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Cleaning of air and other gases — Terminology

Épuration de l'air et autres gaz — Terminologie

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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 documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 142, *Cleaning equipment for air and other gases*.

This second edition of ISO 29464 cancels and replaces the first edition (ISO 29464:2011), which has been technically revised.

Cleaning of air and other gases — Terminology

1 Scope

This document establishes a terminology for the air filtration industry and comprises terms and definitions only.

This document is applicable to particulate and gas phase air filters and air cleaners used for the general ventilation of inhabited enclosed spaces. It is also applicable to air inlet filters for static or seaborne rotary machines and UV-C germicidal devices.

It is not applicable to cabin filters for road vehicles or air inlet filters for mobile internal combustion engines for which separate arrangements exist. Dust separators for the purpose of air pollution control are also excluded.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

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

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1 General, applicable to both particulate and gas-phase air cleaners

3.1.1
air cleaner
device intended to remove *contaminants* (3.1.8) from air in a ventilation system or enclosed space

3.1.2
air velocity
rate of air movement

Note 1 to entry: It is expressed in m/s (fpm) to three significant figures.

3.1.3
bypass
air filter bypass
sneakage
proportion of the *challenge air stream* (3.5.13) that passes around an *air cleaner* (3.1.1) without interacting with the air cleaner

3.1.4
calibrate
to compare readings from the instrument to be calibrated with those from a reference device

3.1.5
capture
extraction of particles, liquid particles or gases, close to their sources for purposes of collection or sampling

3.1.6
classification
allocation of filters into groups and classes according to relevant aspects of their filtration performance

3.1.7
concentration
quantity of one substance dispersed in a defined amount of another

3.1.8
contaminant
pollutant
substance (solid, liquid or gas) that negatively affects the intended use of a fluid

3.1.9
contamination
pollution
presence of a substance that negatively affects the intended use of a fluid

3.1.10
decontamination factor
ratio of the *contaminant* (3.1.8) concentration or particle number upstream of the test device to the contaminant *concentration* (3.1.7) or particle number downstream of the device

Note 1 to entry: The decontamination factor can also be expressed as 1/(1 – overall efficiency) or as 1/penetration.

3.1.11
downstream
area or region into which fluid flows on leaving the test device

3.1.12
efficiency
filter efficiency
fraction or percentage of a challenge *contaminant* (3.1.8) that is removed by a test device

3.1.13
average efficiency
value of efficiency which results from averaging the efficiencies determined over a number of discreet intervals up to the final pressure differential

3.1.14
effluent
fluid discharged from a given source into the external environment

Note 1 to entry: This is a general term describing any fluid discharged from a given source; in this context, the discharged fluid may be liquid or gaseous and may contain associated liquid and/or particulate *contaminants* (3.1.8).

3.1.15
face velocity
filter face velocity
volumetric air flow rate divided by the *nominal filter face area* (3.1.18)

Note 1 to entry: filter face velocity is expressed in m/s.

3.1.16
filter
air filter
device for separating solid or liquid particles or gaseous *contaminant* (3.1.8) from an air stream passing through the device

Note 1 to entry: The device is generally formed of a layer or layers of porous, fibrous or granular material.

Note 2 to entry: Air being cleaned by a filter must pass through the filter, whereas an *air cleaner* (3.1.1) can reduce air *contamination* (3.1.9) by any method.

3.1.17
filter face area
cross-sectional face area of the filter including the header frame when viewed from the direction of air flow using exact dimensions

3.1.18
nominal filter face area
cross-sectional face area of the filter including the header frame when viewed from the direction of air flow using nominal dimensions

3.1.19
filter insert
replaceable part of a filter which contains the filter medium but which can only operate mounted inside a frame

3.1.20
filter medium
material separating *particulate matter* (3.2.139) from gases and characterized by its separating structure and its structural and/or textile-technological characteristics

3.1.21
filter medium area
area of *filter medium* (3.1.20) contained in the filter

Note 1 to entry: For filters with pleats or folds, the filter medium area may be much larger than the *filter face area* (3.1.17).

