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Iron ore and direct reduced iron — Vocabulary

Minerais de fer et minerais de fer préréduits — Vocabulaire

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Foreword

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ISO 11323 was prepared by Technical Committee ISO/TC 102, *Iron ore and direct reduced iron*.

This third edition cancels and replaces the second edition (ISO 11323:2002), which has been technically revised.

Iron ore and direct reduced iron — Vocabulary

1 Scope

This International Standard gives the definitions for terms used in TC 102 standards for sampling, sample preparation, moisture and particle size analysis and physical testing of iron ore and direct reduced iron. Some specific analytical terms used in the relevant International Standards are also included.

2 Normative references

The following reference documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated dated references, the latest edition of the reference document (including any amendments) applies.

ISO 565:1990, *Test sieves — Metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings*

ISO 3310-1:2000, *Test sieves — Technical requirements and testing — Part 1:Test sieves of metal wire cloth*

ISO 3310-2:1999, *Test sieves — Technical requirements and testing — Part 2:Test sieves of perforated metal plate*

3 Natural and processed iron ore

3.1
iron ore
any rocks, minerals or aggregates of minerals, natural or processed, from which iron can be produced commercially

NOTE The principal ferriferous minerals occurring in iron ore either singly or severally are the following:

a) red, brown and specular hematites, martite and maghemite;

b) magnetite;

c) hydrated iron oxides, including goethite, limonite and limnite;

d) iron carbonates, including siderite or chalybite, ankerite and other mixed carbonates;

e) roasted iron pyrites or pyrite cinders;

f) ferrites (e.g. calcium ferrite) occurring sometimes in natural ores, but mainly in fluxed pellets and sinters.

Also included are manganiferous iron ore and concentrates that contain not more than 8 % manganese by mass (dry basis after heating to 105 °C).

Excluded are finely ground ferriferous minerals used for pigments, glazes, dense medium suspension and other materials not related to iron- and steel-making.

3.2
natural iron ore
ores as extracted from mines and not subjected to any processes of beneficiation other than sizing

NOTE Such ores are also called direct shipping ores or run-of-mine ores.

3.3
lump ore
ore lump
ores consisting of coarse particles, with a specified lower size limit in the range of 10 mm to 6,3 mm

3.4
sized ores
ores that have been prepared to meet specific size limits

3.5
fine ores
ore fines
ores consisting entirely of small particles, with specified upper size limits in the range of 10 mm to 6,3 mm

3.6
processed ores
ores treated by physical or chemical processes to make them more suitable for the subsequent production of iron and steel

NOTE The main purposes of processing include the following:

a) raising the iron content;

b) decreasing slag-forming constituents;

c) decreasing harmful impurities, such as phosphorus, arsenic or sulfur compounds;

d) adjusting size distribution;

e) improving metallurgical behaviour of the metallic furnace burden.

3.7
concentrates
processed ores (3.6) in which the percentage iron content has been raised

3.8
agglomerates
processed ores (3.6) formed into coherent pieces which are substantially larger than the original **particles** (6.1)

NOTE The industrial processes for making agglomerates include sintering and pelletizing.

3.9
sinter
type of **agglomerates** (3.8) made from **fine ores** (3.5) by means of forced draught combustion of an admixed fuel

NOTE Sinter forms through adhesion between particles due to superficial melting, diffusion and recrystallization. Sinters may be acid, fluxed or super-fluxed according to their acid and basic oxide contents.

3.10
pellets
spherical **agglomerates** (3.8) formed by balling **fine ores** (3.5), usually finer than 100 µm, with various additives followed sometimes by hot or cold bonding induration

NOTE Pellets may be acid, partially fluxed, fluxed or super-fluxed, according to their acid and basic oxide contents.

3.11
hot bonded pellet
fired pellet
pellets (3.10) hardened by sintering at temperatures higher than 1 200°C

NOTE Pellets hardened with cement without sintering are termed cold bonded pellets.

4 Direct reduced iron

4.1
direct reduced iron
DRI
high grade feed for iron- and steel-making obtained from the reduction of natural or processed iron ores, without reaching the melting temperature

NOTE DRI includes metallized products that have been further processed by hot or cold briquetting.

4.2
briquettes
product formed by compressing **direct reduced iron** (4.1) in moulds

4.3
hot briquetted iron
HBI
direct reduced iron (4.1) briquetted at a temperature greater than 650 °C and having an **apparent density** (7.1.2) greater than 5 g/cm^3

4.4
cold briquetted iron
CBI
direct reduced iron (4.1) briquetted at a temperature lower than 650 °C and having an **apparent density** (7.1.2) lower than 5 g/cm^3

5 Sampling

5.1
lot
discrete and defined quantity of **iron ore** (3.1) or **direct reduced iron** (4.1) for which quality characteristics are to be assessed

5.2
strata
approximately equal parts of a **lot** (5.1) based on time, mass or space

NOTE Examples of strata include production periods (e.g. 5 min), production masses (e.g. 1 000 t), holds in vessels, wagons in a train, containers and trucks representing a lot.

