



**International
Standard**

ISO 1213-2

Coal and coke — Vocabulary —

**Part 2:
Terms relating to sampling, testing
and analysis**

Charbon et coke — Vocabulaire —

Partie 2: Termes relatifs à l'échantillonnage, l'essai et l'analyse

**Third edition
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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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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 document 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).

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This document was prepared by Technical Committee ISO/TC 27, *Coal and coke*, Subcommittee SC 1, *Coal preparation: Terminology and performance*.

This third edition cancels and replaces the second edition (ISO 1213-2:2016), of which it constitutes a minor revision. The changes are as follows:

- the title has been updated to specify coal and coke;
- solid mineral fuels have been replaced by either coal and coke or, in some cases, just coal or just coke.

A list of all parts in the ISO 1213 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Coal and coke — Vocabulary —

Part 2: Terms relating to sampling, testing and analysis

1 Scope

This document defines terms commonly employed in the sampling, testing and analysis of coal (3.39) and coke (3.42).

Alternative names are given for several terms. In some cases, the use of the alternative name is deprecated (as indicated).

2 Normative references

There are no normative references in this document.

3 Terms and definitions

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 abrasion

loss of material from particle surfaces of a *coal* (3.39) or *coke* (3.42) sample, or from other surfaces in contact with the particles, caused by friction between contacting surfaces

3.2 abrasion index

total mass lost by the *abrasion* (3.1) of four carbon steel blades when rotated in a specified mass of *coal* (3.39) under specified conditions

Note 1 to entry: Expressed in milligrams of metal lost per kilogram of a coal and coke sample.

3.3 abrasion value

resistance to *abrasion* (3.1) of the *coke* (3.42) after reaction with carbon dioxide in the *CRI* (3.43) test, measured as the mass fraction expressed as a percentage of a sample passing through a 0,5 mm sieve after tumbling under conditions specified

3.4 adiabatic calorimeter

calorimeter that adjusts its jacket temperature constantly to be identical to bomb temperature, thereby preventing heat losses

Note 1 to entry: The inner calorimeter chamber and the jacket exchange no energy because the water temperature in both is identical during the test. The water in the external jacket is heated or cooled to match the temperature change in the calorimeter proper.

3.5

accuracy

closeness of agreement between an observation and the "true" value

Note 1 to entry: The accuracy of a result should not be confused with its precision. A result may be precise but it is only accurate when it is free of *bias* (3.18).

3.6

adventitious ash

DEPRECATED: extraneous ash

ash arising from *mineral matter* (3.136) associated with, but not inherent in a *coal* (3.39) or *coke* (3.42) sample

3.7

air-dried basis

means of expressing an analytical result based on the condition in which a *coal* (3.39) or *coke* (3.42) sample is in equilibrium with atmospheric humidity

3.8

air-drying

process of bringing the mass fraction of the sample near to equilibrium with the atmosphere, in the area in which further reduction of the sample are to take place

Note 1 to entry: The coal or coke sample in this state is composed of absorbed moisture, mineral matter and organic matter.

3.9

anthracite

coal (3.39) of high *rank* (3.174), with a low *volatile matter* (3.239) content and a semi-metallic lustre, and which does not soften or swell when heated

3.10

apparent relative density

ratio of the mass of a *coal* (3.39) (lump sample) to the mass of an equal volume of water (at the same temperature), inclusive of any voids within the fuel subjected to the test

Note 1 to entry: The apparent relative density should not be confused with the *bulk density* (3.25).

3.11

ash

residue obtained by incineration of a *coal* (3.39) or *coke* (3.42) sample under specified conditions

3.12

ash analysis

analysis of *ash* (3.11) for its elemental composition

Note 1 to entry: The elements usually determined are silicon, aluminium, iron, magnesium, manganese, titanium, calcium, sodium, potassium, phosphorus and sulfur, and these are usually expressed as oxides.

3.13

ash fusibility

characteristic physical state of the *ash* (3.11) obtained by heating under specified conditions

Note 1 to entry: Ash fusibility is determined under either *oxidizing atmosphere* (3.61) or *reducing atmosphere* (3.176) conditions.

Note 2 to entry: See also *deformation temperature* (3.58), *sphere temperature* (3.215), *hemisphere temperature* (3.98) and *flow temperature* (3.75).

3.14

ash viscosity

measure of the resistance to flow of *ash* (3.11) in the fused state

3.15

**as received basis
as sampled basis**

means of expressing an analytical result based on the condition where *total moisture* (3.232) is included

3.16

base/acid ratio

ratio of the mass of basic oxides (iron(III) oxide, calcium oxide, magnesium oxide, disodium oxide and dipotassium oxide) to the mass of acidic oxides (silica, aluminium oxide and titanium (IV) oxide) in *ash* (3.11)

Note 1 to entry: This ratio can be used in the determination of the *fouling factor* (3.81) and the slugging factor.

3.17

batch

quantity of *coal* (3.39) or *coke* (3.42) produced at one time under relatively uniform conditions

3.18

bias

systematic *error* (3.68) which leads to the average value of a series of results being persistently higher or persistently lower than those obtained using a reference sampling method

Note 1 to entry: Bias is the total systematic error as contrasted to random error. There may be one or more systematic error components contributing to the bias. A larger systematic difference from the accepted reference value is reflected by a larger bias value.

3.19

bias of scale

bias (3.18) that is constant and independent of the range of values measured

3.20

bituminous coal

general descriptive term for *coal* (3.39) of *rank* (3.174) between *anthracite* (3.9) and *brown coal and lignite* (3.24)

Note 1 to entry: The vitrinites in all coals in the bituminous range melt and form a coke when the coal is heated above 400 °C in the absence of air.

Note 2 to entry: In some countries, coals of rank immediately below that of bituminous coal are referred to as sub-bituminous coals.

3.21

blast furnace coke

strong, *large coke* (3.116) for use in blast furnaces

Note 1 to entry: Blast furnace coke is generally produced from blends of *bituminous coals* (3.20), which may incorporate additives.

Note 2 to entry: Blast furnace coke usually has a low reactivity to carbon dioxide.

3.22

breakage

particle size reduction (3.155) resulting from impact and/or compression

3.23

breeze

undersize after separating the smallest size of *graded coke* (3.91)

Note 1 to entry: Breeze is usually less than 10 mm in size.