3.1.22
effective filter medium area
effective filtering area
exposed filter area
area of the *filter medium* (3.1.20) contained in the filter through which air passes during operation

Note 1 to entry: This excludes areas covered by sealant, spacers, struts, etc.

Note 2 to entry: Effective filter medium area is expressed in m^2.

3.1.23
filter medium velocity
media velocity
medium velocity
volumetric air flow rate divided by the *effective filter medium area* (3.1.22) of the *filter element* (3.2.77)

Note 1 to entry: Filter medium velocity is expressed in m/s.

Note 2 to entry: In devices where the filter medium surface area has been increased by use of pleats, folds or bags, the filter medium velocity may be much less than the *filter face velocity* (3.1.15).

3.1.24
flow rate
air flow rate
volume of air flowing through the filter per unit time

3.1.25
nominal flow rate
nominal air flow rate
air flow rate specified by the manufacturer

3.1.26
air flow rate, test
test air flow rate
test flow
test flow rate
test volume flow rate
air flow rate used for testing

Note 1 to entry: The flow rate is usually expressed in volumetric units (m^3/s).

Note 2 to entry: Test flow rate may differ from the manufacturer's rated flow through the air cleaner.

3.1.27
rated flow
flow rate through a test device, either as stated by the manufacturer for defined conditions of use or as agreed between the interested parties for a particular installation

Note 1 to entry: The manufacturer's rated flow may differ from the *test air flow rate* (3.1.26).

3.1.28
gas
substance whose vapour pressure is greater than the *ambient pressure* (3.5.50) at ambient temperature

3.1.29
header frame
integral rigid frame of a filter enabling it to be fastened and sealed against the *holding frame* (3.1.30)

3.1.30
holding frame
rigid structural frame, part of an air handling system into which filters are fastened and sealed

3.1.31
housing
device used to hold filter

3.1.32
hood
inlet device for extraction system

3.1.33
leak
point in a filter at which the local penetration exceeds a given value

3.1.34
penetration
breakthrough
ratio of contaminant concentration downstream of the test device to the upstream (challenge) *concentration* (3.1.7)

Note 1 to entry: Sometimes expressed as a percentage.

Note 2 to entry: Penetration is related to efficiency (E) by the expression: $E = (1 - P) \times 100$ %.

Note 3 to entry: Penetration is related to the *decontamination factor* (DF) (3.1.10) by the expression: DF = 1/penetration.

3.1.35
reference device
primary device possessing accurately known parameters used as a standard for calibrating secondary devices

Note 1 to entry: Reference particle filters are laboratory tested for *removal efficiency by particle size* (3.2.149) and/or resistance to air flow.

3.1.36
resistance to air flow
differential pressure
pressure differential
pressure drop
difference in absolute (static) pressure between two points in a system

Note 1 to entry: Resistance to air flow is measured in Pa.

3.1.37
test air
air to be used for testing purposes

3.1.38
test device
filter element (3.2.77) being subjected to performance testing

3.1.39
upstream
area or region from which fluid flows as it enters the *test device* (3.1.38)

3.1.40
washer
dust separator (3.2.158), *droplet separator* (3.2.157) or *gas purifier* (3.5.38) that depends on a liquid acting as a collecting medium for its operation

3.2 Particulate filters (including general ventilation, HEPA and ULPA filters)

3.2.1
aerosol
system of solid or liquid particles suspended in gas

Note 1 to entry: In general, one divides the atmospheric aerosol into three size categories: the ultrafine range $x < 0{,}1$ µm, the fine range $0{,}1$ µm $\leq x < 1$ and the coarse range $x \geq 1$ µm, whereby x is the *particle diameter* (3.2.124).