5.3
sample
relatively small quantity of **iron ore** (3.1) or **direct reduced iron** (4.1), so taken from a **lot** (5.1) as to be representative in respect of the quality characteristics to be assessed

5.4
gross sample
sample (5.3) comprising all **increments** (5.9), entirely representative of all quality characteristics of a **lot** (5.1)

5.5
partial sample
sample (5.3) comprising less than the complete number of **increments** (5.9) needed for a **gross sample** (5.4)

5.6
test sample
sample (5.3) prepared to meet all specific conditions for a test

5.7
test portion
part of a **test sample** (5.6) that is actually and entirely subjected to the specific test

5.8
reserve sample
spare sample kept for use in case of additional tests or umpire judgment

5.9
increment
quantity of **iron ore** (3.1) or **direct reduced iron** (4.1) taken in a single operation of a device for sampling or **sample division** (5.16)

5.10
cut
amount of material taken in a single traverse of a sample cutter through a stream, bed or stratum of **iron ore** (3.1) or **direct reduced iron** (4.1), or such movement of the sample cutter

5.11
sampling regime
collection plan for constituting a **sample** (5.3) that defines the number of, mass of and interval between **increments** (5.9)

5.12
sampling scheme
methodical and detailed sequence of all **sampling stages** (5.14), defining successive sampling operations and all associated steps of preparation and division

5.13
sampling procedure
instructions specifying the operational requirements of a particular **sampling scheme** (5.12)

5.14
sampling stage
single **sample division** (5.16) operation, together with any associated **sample preparation** (5.15)

5.15
sample preparation
process of rendering a **sample** (5.3) suitable for the determination of specified quality characteristics

NOTE Preparation can include various processes, such as drying, mixing, sieving, sample division or comminution, which may be employed at several stages of sampling.

5.16
sample division
any procedure, without comminution, to decrease the mass of any **sample** (5.3) or **increment** (5.9) retained at any **sampling stage** (5.14)

NOTE Division should be controlled so that each divided sample or the total sum of the divided increments remains representative of the lot for the specific purposes of the tests.

5.17
proportional mass division
division of **samples** (5.3) or **increments** (5.9) such that the mass of each retained divided portion is a fixed proportion of the mass being divided

5.18
constant mass division
division of **sample** (5.3) or **increments** (5.9) such that the retained divided portions are of almost uniform mass, irrespective of variations in mass of the **samples** or **increments** divided

NOTE 1 This method is required for sampling on a mass basis.

NOTE 2 "Almost uniform" means that variations in mass are less than 20 % in terms of the coefficient of variation.

5.19
minimum mass of divided gross sample
minimum mass of a **gross sample** (5.4) necessary for determining its quality characteristics to a certain **precision** (5.36), dependent on the **particle size** (6.2) of the sample and the required measurement precision

5.20
split use of sample
separate use of parts of a **sample** (5.3), as **test samples** (5.6) for separate determinations of quality characteristics

5.21
multiple use of sample
use of a **sample** (5.3) in its entirety for the determination of one quality characteristic, followed by the use of the same sample in its entirety for the determination of one or more other quality characteristics

5.22
interleaved samples
samples (5.3) constituted by placing consecutive primary **increments** (5.9) alternately into two sample containers

5.23
manual sampling
collecting **samples** (5.3) or **increments** (5.9) by human effort

5.24
mechanical sampling
collecting **samples** (5.3) or **increments** (5.9) by mechanical means

5.25
in-situ sampling
direct extraction of a sample from a wagon, hold or stockpile

5.26
stratified sampling
sampling of a **lot** (5.1) carried out by taking **increments** (5.9) from specified positions and in appropriate proportions from **strata** (5.2)

5.27
stratified random sampling
sampling (5.26) of a **lot** (5.1) carried out by taking one or more **increments** (5.9) at random within each stratum

5.28
systematic sampling
sampling carried out by taking **increments** (5.9) from a **lot** (5.1) at regular intervals

5.29
mass-basis sampling
sampling carried out so that **increments** (5.9) are taken at equal mass intervals, increments being as near as possible of uniform mass

NOTE "Uniform mass" means that variations in mass are less than 20 % in terms of the coefficient of variation.

5.30
time-basis sampling
sampling carried out so that **increments** (5.9) are taken from falling streams, or from conveyors, at uniform time intervals, the mass of each increment being proportional to the mass flow rate at the instant of taking the increment

5.31
spear
sampling tool of a spear-like shape, used to sample a stationary lot or part of a lot, capable of being driven down to the bottom of the lot and extracting a sample from the complete depth of the lot

5.32
auger
sampling tool involving an auger mechanism, used to sample a stationary lot or part of a lot, capable of being driven down to the bottom of the lot and extracting a sample from the complete depth of the lot

5.33
reference method
method that serves as an agreed-upon reference for comparison and which is derived from scientific principles, experimental work of a national or international organization, or collaborative experimental work under the auspices of a scientific or engineering group

5.34
reference sample
sample taken by a **reference method** (5.33)

5.35
quality variation
measure of the heterogeneity of the lot, defined as σ_w, the standard deviation of the quality characteristics within strata for mass-basis systematic sampling

5.36
precision
closeness of agreement between independent test results (obtained in a manner not influenced by any previous result on the same or similar test object) obtained under stipulated conditions

NOTE The measure of precision is computed as the standard deviation (σ) of the test results, and is usually expressed in terms of imprecision, β (=2σ), within which the true value of measurement exists with a probability of 95 %. Less precision is reflected by a larger standard deviation.