3.24

brown coal and lignite

coals (3.39) of low rank (3.174) characterized by high inherent moisture, high *volatile matter* (3.239) and low calorific value

Note 1 to entry: In some countries, the terms are used to describe all low-rank coals up to *bituminous coals* (3.20). In other countries, the coals at the higher end of the range are referred to as sub-bituminous coals.

3.25

bulk density

mass of a portion of a *coal* (3.39) or *coke* (3.42) sample divided by the volume of the container which is filled by that portion under specified conditions

Note 1 to entry: Bulk density values can have range and may depend on previous handling, time and weather. The values on stockpiles can also vary from loose free fall situations to compacted filled by that portion under specified conditions.

3.26

bulk sample

sample of large mass, taken in a particular operation for a specific reason such as for *float sink analysis* (3.78)

3.27

caking of coal

property of *coal* (3.39) when heating without access of air to a plastic condition with formation of the connected non-volatile residue

3.28

caking index

measure of the caking power of a coal in terms of the *mechanical strength* (3.132) of the *coke* (3.42) obtained by carbonization, under specified conditions, of an intimate mixture of the *coal* (3.39) and standard *anthracite* (3.9)

3.29

calorific value gross at constant volume

absolute value of the specific energy of combustion, in joules, for unit mass of a *coal* (3.39) or *coke* (3.42) sample burned in oxygen in a calorimetric bomb under the conditions specified

Note 1 to entry: The products of combustion are assumed to consist of gaseous oxygen, nitrogen, carbon dioxide and sulfur dioxide, of liquid water (in equilibrium with its vapour) saturated with carbon dioxide under the conditions of the bomb reaction, and of solid ash, all at the reference temperature.

Note 2 to entry: Equipment such as Adiabatic and or Isothermal bomb calorimeters are used to determine this result.

3.30

calorific value net at constant volume

absolute value of the specific energy of combustion, in joules, for unit mass of the *coal* (3.39) or *coke* (3.42) sample burned in oxygen under conditions of constant volume and such that all the water of the reaction remains as water vapour (in a hypothetical state at 0,1 Mpa), the other products being as for the gross calorific value all at the reference temperature

Note 1 to entry: The net calorific value at constant volume is the negative value of the net specific energy of combustion.

3.31

calorific value net at constant pressure

absolute value of the specific heat (enthalpy) of combustion in joules, for unit mass of the *coal* (3.39) or *coke* (3.42) sample burned in oxygen at constant pressure under such conditions that all the water of the reaction products remains as water vapour (at 0,1 Mpa), the other products being as for the gross calorific value, all at the reference temperature

3.32

carbominerite

collective term for inter growths of minerals and *macerals* (3.121)

Note 1 to entry: The various types of carbominerite with their compositions are given in Table 1.

Table 1 — Types and compositions of carbominerite

Type	Volume fraction % of minerals
Carbargilite	20 to 60, clay minerals
Carbopyrite	5 to 20, sulfides
Carbankerite	20 to 60, carbonates
Carbosilicite	20 to 60, quartz
Carbopolyminerite ^a	20 to 60, various minerals
^a The term is used also for carbopolyminerite containing a maximum of 5 % of mineral matter, provided that sulfides form a substantial part of the mineral matter.	

3.33

carbon in mineral matter

carbon in the mineral matter carbonates of a *coal* (3.39) or *coke* (3.42) sample

3.34

carboxyreactivity

rate of reaction of a *coal* (3.39) or *coke* (3.42) sample with carbon dioxide under specified conditions

3.35

channel sample

sample of raw *coal* (3.39) and associated inorganic material taken by removing a channel of even cross-section from the seam

Note 1 to entry: Where the full section of the seam is not accessible or not required, this term may refer to a sample taken either from a specifically defined portion of the seam, or from the floor to roof as mined or exposed.

3.36

char

solid, partially or non-agglomerated carbonaceous material produced by the pyrolysis of a *coal* (3.39) sample

3.37

chute

inclined trough for conveying *coal* (3.39) or *coke* (3.42) to a lower level

3.38

clinkering

aggregation of particles of *ash* (3.11) after it has melted during the course of combustion of *coal* (3.39) sample or during gasification

Note 1 to entry: The aggregated particles may include small amounts of unburnt *coal* (3.39).

3.39

coal

combustible sedimentary rock formed from altered plant remains consolidated under superimposed strata

Note 1 to entry: The characteristics of different coals are due to differences in source plant material, in the conditions and the degree of change that the material has undergone in its geological history, and in the range of impurities present. Coals can be characterized macroscopically by their lithotype composition and microscopically by their maceral and *microlithotype* (3.123) compositions.

3.40

coalification

process by which accumulated plant matter is compacted and transformed into *coal* (3.39)

3.41

coefficient of variation

standard deviation (3.216), expressed as a percentage of the absolute value of the arithmetic mean

Note 1 to entry: to entry: $CV = \frac{s}{\bar{x}} \times 100$

where

s is the value of standard deviation;

\bar{x} is the arithmetic mean;

Note 2 to entry: CV is normally denoted as v .

3.42

coke

solid, agglomerated carbonaceous residue produced by the pyrolysis of *coal* (3.39) in the absence of air

3.43

coke reactivity index

CRI test

mass fraction loss, expressed as a percentage of *coke* (3.42) after reaction with carbon dioxide and carbon monoxide under specified conditions

3.44

coke strength after reaction

CSR

strength of *coke* (3.42) after reaction with carbon dioxide and carbon monoxide in the *CRI* (3.43) test, measured as mass fractions expressed as a percentage retained on either a 10,0 mm or a 9,5 mm sieve after tumbling under specified conditions

3.45

combustible matter

theoretical state of *coal* (3.39) or *coke* (3.42) without moisture and *mineral matter* (3.136) other than *pyritic sulfur* (3.170) and sulfidic sulfur

3.46

combustible sulfur

sulfur which reacts with oxygen when a *coal* (3.39) or *coke* (3.42) sample is burnt under specified controlled conditions

Note 1 to entry: Most of the reacted sulfur reports as SO_2 in the chimney gas, but under certain conditions, some of the sulfur is captured by alkaline minerals in the ash

3.47

common sample

sample collected for more than one intended use

3.48

complete seam profile sample for each bench

collective designation of the coal samples taken separately from each coal bench and band of the tested seam or a part of it which is a section of a thick seam

3.49

constant mass division

method of increment or *sample division* (3.194) in which the portions retained from individual *increments* (3.106), *partial samples* (3.153) or *gross samples* (3.94) are of uniform mass

3.50

continuous sampling

taking of a sample from each consecutive *sub-lot* (3.221) so that *increments* (3.106) are taken at uniform intervals whenever the *coal* (3.39) or *coke* (3.42) is handled at the point of sampling

3.51

correlation coefficient

measure of the degree of correlation between the members of paired sets

3.52

core sample

cylindrical sample of the whole or part of a *coal* (3.39) seam obtained from drilling using a coring barrel

Note 1 to entry: The diameter of the core may vary from 50 mm to 1000 mm depending on the reason for which the sample is required. However, 50 mm to 200 mm is the most common core diameter range.