3.2.2
liquid phase aerosol
liquid particles suspended in a gas

3.2.3
monodisperse aerosol
aerosol, the width of whose distribution function, described by the geometric standard deviation σg, is less than 1,15 µm

3.2.4
aerosol photometer
light-scattering airborne particle mass *concentration* (3.1.7) measuring apparatus, which uses a forward-scattering-light optical chamber to make measurements

3.2.5
polydisperse aerosol
aerosol, the width of whose distribution function, described by the geometric standard deviation σg, exceeds 1,5 µm

3.2.6
quasi-monodisperse aerosol
aerosol, the width of whose distribution function, described by the geometric standard deviation σg, is between 1,15 µm and 1,5 µm

3.2.7
reference aerosol
defined approved aerosol for test measurement within a specific size range

3.2.8
solid phase aerosol
solid particles suspended in a gas

3.2.9
test aerosol
aerosol used for determining performance of the device being tested and for calibrating particle measurement devices

3.2.10
agglomerate
collection of solid particles adhering to each other

3.2.11
agglomeration
action leading to the formation of *agglomerates* (3.2.10)

3.2.12
agglutination
action of joining, by *impact* (3.2.102), solid particles coated with a thin adhesive layer or of trapping solid particles by impact on a surface coated with adhesive

3.2.13
aggregate
relatively stable assembly of dry particles, formed under the influence of physical forces

3.2.14
arrestance
measure of the ability of a filter to remove a standard test dust from the air passing through it, under given operating conditions

Note 1 to entry: This measure is expressed as a weight percentage.

3.2.15
average arrestance
ratio of the total amount of loading dust retained by the filter to the total amount of dust fed up to final test pressure differential

3.2.16
average gravimetric arrestance
ratio of the total mass of a standard test dust retained by the filter to the total mass of dust fed up to final test pressure differential

3.2.17
gravimetric arrestance
measure of the ability of a filter to remove mass of a standard test dust from the air passing through it under given operating conditions

Note 1 to entry: This measure is expressed as a weight percentage.

3.2.18
initial arrestance
value of arrestance determined after the first loading cycle in a filter test

Note 1 to entry: For example, in ISO 29461-1 or ISO 16890-3 procedure.

Note 2 to entry: This measure is expressed as a weight percentage.

3.2.19
initial gravimetric arrestance
ratio of the mass of a standard test dust retained by the filter to the mass of dust fed after the first loading cycle in a filter test

Note 1 to entry: This measure is expressed as a weight percentage.

3.2.20
ash
solid residue of effectively complete combustion

3.2.21
fly ash
ash entrained by combustion gases

3.2.22
bioaerosol
particles of biological origin with an aerodynamic diameter of up to 100 µm suspended in a gaseous medium

Note 1 to entry: Bioaerosol particles include viruses, bacteria, fungi, pollen, plant debris, fragments of these and their derivatives such as endotoxins, glucans, allergens and mycotoxins.

3.2.23
burst pressure
value of differential pressure across a filter, above which damage/destruction of the *filter medium* (3.1.20) or the structure occurs

3.2.24
calibration particle
mono-disperse spherical particle with a known mean particle size, e.g. polystyrene latex (PSL) particle traceable to an international standard of length where the standard uncertainty of the mean particle size is equal to or less than ±2,5 %

Note 1 to entry: The refractive index of (PSL) calibration particles is close to 1,59 at a wavelength of 589 nm (sodium D line).

3.2.25
dust holding capacity
DHC
total weight of loading dust captured by the air-cleaning device up to the final pressure differential

3.2.26
test dust capacity
dust loading capacity
TDC
amount of a standard test dust held by the test device at the final test pressure differential

3.2.27
cleaning
<after clogging> removal of the deposit of solid or liquid particles which has produced clogging

3.2.28
clogging
deposition, progressive or otherwise, of solid or liquid particles on or within a *filter medium* (3.1.20), causing the flow to be obstructed

3.2.29
coagulation losses
particle losses due to collision and adhesion of particles

Note 1 to entry: Coagulation affects the measured particle parameters as follows: the *particle number concentration* (3.2.131) decreases, the particle mass *concentration* (3.1.7) remains the same and the *particle size* (3.2.133) increases.

