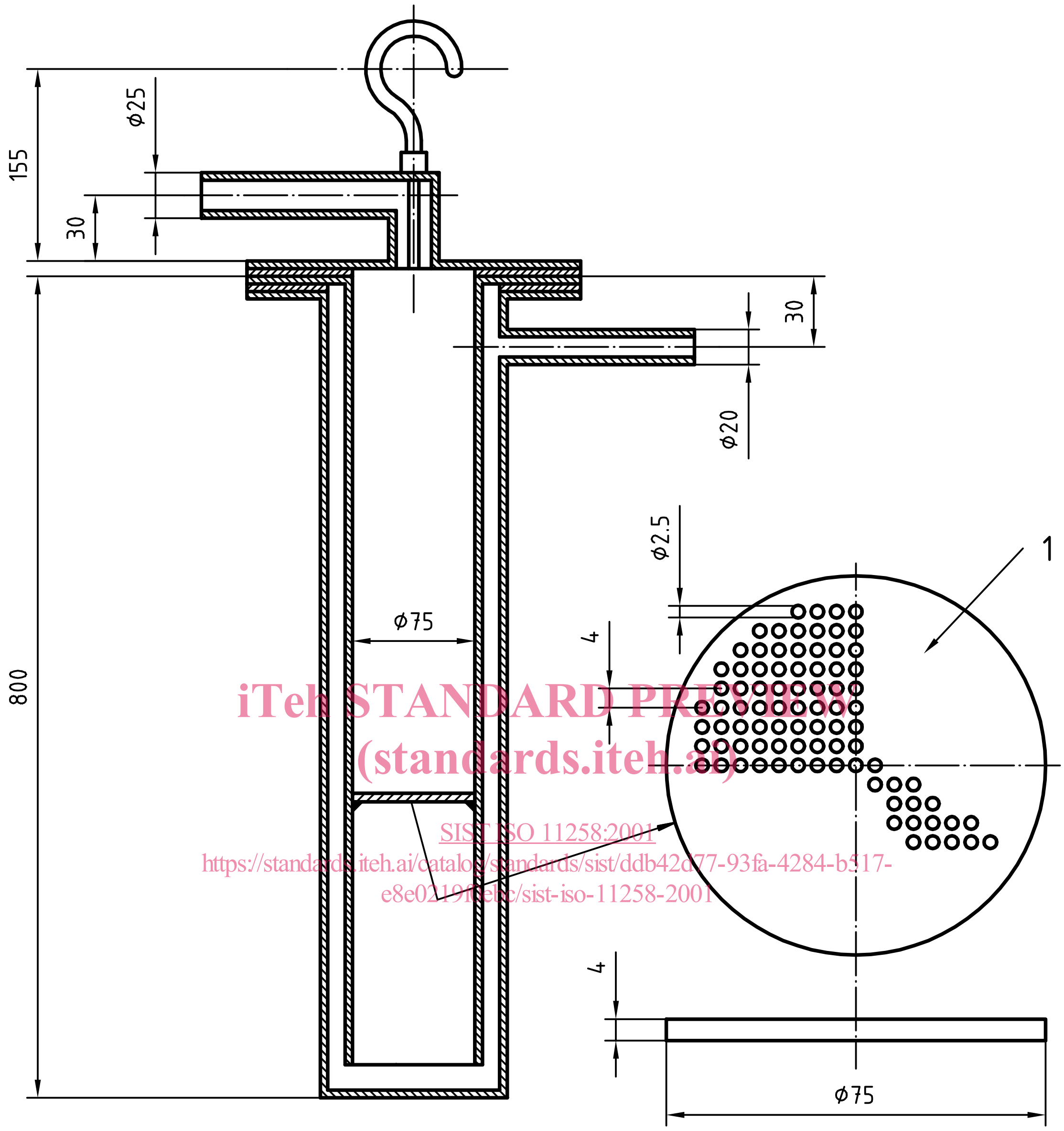


Key

1 Plotter for recording temperature
2 Gas outlet
3 Beam
4 Mixing vessel
5 Gas inlet
6 Thermocouple
7 Test portion
8 Layer of porcelain balls
9 Double wall retort with perforated plate as sample holder
10 Electrically heated furnace
11 Gas flow meters
12 Gas cylinders with manometers and reduction valve

Figure 1 — Arrangement of a test unit

Dimensions in millimetres



NOTE — The dimensions specified in clause 5 are shown for information only.

Key

1:

Hole diameter:	2,5 mm
Pitch between holes:	4,0 mm
Number of holes:	241
Total hole area:	11,8 cm^2
Thickness of plate:	4 mm

Figure 2 — Example of reduction tube

6 Test conditions

6.1 General

Volumes and flow rate of gases used in this International Standard are as measured at a temperature of 0 °C and at an atmospheric pressure of 101,325 kPa (1,013 25 bar).

6.2 Composition of reducing gas

The reducing gas shall consist of:

— H_2 45 % ± 1,0 % (*V/V*)

— CO 30 % ± 1,0 % (*V/V*)

— CO_2 15 % ± 1,0 % (*V/V*)

— N_2 10 % ± 1,0 % (*V/V*)

6.3 Purity of reducing gas

Impurities in the reducing gas shall not exceed

— O_2 0,1 % (*V/V*)

— H_2O 0,2 % (*V/V*)

6.4 Flow rate of reducing gas

Flow rate of the reducing gas shall, during the test period, be maintained at 50 l/min ± 0,5 l/min.

6.5 Purity of heating and cooling gas

Impurities in nitrogen shall not exceed 0,1 % (*V/V*).

6.6 Temperature of test

The test portion shall be reduced at 800 °C ± 5 °C.

The reducing gas shall be preheated while entering the reduction tube to maintain the temperature within the reduction tube and hence the entire test portion at 800 °C ± 5 °C, during the entire reduction period.

7 Sampling and sample preparation

The sampling and the preparation of test samples and test portions shall be in accordance with ISO 10836 [2)].

The test sample shall be oven dried at 105 °C ± 5 °C and cooled to room temperature before the preparation of the test portions.

At least five test portions each of approximately 500 g mass shall be prepared.

Collect each test portion by taking ore particles at random. The target mass of the test portion is 500 g ± the mass of one particle.

[2)] ISO 10836:1994 does not yet include test sample preparation for this test method. Subclause 7.2.3 of ISO 10836:1994 can be applied with the sieves adjusted accordingly.