3.53

crucible swelling number

CSN

number which defines, by reference to a series of standard profiles, the size and shape of the residue obtained when a specified mass of *coal* (3.39) is heated in a covered crucible under specified conditions

Note 1 to entry: ASTM Standards use the term free swelling index (FSI) for this test.

3.54

crush (verb)

action of reducing the particle size of a sample to produce particles at the required *nominal top size* (3.144) required

Note 1 to entry: See also *grind* (3.93).

3.55

cut coke

screened *coke* (3.42) from which the oversize has been reduced by mechanical means and rescreened

3.56

cutter

mechanical sampling device which extracts *increments* (3.106)

3.57

deformation interval

softening interval

interval between the *deformation temperature* (3.58) and the *hemisphere temperature* (3.98)

3.58

deformation temperature

temperature at which deformation of a test piece prepared from *ash* (3.11), by a specified procedure, occurs

Note 1 to entry: When using cylindrical (or cubicoidal) test pieces, a change of the surface and the rounding of the edges at the rim or corner.

Note 2 to entry: When using pyramidal test pieces, the rounding of the tip of the test piece. Shrinkage or distortion of the test piece, or rounding of cracks and fins, are not criteria for deformation and should be ignored if the tip and edges remain sharp.

3.59

dial divisions per minute

ddpm

measure of stirrer rotation rate, in the Gieseler Plastometer method

Note 1 to entry: There are 100 dial divisions for each full 360° rotation of the stirrer. The *fluidity* (3.77) result is expressed as total dial division turned by the stirrer in a one-minute time period

3.60

dilatation

measure of the volume change produced by heating a *coal* (3.39) through its *plastic range* (3.162) under specified conditions

Note 1 to entry: Similar tests with their own specified conditions have been developed historically, including Audibert-Arnu and the Ruhr Coal test.

3.61

dirt band

DEPRECATED: shale band

layer of *mineral matter* (3.136) lying parallel to the bedding plane in a seam of *coal* (3.39)

3.62

divided increment

part obtained from the division of the *increment* (3.106) in order to decrease its mass

Note 1 to entry: Such division may be done with or without prior size reduction.

3.63

dry ash-free basis

means of expressing an analytical result based on a hypothetical condition in which the *coal* (3.39) or *coke* (3.42) is considered to be free from both moisture and *ash* (3.11)

3.64

dry basis

means of expressing an analytical result based on the condition in which the *coal* (3.39) or *coke* (3.42) is free from moisture

3.65

dry mineral-matter-free basis

means of expressing an analytical result based on a hypothetical condition in which the *coal* (3.39) or *coke* (3.42) is considered to be free from both moisture and *mineral matter* (3.136)

3.66

duplicate determination

determination of a characteristic on two portions of the same *test sample* (3.226) carried out by the same operator using the same apparatus but at different times

3.67

duplicate sampling

particular case of *replicate sampling* (3.185) with only two replicate samples

3.68

error

difference between the observation and the accepted reference value as defined in ISO 5725-1

3.69

falling stream

stream of *coal* (3.39) or *coke* (3.42) in free fall, for example, from the end of a conveyor

3.70

final fluidity temperature

temperature at which stirrer rotation rate reached 1 ddpm in the Gieseler Plastometer test

3.71

fixed carbon

remainder after the mass fractions expressed as percentages of the moisture in the analysis sample, *ash* (3.11) and *volatile matter* (3.239) are subtracted from 100 reported on an air-dried basis

Note 1 to entry: Fixed carbon may also be calculated to different bases.

3.72

fixed mass division

method of *sample division* (3.194) in which the mass retained is predetermined and independent of the mass of the feed

3.73

fixed rate division

method of increment or *sample division* (3.194) in which the portions retained from individual *increments* (3.106), *partial samples* (3.153) or *gross samples* (3.94) have a mass proportional to the mass of the increment, partial sample or gross sample

Note 1 to entry: In fixed rate division, the mass of sample retained is a fixed proportion of the mass of the feed.

3.74

fixed sulfur

sulfur which is present in the solid residue (non-volatile) after the pyrolysis of a *coal* (3.39) or *coke* (3.42) sample at a particular temperature

3.75

flow temperature

temperature at which a test piece, prepared from *ash* (3.11) by a specified procedure, loses its profile and flows to the extent that its height is one third of its height at the *hemisphere temperature* (3.98)

3.76

flattened-heap method

method of *sample division* (3.194) in which a sample is flattened and divided into identical rectangles and from each rectangle, one *increment* (3.106) is taken using a scoop and bump plate and combined into a divided sample

3.77

fluidity

measure of the viscosity of a *coal* (3.39) in its plastic state determined under specified conditions

3.78

float sink analysis

laboratory procedure for analysing raw *coal* (3.39) samples, using organic and/or other high specific gravity solutions adjusted to various gravities to predict *ash* (3.11) levels and yield for *coal* (3.39) product(s) and reject(s) in a *coal* (3.39) preparation plant

3.79

formed coke

coke (3.42) specially prepared from *coal* (3.39) by processes involving the compaction of particles into a regularly shaped artefact

3.80

forms of sulfur

collective term for the *pyritic sulfur* (3.170), *sulfate sulfur* (3.222) and *organic sulfur* (3.149) in a *coal* (3.39) or *coke* (3.42) sample

Note 1 to entry: For the purposes of this definition, elemental sulfur and monosulfides, which may be present in certain solid mineral fuels, are disregarded.