3.2.30
coalescence
action by which liquid particles in *suspension* (3.2.162) unite to form larger particles

3.2.31
coefficient of variation
CV
standard deviation of a group of measurements divided by the mean

3.2.32
coincidence error
error which occurs because at a given time more than one particle is contained in the measurement volume of a particle counter

Note 1 to entry: The coincidence error leads to a measured number *concentration* (3.1.7) which is too low and a value for the *particle diameter* (3.2.124) which is too high.

3.2.33
correlation ratio
calculation of any potential bias between the upstream and downstream sampling systems

3.2.34
correlation ratio
<sampling points>downstream particle concentration divided by the upstream particle concentration (measured without filter)

3.2.35
counting efficiency
expression of that proportion of the particles of detectable size suspended in the volume flow under analysis that make their way through the measured volume and are counted by the particle counter

EXAMPLE The ratio of the *concentration* (3.1.7) measured to actual aerosol concentration.

Note 1 to entry: The counting efficiency depends on the *particle size* (3.2.133) and decreases progressively in the proximity of the lower detection limit of the particle counter.

3.2.36
counting rate
number of counting events per unit time

3.2.37
cyclone
dust separator (3.2.158) or *droplet separator* (3.2.157) utilizing essentially the centrifugal force derived from the motion of the gas

3.2.38
DiEthylHexylSebacate
DEHS
liquid used for generating the DEHS *test aerosol* (3.2.9)

3.2.39
equivalent diameter
diameter of a spherical particle which will give behaviour equivalent to that of the particle being examined

3.2.40
median diameter
diameter of the particle for which the cumulated volume fraction is equal to 50 % on a cumulated volume particle size distribution curve

3.2.41
count median diameter of aerosol
number median diameter of aerosol
CMD
50th percentile of the number distribution of the aerosol

Note 1 to entry: 50 % of the particles are smaller than the count median diameter and 50 % are larger than the count median diameter.

3.2.42
final differential pressure
differential pressure up to which the filtration performance is measured for *classification* (3.1.6) purposes

3.2.43
initial differential pressure
differential pressure of the clean filter operating at its *test air flow rate* (3.1.26)

3.2.44
mean differential pressure
arithmetical mean value of the measured number of differential pressures

3.2.45
recommended final differential pressure
maximum operating differential pressure of the filter as recommended by the manufacturer

3.2.46
diluter
dilution system
system for reducing the sampled *concentration* (3.1.7) to avoid coincidence error in the particle counter

3.2.47
dispersion
operation as a result of which solid particles or liquid particles are distributed in a fluid

Note 1 to entry: Also applied to a two-Phase System in which one phase, known as the “disperse phase”, is distributed throughout the other, known as the “continuous medium”. For example, Dioctyl phthalate (DOP) liquid or liquids with similar physical properties, are dispersed in air to generate a *test aerosol* (3.2.9).

3.2.48
D.O.P.
dispersed oil particulates

3.2.49
DOP
dioctyl phthalate

3.2.50
droplet
liquid particle of small mass, capable of remaining in *suspension* (3.2.162) in a gas

Note 1 to entry: In some turbulent systems, for example clouds, its diameter can reach 200 µm.

3.2.51
dust
airborne solid particles which settle by gravity in calm conditions

3.2.52
dust control
whole of the processes for the separation of solid particles from a gas stream in which they are suspended

Note 1 to entry: By extension, also the activities involved in the construction and commissioning of a *dust separator* (3.2.158).

3.2.53
dust feeder
device which is used to distribute test dust to the filter

3.2.54
loading dust
synthetic test dust
synthetic dust formulated specifically for determination of the test dust capacity and arrestance of *air filters* (3.1.16)

Note 1 to entry: A number of loading dusts are currently in use. Some of them are defined in ISO 15957:2015.

3.2.55
collection efficiency
ratio of the quantity of particles retained by a *separator* (3.2.156) to the quantity entering it with regard to *filters* (3.1.16), *dust separators* (3.2.158) and *droplet separators* (3.2.157)

Note 1 to entry: This measure is normally expressed as a percentage.