5.37
repeatability limit
the value below which the absolute difference between two test results obtained under repeatability conditions may be expected to be with a probability of 95 %

NOTE The repeatability limit is generally expressed as r, rejecting the use of any measured value outside this range for reporting; when duplicate measurements are made, it may be expressed as $r = \sqrt{2}\beta$.

5.38
Grubbs' test
one of the statistical methods used to detect outliers in a series of data

NOTE 1 ISO 3086 defines any value beyond the limit value at the 5 % significance level as an outlier.

NOTE 2 The procedure of Grubbs' test is given in ISO 5725-2.

6 Particle size analysis/Moisture determination

6.1
particle
discrete and coherent piece of **iron ore** (3.1) or **direct reduced iron** (4.1), regardless of size, shape or mineral content

6.2
particle size
practical size definition, irrespective of **particle** (6.1) shape, obtained by **sieving** (6.10)

NOTE The particle size may be defined by the size of the smallest sieve aperture through which the particle has passed and the size of the largest sieve aperture on which the particle has been retained ($-a+b$ mm). Particle size may be less precisely defined by stating only one sieve aperture size ($+x$ mm) or ($-z$ mm).

6.3
specification size
sieve aperture size (or sizes) chosen to define a percentage mass limit (or limits) for any size fraction (or fractions) considered to be significant

NOTE A specification sieve has the aperture size that corresponds to the specification size; e.g. a pellet feed may be specified as not more than m % $+x$ mm, or a sinter feed as not more than n % $-z$ mm.

6.4
nominal top size
particle size (6.2) expressed by the smallest aperture size of the test sieve (from a square opening, comprising the R20 and R40/3 series in ISO 565), such that no more than 5 % by mass of **iron ore** (3.1) or **direct reduced iron** (4.1) is retained on the sieve

NOTE This definition applies to iron ore and crushed hot briquetted iron HBI, but not to HBI prior to crushing.

6.5
size fraction
sample portion separated by using one sieve, or two sieves of different aperture sizes

6.6
oversize fraction
coarsest portion of a **sample** (5.3), comprising all **particles** (6.1) that are retained on the sieve of aperture x mm, designated as $+x$ mm and quoted as a percentage of the total mass of the sample

6.7
intermediate size fraction
sieved sample portion specified by two sizes, i.e. the smallest sieve aperture (a mm) through which it has passed and the largest sieve aperture (b mm) on which it has been retained, designated as $-a+b$ mm and quoted as a percentage of the total mass of the **sample** (5.3)

6.8
undersize fraction
finest portion of a **sample** (5.3), comprising all **particles** (6.1) that have passed the sieve of aperture z mm, designated as $-z$ mm and quoted as a percentage of the total mass of the sample

6.9
size distribution
in size analysis by **sieving** (6.10), the proportion of **particles** (6.1) according to the sizes of sieve apertures used and expressed as percentage masses, passed or retained on sieves of selected apertures, relative to the total mass of all **size fractions** (6.5)

6.10
sieving
process for separating particulate **iron ore** (3.1) or **direct reduced iron** (4.1) into two or more **size fractions** (6.5), using one or more sieves

6.11
test sieve
sieve, satisfying the requirements of ISO 3310-1 (metal wire cloth) or ISO 3310-2 (perforated metal plate), used for screening tests of powdery or granular matter

6.12
charge
quantity of **iron ore** (3.1) or **direct reduced iron** (4.1) to be treated at one time on one sieve or on a set of sieves

NOTE The permissible mass of a charge depends on the size and aperture of sieves used.

6.13
mass of sample used for sieving
quantity of **iron ore** (3.1) or **direct reduced iron** (4.1) actually sieved for one complete size analysis

NOTE This may comprise several separate **charges** (6.12); in which case it is expressed as the sum of all charges used.

6.14
hand placing

sieving (6.10) method that may be used when a **sample** (5.3) contains relatively coarse **particles** (6.1), usually 40 mm or larger in size, each particle being individually presented to a sieve aperture by hand and turned until it can either pass through, without force being applied, or can be classed clearly as oversize

6.15
hand sieving
sieving (6.10) operation in which a sieve or a set of sieves is supported and agitated manually

6.16
assisted hand sieving
sieving (6.10) operation in which a sieve or a set of sieves is supported mechanically, but is agitated manually

6.17
mechanical sieving
sieving (6.10) operation, in batch or continuous sieving, in which one or more sieves are supported and agitated by mechanical means

6.18
batch sieving
sieving (6.10) operation in which a specific mass or volume of sample is presented to one or more sieves which are agitated either by hand or by mechanical means

NOTE Oversize fractions remain within the frames of the retaining sieves until the end of the sieving operation. The number of presentations of the particles to the sieve apertures depends on the length of sieving time.