3.81

fouling factor

measure of the tendency of *ash* (3.11) to form sintered deposits in the convective zone of a furnace

3.82

fouling index

empirical estimate of the fouling propensity of coal ash

3.83

foundry coke

very strong, very large, dense *coke* (3.42) for use in foundry cupola furnaces

Note 1 to entry: It is prepared in coke ovens from selected coking coal blends, and may incorporate additives. Many cokes including foundry and *blast furnace cokes* (3.21) have several functions, provide carbon for reduction, heat to melt the metal, support the burden and finally aid permeability for passage of CO₂ and CO.

3.84

free moisture

moisture which is lost by *coal* (3.39) or *coke* (3.42) sample in attaining approximate equilibrium with the atmosphere to which it is exposed

Note 1 to entry: This is sometimes called surface moisture.

3.85

froth flotation laboratory test

laboratory procedure for the froth flotation testing of fine *coal* (3.39) less than 0,5 mm under specified conditions

3.86

fuel

energy carriers intended for energy conversion such as *coal* (3.39) or *coke* (3.42)

3.87

fuel ratio

ratio of *fixed carbon* (3.71) to *volatile matter* (3.239) on the same basis of analysis

3.88

gas coke

coke (3.42) usually made from high volatile *bituminous coal* (3.20) at high temperature in gas making carbonization plants

3.89

general analysis

determination of the chemical and physical characteristics of a *coal* (3.39) or *coke* (3.42) sample, other than the determination of *total moisture* (3.232)

3.90

general analysis test sample

sample, crushed to minus 212 µm nominal top size, conforming with ISO 3310-1, used for the determination of most chemical and some physical characteristics of *coal* (3.39) or *coke* (3.42)

3.91

graded coke

coke (3.42) which has been screened between two specified sizes

3.92

Gray-King coke type

type, denoted by a letter, with a subscript in certain cases, which defines, by reference to a series of standard profiles, the size, strength and texture of the *coke* (3.42) residue obtained when a specified mass of *coal* (3.39) is heated in a retort tube under specified conditions

3.93

grind, verb

DEPRECATED: mill (verb)

action of reducing the particle size of a sample to produce fine particles

3.94**gross sample**

quantity of a *coal* (3.39) or *coke* (3.42) consisting of all the *increments* (3.106) or *partial samples* (3.153) taken from a *sub-lot* (3.221), either in the condition as taken or after the increments have been individually reduced and/or divided

3.95**hand placing**

operation by which an attempt is made to pass each particle of *coal* (3.39) or *coke* (3.42) through a stationary sieve by presenting it to the sieve in all possible orientations but without the use of force

3.96**hand shaking****manual shaking**

operation in which a sieve is held in the hands and is given a gentle horizontal oscillatory motion

3.97**hardgrove grindability index**

measure of the grindability of a *coal* (3.39) determined by testing a specially prepared sample in standard apparatus

3.98**hemisphere temperature**

temperature at which the height of a test piece, prepared from *ash* (3.11) by a specified procedure, is equal to half the width of the base, and its shape becomes approximately hemispherical

3.99**high temperature coke**

solid, agglomerated carbonaceous residue of the pyrolysis of *coal* (3.39) at temperatures above 850 °C

3.100**humic acid**

group of complex organic, amorphous compounds of high relative molecular mass occurring as free acids and as metal salts (humates) in *coal* (3.39), which can be extracted by a sodium hydroxide solution

3.101**huminite**

group of medium grey *macerals* (3.121) having *reflectances* (3.177) generally between those of the associated darker *liptinites* (3.117) and the lighter *inertinites* (3.109)

3.102**hydrogen in mineral matter**

hydrogen in the *water of constitution* (3.243) in the *mineral matter* (3.136) of a *coal* (3.39) or *coke* (3.42) sample

3.103**hydroreactivity**

rate of reaction of a sample of *coal* (3.39) with water vapour under specified conditions

3.104**hygroscopic moisture of brown coals and lignites**

part of *total moisture* (3.232) which is retained by a brown *coal* (3.39) or lignite after exposing it to the atmosphere and allowing it to attain a constant mass, at 20 °C ± 2 °C and (70 ± 5) % relative humidity

3.105**ignition temperature**

minimum temperature at which a *coal* (3.39) sample liberates enough *volatile matter* (3.239) to form, together with the surrounding atmosphere, a flammable mixture

3.106

increment

portion of *coal* (3.39) or *coke* (3.42) extracted in a single operation of the sampling device

Note 1 to entry: For some types of sampling device, a single operation consists of a double pass (back and forth) through the stream.

3.107

inert

<inorganic>constituents of a *coal* (3.39) which decrease its efficiency in a specific use

3.108

inert

<organic>*maceral* (3.121) components of a *coal* (3.39) which do not soften or swell during the process of carbonization

3.109

inertinite

maceral (3.121) group that comprises macerals whose *reflectance* (3.177) in low and medium-rank *coals* (3.39) and in sedimentary rocks of corresponding *rank* (3.174) is higher in comparison to the macerals of the *vitrinite* (3.241) and *liptinite* (3.117) groups

3.110

inherent ash

ash (3.11) arising from *mineral matter* (3.136) present in the original plant material from which the *coal* (3.39) was formed and from mineral matter incorporated intimately in the solid mineral fuel during the *coalification* (3.40) process

3.111

intermittent sampling

taking of a sample from only certain *sub-lots* (3.221) of *coal* (3.39) or *coke* (3.42)

3.112

irsid indices

mass fractions expressed as percentages of a specially prepared sample of *coke* (3.42) remaining on a test sieve of 40 mm nominal size of openings (round hole) and passing a test sieve of 10 mm nominal size of openings (round hole), denoted by I_{40} and I_{10} , respectively, after the sample has been subjected to 500 revolutions by a specified procedure in a rotating drum

Note 1 to entry: Other indices, for example, I_{20} , may be reported in addition to, or in place of, I_{40} if required.

3.113

isoperibol calorimeter

isothermal type calorimeter that has a jacket of uniform and constant temperature

Note 1 to entry: These calorimeters have the inner chamber surrounded by a water jacket in which the temperature is maintained at ambient temperature. The outer jacket acts like a thermostat and the thermal conductivity of the interspace between the two chambers is kept as even as possible.