3.2.56
conditioned efficiency
efficiency of the conditioned filter medium operating at an average medium velocity corresponding to the *test air flow rate* (3.1.26) in the filter

Note 1 to entry: The conditioning procedure varies depending on the standard being used.

3.2.57
counting efficiency
ratio, expressed as a percentage, of detected number *concentration* (3.1.7) of particles divided by the actual number concentration of particles in a given size or range of sizes

3.2.58
dust loaded efficiency
efficiency of the filter operating at test flow rate and after dust loadings up to final test pressure differential

3.2.59
fractional efficiency
ability of an air cleaning device to remove particles of a specific size or size range

Note 1 to entry: The efficiency plotted as a function of particle size gives the particle size efficiency spectrum.

3.2.60
initial efficiency
initial particulate efficiency
efficiency of the air cleaning device measured at the start of a performance test while operating at the *test air flow rate* (3.1.26)

Note 1 to entry: Expressed in % for each selected size of particle.

3.2.61
integral efficiency
overall efficiency
efficiency, averaged over the whole superficial face area of a filter under given operating conditions

3.2.62
local filter efficiency
efficiency at a specific point of a *filter element* (3.2.77) under given operating conditions

3.2.63
minimum filter efficiency
minimum value of the filter efficiency curve under given operating conditions

3.2.64
particle size efficiency (%)
efficiency for a specific particle diameter

Note 1 to entry: The efficiency plotted as a function of the *particle diameter* (3.2.124) gives the fractional efficiency curve.

3.2.65
elutriation
method of separating a mixture of particles according to their settling velocities within a fluid

3.2.66
superficial face area
cross-sectional area of the *filter element* (3.2.77) through which the air flow passes

3.2.67
brush filter
air filter (3.1.16) in which the medium consists of a screen of intermeshing brushes

3.2.68
cartridge filter
compact filter often of cylindrical design

3.2.69
cellular filter
replaceable *filter insert* (3.1.19) which is or may be installed in a multiple bank or wall structure

Note 1 to entry: Examples of these are *HEPA filters* (3.2.84), rigid bags and panels.

3.2.70
ceramic filter
filter with a medium consisting of ceramic fibres or sintered porous ceramic

3.2.71
charged filter
electret filter
filter with an electrostatically charged medium

3.2.72
filter class
range of filtration performances clearly defined by lower and upper limit values

3.2.73
cleanable filter
filter designed to permit the removal of collected dust by application of an appropriate technique

Note 1 to entry: The removal of collected dust is usually partial.

3.2.74
coarse filter
filtration device with particle *removal efficiency* (3.5.26) < 50 % in the PM_{10} particle range

3.2.75
disposable filter
filter which is not intended to be cleaned or regenerated for reuse

3.2.76
efficient particulate air filter
EPA filter
filter with performance complying with requirements of classes ISO 15 to ISO 30 as given in ISO 29463-1

3.2.77
filter element
structure made of the filtering material, its supports and its interfaces with the filter housing

3.2.78
fabric filter
filter medium (3.1.20) manufactured either from woven or non-woven textile or a combination of both

Note 1 to entry: The term is most often applied to dust collectors. In these devices the filtering is effectively carried out by a bed of deposited dust, the textile providing a supporting substrate.

3.2.79
fibrous filter
filter comprising a medium consisting of a mass of fibres, including fine and very fine fibres

Note 1 to entry: The efficiency of these filters is derived from the presence of very fine fibres which are supported by coarser fibres in a relatively open structure.

Note 2 to entry: Fibrous filters are usually disposable.

3.2.80
final filter
air filter (3.1.16) used to collect the loading dust passing through or *shedding* (3.2.159) from the filter under test

3.2.81
fine filter
filtration device with particle removal efficiency ≥50 % in the PM_{10} particle range

3.2.82
filter group designation
designation of a *group of filters* (3.2.83) fulfilling certain requirements in the filter classification

Note 1 to entry: ISO 16890-1 defines four groups of filters. Group designations are “ISO coarse”, “ISO *e*PM10”, “ISO *e*PM2,5” and “ISO *e*PM1”.