3.114

laboratory sample

sample prepared from the gross or *partial sample* (3.153) as delivered to the laboratory and from which further samples are prepared for test purposes

3.115

large coal

coal (3.39) above a specified lower limiting size, without any upper size limit

3.116

large coke

coke (3.42) with lower size of 20 mm and above, with or without upper size limit

3.117

liptinite

maceral (3.121) distinguished from other macerals by its lower reflectance

Note 1 to entry: Fluorescence properties have become an important secondary distinguishing feature.

Note 2 to entry: Liptinite macerals have a low reflectance and high hydrogen mass fraction until their properties converge with those of *vitrinite* (3.241).

3.118

lot

defined quantity of *coal* (3.39) or *coke* (3.42) for which the overall quality is to be determined

Note 1 to entry: A lot may be divided into a number of *sub-lots* (3.221).

3.119

low temperature coke

solid, agglomerated carbonaceous residue of the pyrolysis of *coal* (3.39) at a temperature between 500 °C and 850 °C

3.120

lump section

piece of *coal* (3.39) or *coke* (3.42) of size suitable for polishing and examination under the microscope

Note 1 to entry: One face of the lump section, usually that perpendicular to the bedding plane, is ground and polished.

3.121

maceral

smallest microscopically identifiable constituents of *coal* (3.39) and of fossil organic matter finely dispersed in sediments

3.122

maceral group

collective term for *macerals* (3.121) having broadly similar properties in a single *coal* (3.39) of specific *rank* (3.174)

Note 1 to entry: See [Table 2](#).

Table 2 — Macerals as defined in the ICCP 1994 system

Maceral group	Maceral sub-group	Maceral		Maceral variety
Vitrinite/ huminite	Telovitrinite/ telohuminite	Telinite	Textinite	
		Collotelinite	Ulminite	
	Detrovitrinite/ detrohuminite	Vitrodetrinite	Attrinite	
		Collodetrinite	Densinite	
	Gelovitrinite/ gelohuminite	Corpogelinite	Corpohuminite	
		Gelinite	Gelinite	
Inertinite	Not sub-groups sensu stricto: (with plant cell structure)	Fusinite Semifusinite Funginite		
	(lacking plant cell structure)	Secretinite Macrinite Micrinite		
	(fragmented inertinite)	Inertodetrinite		

NOTE 1: Huminite maceral subgroups can be used synonymously with those from the vitrinite group. Huminite macerals, however, cannot be used synonymously with vitrinite macerals.

NOTE 2: ICCP is the International Committee for Coal and Organic Petrology

Table 2 (continued)

Maceral group	Maceral sub-group	Maceral	Maceral variety
Liptinite		Cutinite Suberinite Sporinite	
		Resinite	
		Exsudatinite Chlorophyllinite	
		Alginite	
			Lamalginite
		Liptodetrinite	
		Bituminite	
NOTE 1: Huminite maceral subgroups can be used synonymously with those from the vitrinite group. Huminite macerals, however, cannot be used synonymously with vitrinite macerals.			
NOTE 2: ICCP is the International Committee for Coal and Organic Petrology			

**3.123
microlithotype**

naturally occurring *maceral* (3.121) or association of macerals with a minimum band width of 50 µm

Note 1 to entry: Microlithotypes are classified in one of three categories, namely, monomaceral, bimaceral and trimaceral microlithotypes, according to whether they contain significant proportions of macerals of one, two or three *maceral groups* (3.122). For the bimaceral and trimaceral microlithotypes, the proportion of an individual maceral group is equal to a 95,0 % volume fraction in each case.

Note 2 to entry: The classification of the main microlithotypes in *bituminous coal* (3.20) and anthracite and their maceral group compositions are given in Table 3.

Table 3 — Classification of the main microlithotypes

Microlithotype	Maceral-group composition (total greater than or equal to a 95 % volume fraction, mineral-free basis)
Monomaceral Vitrinite Liptinite Inertinite	Vitrinite Liptinite Inertinite
Bimaceral Clarite Durite Vitrinertite	Vitrinite + Liptinite Inertinite + Liptinite Vitrinite + Inertinite
Trimaceral Trimacerite	Vitrinite + Liptinite + Inertinite

**3.124
manual sampling**

collection of *increments* (3.106) by human effort

**3.125
mass based sampling**

taking of *increments* (3.106), whereby the position of each increment to be collected from the stream of *coal* (3.39) or *coke* (3.42) is measured by a mass interval of stream flow and the increment mass is fixed

Note 1 to entry: Each increment or *divided increment* (3.62) constituting the *partial sample* (3.153) or the *gross sample* (3.94) should be of almost uniform mass.

3.126

maximum fluidity

maximum rate of rotation for the stirring shaft in *dial divisions per minute* (3.59), in the Gieseler Plastometer test

3.127

maximum fluidity temperature

temperature at which the stirring shaft rotation reached the maximum rate in the Gieseler Plastometer test

3.128

maximum reflectance

highest value of *reflectance* (3.177) obtained when any polished section of a particle or lump of *coal* (3.39) is rotated in its own plane in linearly polarized light

3.129

mean size

weighted average particle size of any sample

3.130

mechanical sampling

taking of *increments* (3.106) by mechanical means

3.131

mechanical sampling system

operational mechanism and/or mechanical installation for taking *increments* (3.106) and *sample preparation* (3.195)

3.132

mechanical strength

measure of the strength of *coke* (3.42) by applying mechanical stresses in a rotating drum

3.133

melting interval

interval between the *hemisphere temperature* (3.98) and the *flow temperature* (3.75)

3.134

micum index

mass fraction expressed as a percentage of a specially prepared sample of *coke* (3.42) remaining on a test sieve of 40 mm nominal size of openings (round hole) and passing a test sieve of 10 mm nominal size of openings (round hole), denoted by M_{40} and M_{10} , respectively, after the sample has been subjected to 100 revolutions by a specified procedure in a rotating drum

Note 1 to entry: Other indices, e.g. M_{60} and M_{20} , may be reported if required.

3.135

milled coke

coke (3.42) reduced in size by milling (grinding) so that it will meet a *nominal top size* (3.144) of minus 212 μm with minimum fines

3.136

mineral matter

inorganic material, excluding moisture but including *water of constitution* (3.243), in *coal* (3.39) or *coke* (3.42)

Note 1 to entry: Mineral matter is calculated on a mass basis either from a direct determination at low temperature or from the ash yield at high temperature.