3.2.83
group of filters
comprises filters of more than one adjacent class within a performance spectrum

3.2.84
HEPA filter
filters with performance complying with requirements of *filter class* (3.2.72) ISO 35H – ISO 45H per ISO 29463-1

3.2.85
filter installation
filtration devices and systems such as a single filter or a *group of filters* (3.2.83) mounted together with the same inlet and outlet of air

3.2.86
metal filter
filter with a medium consisting of metal mesh(es), fibres or sintered porous metal

3.2.87
filter pack
filtering material in a preformed shape being a part of a complete filter

3.2.88
panel filter
shallow parallel-faced *filter element* (3.2.77) or cell

3.2.89
particulate air filter
filter designed to remove suspended particles from air flowing through it

3.2.90
pocket filter
bag filter
filter in which the medium is formed into pockets or bags

3.2.91
renewable media filter
filter in which the medium can be replaced

3.2.92
roll filter
filter incorporating a means for advancing new medium

Note 1 to entry: For example, from a roll.

3.2.93
self-cleaning filter
filter having an inbuilt mechanism for removing collected *contaminants* (3.1.8)

3.2.94
filter type
designation of the structure and test regime of a filter

3.2.95
ULPA filter
filter with performance complying with the requirements of classes ISO 50 U – ISO 75 U as given in ISO 29463-1

3.2.96
sampling volume flow rate
representative partial flow rate used for the determination of airborne particle characteristics

3.2.97
service flow
gas flow rate through a *separator* (3.2.156) under given service conditions

3.2.98
folded pack
pack of the *filter medium* (3.1.20) formed by uniform individual folds

3.2.99
fume
solid aerosol generated by condensation, generally after evaporation from melted substances such as metals and often accompanied by chemical reactions such as oxidation

Note 1 to entry: In popular usage, gaseous effluent, often unpleasant and malodorous, which may arise from chemical processes.

3.2.100
general ventilation
process of moving air from outside the space, recirculated air, or a combination of these into or about a space or removing it from the space

3.2.101
grit
airborne solid particles in the atmosphere or flues

Note 1 to entry: In the UK, defined to be of size greater than 75 μm.

3.2.102
impact
collision of two particles with each other, or of a particle with a solid or liquid surface

3.2.103
impaction
inertial separation due to mass and velocity of a particle causing divergence from the airflow stream lines onto individual filter fibres

3.2.104
isoaxial sampling
sampling in which the flow in the sampler inlet is moving in the same direction as the flow being sampled

3.2.105
isokinetic sampling
technique for air sampling such that the probe inlet *air velocity* (3.1.2) is the same as the velocity of the air surrounding the sampling point

3.2.106
KCl
solid potassium chloride particles generated from an aqueous solution and used as *test aerosol* (3.2.9)

3.2.107
measuring procedure with fixed sampling probes
determination of the *overall efficiency* (3.2.61) using fixed sampling probes upstream and *downstream* (3.1.11) of the filter being tested

3.2.108
minimum fractional test efficiency
fractional efficiency measured according to ISO 16890-2 after applying the conditioning method defined in this document (also named as "*minimum filter efficiency*" (3.2.63) or "minimum test efficiency")

3.2.109
mist
suspension (3.2.162) of droplets in a gas

3.2.110
neutralisation
action of bringing the aerosol to a Boltzmann charge equilibrium distribution with bipolar ions

Note 1 to entry: This process is more often described as “discharging”.

3.2.111
particle
small discrete mass of solid or liquid matter

3.2.112
particle bounce
behaviour of particles that impinge on the filter without being retained

3.2.113
particle concentration method
method that can determine the total concentration of particles in the aerosol either by multiple particle counting or chemical concentrations

Note 1 to entry: No particle size classification can be determined by this method.

3.2.114
particle counter
device for detecting and counting numbers of discrete airborne particles present in a sample of air

3.2.115
allowable measurable concentration of the particle counter
fifty percent of the maximum measurable concentration as stated by the manufacturer of the *particle counter* (3.2.114)

3.2.116
particle counter border zone error
particle sizing error that occurs when particles pass through the optical border of the sensing zone and receive less illumination

Note 1 to entry: The border zone error is device and particle size dependent and has a direct effect on the size resolution.

Note 2 to entry: Due to the border zone error, the *particle size* (3.2.133) is underestimated.

Note 3 to entry: The larger the particle to be measured, the bigger the border zone error.

3.2.117
particle counter calibration curve
graph depicting the relationship between scattered light intensity and particle size

Note 1 to entry: For the clear particle size and quantity determination, an unambiguous, monotonically increasing calibration curve offers advantages. This enables narrower size intervals to be chosen.

3.2.118
condensation particle counter
CPC
type of *optical particle counter* (3.2.119) in which very fine airborne particles are enlarged by condensation to a size which may readily be counted by other particle counting methods

Note 1 to entry: It can provide data on *particle numbers* (3.2.130) but not the original size distribution.

Note 2 to entry: ISO committee dealing with CPC is TC 24/SC 4.

3.2.119
optical particle counter
OPC
particle counter which functions by illuminating airborne particles in a sample flow of air, converting the scattered light impulses to electrical impulse data capable of analysis to provide data on particle population and size distribution

Note 1 to entry: See ISO 21501-4.

3.2.120
particle counter sizing accuracy
the sizing accuracy Ɛ(x) is determined by the function:

$$\varepsilon(x) = \frac{x_{\text{measured}} - x_{\text{reference}}}{x_{\text{reference}}} \cdot 100$$

Note 1 to entry: x_{measured} is the particle size indicated by the counter for a reference particle and $x_{\text{reference}}$ is the actual size of the reference particle. Sizes are usually stated in µm.

3.2.121
particle counter sizing resolution
indicates which particle sizes can be differentiated by a particle measuring instrument

Note 1 to entry: The sizing resolution can be evaluated for any particle size as follows:

$$R(x) = \frac{\sqrt{\sigma^2_{\text{measured}}(x) - \sigma^2_{\text{reference}}(x)}}{x_{\text{reference}}} \cdot 100\text{ , } \sigma = \text{geometric standard deviation.}$$

σ_{measured} is the standard deviation of the reference particle size indicated by the particle counter. $\sigma_{\text{reference}}$ is the standard deviation of the reference particle size reported by the reference particle producer. $x_{\text{reference}}$ is the reference particle size reported by its producer.

3.2.122
particle counter sampling flow rate
particle counter sampling air flow
volumetric flow rate through the instrument

Note 1 to entry: Any error in the volumetric flow rate will affect the reported *particle number concentration* (3.2.131).

3.2.123
particle counting and sizing method
particle counting method which allows both the determination of the number of particles and also the classification of the particles according to size

EXAMPLE By using an *optical particle counter* (3.2.119).

3.2.124
particle diameter
geometric diameter (equivalent spherical, optical or aerodynamic, depending on context) of the particles of an aerosol

Note 1 to entry: Particle diameter is often referred to simply as “particle size”.

3.2.125
count mean particle diameter
number mean particle diameter
geometric average of the lower and upper limit of the size range

3.2.126
mean diameter
mean particle diameter
geometric mean of the upper and lower border diameters in a size range

3.2.127
particle flow distribution
distribution of the particle flow over a plane at right angles to the direction of flow

3.2.128
particle flow rate
number of particles that are measured or that flow past a specified cross-section per unit time

3.2.129
particle lower size limit
smallest *particle diameter* (3.2.124) with a counting *efficiency* (3.1.12) of 0,5 ± 0,15 (50 % ± 15 %)

3.2.130
particle number
number of particles present in a defined group

3.2.131
particle number concentration
number of particles per unit of volume of air

3.2.132
particle production rate
number of particles produced per unit time by an aerosol generator