3.137

mineral sulfur

sum of the *pyritic sulfur* (3.170) and *sulfate sulfur* (3.222) *coal* (3.39) or *coke* (3.42) sample

Note 1 to entry: For the purposes of this definition, elemental sulfur and monosulfides, which may be present in certain solid mineral fuels, are disregarded.

3.138

minerite

collective term for intergrowths of minerals with different *macerals* (3.121) where the proportion of the total *mineral matter* (3.136) is more than 60 % by volume fraction or if more than 20 % by volume fraction of sulfide minerals are present

3.139

moist

<ash-free basis> means of expressing an analytical result based on a hypothetical condition in which the *coal* (3.39) or *coke* (3.42) is considered to be ash-free but with a moisture mass fraction equal to the *moisture-holding capacity* (3.141)

3.140

moist

<mineral-matter-free basis> means of expressing an analytical result based on a hypothetical condition in which a *coal* (3.39) or *coke* (3.42) sample is mineral-matter-free but with a moisture mass fraction equal to the *moisture-holding capacity* (3.141)

3.141

moisture-holding capacity

moisture mass fraction of a *coal* (3.39) sample in equilibrium with an atmosphere of 96 % to 97 % relative humidity at a temperature of 30 °C determined under specified conditions.

Note 1 to entry: Moisture holding capacity is also referred to as equilibrium moisture.

3.142

moisture in air-dried sample

moisture in the *coal* (3.39) or *coke* (3.42) sample after it has attained approximate equilibrium with the atmosphere to which it is exposed

3.143

moisture in the general analysis sample

moisture mass fraction of the general analysis sample of a *coal* (3.39) or *coke* (3.42) after it has attained approximate equilibrium with the atmosphere in the laboratory and which is removable under specified conditions

3.144

nominal top size

smallest sieve in the *range* (3.173) included in the R 20 series on which not more than 5 % of the sample is retained

Note 1 to entry: See ISO 565, square hole.

Note 2 to entry: See also *top size, upper size* (3.229).

3.145

off-line sample preparation

sample preparation (3.195) performed manually or by mechanical equipment not integral with the *mechanical sampling system* (3.131)

3.146

on-line sample preparation

sample preparation (3.195) by mechanical equipment integral with the sampling system

3.147

organic coal substance

part of a *coal* (3.39) which contains all of the organically combined carbon, hydrogen, nitrogen, oxygen and sulfur.

Note 1 to entry: Also includes other organically combined elements in plant tissue such as calcium, magnesium, iron, phosphorus, potassium and some trace elements.

3.148

organic hydrogen

hydrogen in the organic matter of a *coal* (3.39) or *coke* (3.42) sample

3.149

organic sulfur

sulfur which is bound in the organic matter of a *coal* (3.39) or *coke* (3.42) sample

3.150

outlier

result which meets statistical criteria identifying it as an outlier, using, for example, Cochran's maximum variance test, and for which there is direct physical evidence of causation by gross deviation from the prescribed experimental procedure

3.151

oxidizing atmosphere

gaseous medium consisting of oxygen, air, carbon dioxide, water vapour or a mixture of these, irrespective of the proportions used

3.152

oxyreactivity

rate of reaction of a solid mineral fuel with oxygen under specified conditions

3.153

partial sample

sample representative of a part of the whole *sub-lot* (3.221), constituted in order to prepare *laboratory samples* (3.114) or *test samples* (3.226)

Note 1 to entry: A partial sample may be obtained by combining all increments from a *sub-lot* (3.221) into two or more sets, each set being composed of consecutive increments, the number of which need not be the same in all sets.

3.154

particle size

size of the sieve opening in which the particle is retained (i.e. does not pass)

Note 1 to entry: This may refer to sieves with round or square shaped holes. The shape of the holes shall be stated.

3.155

particle size reduction

process of crushing or grinding the sample to reduce the *particle size* (3.154)

3.156

particulate block

solid block consisting of particles of crushed *coal* (3.39) representative of the sample, bound in resin, cast in a mould and with one face ground and polished

3.157

pass

<in sample division> passage of an *increment* (3.106) or a sample once through a sample divider

3.158

petrography

description of the macroscopic and microscopic characteristics of rocks including *coal* (3.39) or *coke* (3.42) and including the textures and composition of the individual constituents and their classification and assessment

Note 1 to entry: In its narrower sense, petrography covers the microscopic examination analysis and measurement of *coal* (3.39) and *coke* (3.42).

3.159

petroleum coke

solid agglomerated product consisting principally of carbon, obtained most often by thermal cracking of materials derived from petroleum.

Note 1 to entry: to entry For *coke* (3.42) produced from coal, see *coke* (3.42)

Note 2 to entry: to entry The scope of ISO Standards for *coal* (3.39) and *coke* (3.42) is not applicable to petroleum cokes. The definition for petroleum coke is included for reference and clarification.

3.160

physical sample

sample taken specifically for the determination of physical characteristics, e.g. *size analysis* (3.205) or strength indices

3.161

pillar sample

section of a seam taken in the form of a block or series of blocks of *coal* (3.39) with associated inorganic rock which when arranged in correct vertical sequence, represent a true section of the seam

Note 1 to entry: Where the full section of the seam is not accessible or not required, this term refers to a sample taken either from a specifically defined portion of the seam, or from the floor to roof as mined or exposed.

3.162

plastic range

difference between the initial softening temperature and the *solidification temperature* (3.214), in the Gieseler Plastometer test

3.163

ply sample

sample taken from an individual ply or leaf or from a series of plies or leaves of a coal seam

3.164

porosity of coke

ratio of the volume of the voids within a piece of *coke* (3.42) to its apparent volume

Note 1 to entry: It is the difference between the *true relative density* (3.236) and the *apparent relative density* (3.10) of a sample of coke expressed as a proportion of the true relative density.

3.165

post reaction strength

measure of the residual strength of a *coke* (3.42) after it has been subjected to a *reactivity* (3.175) test

3.166

precision

closeness of agreement between independent test results obtained under stipulated conditions

Note 1 to entry: It is often defined using an index of precision, such as two standard deviations.

Note 2 to entry: A determination may be made with great precision, and the standard deviation of a number of determinations on the same sampling unit may therefore be low, but the results will be accurate only if they are free from *bias* (3.18).

3.167

primary increment

increment (3.106) taken at the first stage of sampling, prior to any *sample division* (3.194) and/or *sample reduction* (3.196)

3.168

production seam profile sample

sample taken from the section of the seam being worked

3.169

proximate analysis

analysis of a solid mineral fuel reported in terms of moisture in the analysis sample, *volatile matter* (3.239), *ash* (3.11) and *fixed carbon* (3.71)

Note 1 to entry: Analysis carried out on equilibrated samples crushed to minus 212 µm, such as the *general analysis test sample* (3.90) and/or individual *sub-lot* (3.221) samples, lot samples, etc.

3.170

pyritic sulfur

sulfur present in the *mineral matter* (3.136) of a *coal* (3.39) or *coke* (3.42) samples pyrite or marcasite

3.171

random error

error (3.68) that is statistically independent of previous errors

Note 1 to entry: This implies that any two errors in a series of random errors are uncorrelated, and that individual errors are unpredictable in consequence of the partitioning of error into systematic (bias) and random components. The theoretical mean of the random errors is zero. Whereas individual errors are unpredictable, the mean of the random errors in a series of observations tends towards zero as the number of observations increases.

3.172

random reflectance

microscopically determined *reflectance* (3.177) of the polished surface of a *maceral* (3.121) (usually vitrinite) determined in non-polarized white light at 546 nm

3.173

range

difference between the greatest and least values of a number of observations

3.174

rank

position of a *coal* (3.39) in the *coalification* (3.40) series indicating maturity in terms of chemical and physical properties

Note 1 to entry: Higher rank coals are of greater maturity.

3.175

reactivity

rate of reaction of a *coal* (3.39) sample with a given agent under specified conditions

Note 1 to entry: See also *carboxyreactivity* (3.34), *hydroreactivity* (3.103) and *oxyreactivity* (3.152).

3.176

reducing atmosphere

gaseous medium consisting of a mixture of carbon monoxide and carbon dioxide, or a mixture of hydrogen and carbon dioxide, irrespective of the proportions used

3.177

reflectance

percentage of the normal incident light reflected from a polished surface

Note 1 to entry: In the context of organic *petrography* (3.158), reflectance refers to the microscopically determined percentage of incident white light reflected from the polished surface of macerals (usually vitrinite) under oil immersion at 546 nm.

3.178

reflectance standard

polished surface of a material of known *reflectance* (3.177) which is used for calibrating reflectance measuring equipment

Note 1 to entry: It is essential that the reflectance standard meets stringent requirements with regard to the properties of the material of which it is composed, and the way in which it is mounted and prepared.

3.179

relative density of the analysis sample

ratio of the mass of a volume of a representative sample, ground to pass a 212 μm aperture sieve, to the mass of an equal volume of water at the same temperature

3.180

repeatability

precision (3.166) under *repeatability conditions* (3.181)

3.181

repeatability conditions

conditions where independent observed values or test results are obtained with the same method on identical test material in the same laboratory by the same operator using the same equipment within short intervals of time

3.182

repeatability critical difference

value less than or equal to which the absolute difference between two final values, each representing a series of observed values or test results obtained under *repeatability conditions* (3.181), may be expected to be, with a specified probability

Note 1 to entry: Examples of final values are the mean and the median of the series of observed values or test results. The series itself may consist of only one single observation.

3.183

repeatability limit

value less than or equal to which the absolute difference between two single observed values or test results obtained under *repeatability conditions* (3.181) may be expected to be, with a probability of 95 %

Note 1 to entry: The symbol used is γ .

Note 2 to entry: The repeatability limit corresponds to the *repeatability critical difference* (3.182) for two single observed values or test results and a probability of 95 %.

3.184

repeatability standard deviation

standard deviation (3.216) of observed values or test results obtained under *repeatability conditions* (3.181)

Note 1 to entry: It is a measure of the dispersion of the distribution of observed values or test results under repeatability conditions.

Note 2 to entry: Similarly, "repeatability variance" and "repeatability coefficient of variation" can be defined and used as measures of the dispersion of observed values or test results under repeatability conditions.

3.185

replicate sampling

taking from the *sub-lot* (3.221) of *increments* (3.106) which are combined in rotation into different containers to give two or more samples of approximately equal mass, each being representative of the whole *sub-lot* (3.221)

Note 1 to entry: See also *duplicate sampling* (3.67).

3.186

reproducibility

precision (3.166) under *reproducibility conditions* (3.187)

3.187

reproducibility conditions

conditions where observed values or test results are obtained with the same method on identical test material in different laboratories with different operators using different equipment

3.188

reproducibility critical difference

value less than or equal to which the absolute difference between two final values, each representing a series of observed values or test results obtained under *reproducibility conditions* (3.187), may be expected to be with a specified probability

Note 1 to entry: Examples of final values are the mean and the median of the series of observed values or test results. The series itself may consist of only one single observation.

3.189

reproducibility limit

value less than or equal to which the absolute difference between two single observed values or test results obtained under *reproducibility conditions* (3.187) may be expected to be with a probability of 95 %

Note 1 to entry: The symbol used is *R*.

Note 2 to entry: The reproducibility limit corresponds to the *reproducibility critical difference* (3.188) for two single observed values or test results and a probability of 95 %.

3.190

reproducibility standard deviation

standard deviation (3.216) of observed values or test results obtained under *reproducibility conditions* (3.187)

Note 1 to entry: It is a measure of the dispersion of the distribution of observed values or test results under reproducibility conditions.

Note 2 to entry: Similarly, "reproducibility variance" and "reproducibility coefficient of variation" could be defined and used as measures of the dispersion of observed values or test results under reproducibility conditions.

3.191

riffle

non-mechanical divider in which the material is divided by means of alternate parallel slots, each of the same width, feeding into two opposite and separate containers

Note 1 to entry: Care is taken in distributing the feed evenly so that all slots have an equal chance in the division. Closed types with holding hoppers and gate mechanisms to smooth the feed to the riffle are recommended.

3.192

sample (noun)

portion taken from a *lot* (3.118) or *sub-lot* (3.221) to be representative of it with regard to the characteristic to be investigated

3.193

sample (verb)

process of taking a portion of a material which is representative of the whole

3.194

sample division

process in *sample preparation* (3.195) whereby the sample is divided into separate representative portions, one or more of which is retained

3.195

sample preparation

process of bringing samples to the condition required for analysis or testing

Note 1 to entry: Sample preparation covers mixing, sample division, particle size reduction and sometimes air drying of the sample and may be performed in several stages.

3.196

sample reduction

process in *sample preparation* (3.195) whereby the *particle size* (3.154) of the sample is reduced by *crushing* or *grinding* (3.54)

3.197

sampling frame

parallel-sided frame used for taking a stopped-belt increment of a *coal* (3.39) or *coke* (3.42)

Note 1 to entry: The distance between the parallel sides of the frame should be not less than 3,0 times the nominal top size of the solid mineral fuel. However, the minimum width between the parallel sides is 30 mm (all nominal top sized coal at minus 10,0 mm) to avoid blockages and to ease the extraction of the sample

3.198

sapozhnikov

Russian method of determining plastometric parameters such as “y” plastic thickness and “x” plastometric shrinkage

Note 1 to entry: See GOST 1186-87.

3.199

seam section

sample of a *coal* (3.39) seam taken from roof to floor, either as one representative mass or split into a number of subsections of different qualities

3.200

segregation

accidental separation of particles of different physical characteristics

Note 1 to entry: It takes place when fuel particles are in motion which have differences in size, shape, moisture and electrostatic properties.

3.201

shale

generic term for certain fine-grained sedimentary rocks, commonly occurring as an impurity in *coal* (3.39) seams

Note 1 to entry: This term should not be used as a general term for washery rejects.

3.202

shatter index

percentage of a specially prepared sample of *coke* (3.42) remaining on a test sieve of stated size of openings after the sample has been subjected to a specified dropping test

3.203

sieving test machine

machine designed to simulate the *hand shaking* (3.96) procedure specified in the method for carrying out a *size analysis* (3.205)

3.204

silica ratio

ratio of the mass of silica to the total mass of silica, iron(III) oxide, calcium oxide and magnesium oxide in *ash* (3.11)

Note 1 to entry: The ratio is a mass fraction expressed as a percentage.

Note 2 to entry: This ratio gives an indication of the refractoriness of the ash and the tendency to form slag.

3.205

size analysis

DEPRECATED: sieve analysis

process or the result of the separation of a sample into *size fractions* (3.209) with defined limits, the proportions of the fractions being expressed as percentages of the total sample

3.206

size analysis sample

sample taken specifically for *particle size* (3.154) analysis.

3.207

sized coal

DEPRECATED: graded coal

coal (3.39) which has been screened between two specified sizes

3.208

size distribution

DEPRECATED: size consist

proportions of various *particle sizes* (3.154) in a product

3.209

size fraction

part of the sample belonging to a specified *size range* (3.210) limited by either one or two sieve sizes

3.210

size range

top size (3.229) (upper-size) and the bottom size (lower size) of a coal (3.39) or coke (3.42)

3.211

slagging factor

measure of the tendency of *ash* (3.11) to form fused deposits in the radiant zone of a furnace

3.212

small coal

DEPRECATED: smalls

coal (3.39) with a specified *nominal top size* (3.144) but with no lower size limit

Note 1 to entry: The nominal top size is usually between 50 mm and 4 mm.

3.213

small coke

coke (3.42) with *nominal top size* (3.144) of 20 mm or smaller

3.214

solidification temperature

temperature at which the stirring shaft stops in the Gieseler Plastometer test

3.215

sphere temperature

temperature at which the height is equal to the width of the base in the ash fusion test

3.216

standard deviation

positive square root of the *variance* (3.238)

Note 1 to entry: This term is usually designated as *s*.

3.217

stratified random sampling

taking of an *increment* (3.106) at random within the mass interval or time interval determined for mass basis sampling or *time basis sampling* (3.228), respectively

3.218

strip mixing and splitting method

method of *sample division* (3.194), in which splitting sections are taken using a *sampling frame* (3.197) from a strip of sample to be divided

Note 1 to entry: A single strip sample may often be regarded as being too small to guarantee that all horizons of the seam are adequately represented. However, a number of such samples may be taken to achieve better representativity in a variable seam.

3.219

strip sampling

sample similar to a *channel sample* (3.35) but smaller in cross section

3.220

struck levelling

method of levelling the surface of a *coal* (3.39) or *coke* (3.42) sample in a container when determining *bulk density* (3.25), whereby a straight edge is slid across the top of the container, any piece of *coal* (3.39) or *coke* (3.42) which touches the straight edge being removed

3.221

sub-lot

part of a *lot* (3.118) for which a test result is required

Note 1 to entry: There may be two or more sub-lots per lot

3.222

sulfate sulfur

sulfur present in the *mineral matter* (3.136) of a *coal* (3.39) or *coke* (3.42) sample as sulfate

3.223

sulfur in ash

sulfur which is present in the *ash* (3.11) after a *coal* (3.39) sample is burnt under specified controlled conditions

3.224

systematic sampling

taking of *increments* (3.106) at equal intervals of time, space or mass over the whole *lot* (3.118) or *sub-lot* (3.221), the first increment being taken at random within the first such interval

3.225

test portion

quantity of material taken from the *test sample* (3.226) and used for one determination

3.226

test sample

sample which is prepared to meet the requirements of a specific test

3.227

thermal stability

dimensional stability of a sample of *coal* (3.39) heated under specified conditions

3.228

time basis sampling

taking of *increments* (3.106), whereby the position of each increment to be collected from the stream is measured by a time interval and the increment mass is proportional to the flow rate at the time the increment is taken

Note 1 to entry: Each increment or *divided increment* (3.62) constituting the partial sample or the *gross sample* (3.94) should be of a mass proportional to the flow rate of the solid mineral fuel stream at the time of taking the increment.

3.229

top size

upper size

size corresponding to the 5th percentile on the cumulative *size distribution* (3.208) curve of a material, i.e. the largest sieve size on which 5 % of the material is retained

3.230

total carbon

sum of the carbon in the organic matter and the carbon in the *mineral matter* (3.136) of a *coal* (3.39) or *coke* (3.42) sample