3.2.133
particle size
geometric diameter (equivalent spherical, optical or aerodynamic, depending on context) of the particles of an aerosol

3.2.134
particle size analysis
technique used to measure the size distribution of an assembly of particles

3.2.135
particle size distribution
presentation, in the form of tables of numbers or of graphs, of the experimental results obtained using a method or an apparatus capable of measuring the equivalent diameter of particles in a sample or capable of giving the proportion of particles for which the equivalent diameter lies between defined limits

3.2.136
most penetrating particle size
MPPS
particle size (3.2.133) at which the minimum of the particle size efficiency curve occurs under test conditions

Note 1 to entry: This MPPS is dependent on the *filter medium* (3.1.20) and the test conditions.

3.2.137
particle size range
defined particle counter channel

3.2.138
particle upper size limit
largest *particle diameter* (3.2.124) with a counting efficiency of 0,5 ± 0,15 (50 % ± 15 %)

3.2.139
particulate matter
PM
solid and/or liquid particles suspended in ambient air

3.2.140
particulate matter efficiency
***e*PM$_x$**
efficiency (3.1.12) of an air cleaning device to reduce the mass concentration of particles with an optical diameter between 0,3 µm and *x* µm

3.2.141
particulate matter
PM$_{10}$
particulate matter (3.2.139) which passes through a size-selective inlet with a 50 % efficiency cutoff at 10 µm aerodynamic diameter

3.2.142
particulate matter
PM$_{2,5}$
particulate matter (3.2.139) which passes through a size-selective inlet with a 50 % efficiency cutoff at 2,5 µm aerodynamic diameter

3.2.143
particulate matter
PM$_1$
particulate matter (3.2.139) which passes through a size-selective inlet with a 50 % efficiency cutoff at 1 µm aerodynamic diameter

3.2.144
porous layer
permeable layer of solid material in any form having interstices of small size, generally known as “pores”

3.2.145
precipitation
operation in which particles are separated from a gas stream in which they are suspended

Note 1 to entry: For example, by the action of an electrical field or a thermal gradient.

3.2.146
electrostatic precipitator
device in which particles become charged and are precipitated on the collecting surface

Note 1 to entry: Also referred to as electrostatic collector, electrical separator or electrostatic separator.

3.2.147
purification
total or partial removal of unwanted constituents from a gaseous medium

3.2.148
re-entrainment
release to the air flow of particles previously collected on the filter

3.2.149
removal efficiency by particle size
ratio of the number of particles retained by the filter to the number of particles measured upstream of the filter for a given particle-size range

3.2.150
final resistance to air flow
resistance to air flow up to which the filtration performance is measured to determine the average arrestance and test dust capacity

Note 1 to entry: Final resistance to air flow is measured in Pa.

3.2.151
initial resistance to air flow
resistance to air flow of the clean filter operating at its *test air flow rate* (3.1.26)

Note 1 to entry: Initial resistance to air flow is measured in Pa.

3.2.152
recommended final resistance to air flow
maximum operating resistance to air flow of the filter as recommended by the manufacturer

Note 1 to entry: Recommend final resistance to air flow is measured in Pa.

3.2.153
sampling duration
time during which the particles in the sampling volume flow are counted (upstream or *downstream* (3.1.11))

3.2.154
scan test
test procedure by which local efficiency or penetration values are determined by sampling filtered air at the downstream filter face according to a specified grid pattern

3.2.155
sedimentation
separation of particles from the fluid in which they are suspended, by the action of gravity

3.2.156
separator
apparatus for separating solid or liquid particles or gases from a gaseous stream in which they are suspended or mixed

Note 1 to entry: A separator (also known as an inertial separator or a collector) takes larger *contaminants* (3.1.8) out of the air stream, often to prevent them from reaching filters downstream.

3.2.157
droplet separator
apparatus for separating suspended liquid particles from a gas stream

3.2.158
dust separator
apparatus for separating suspended solid particles from a gas stream

3.2.159
shedding
release to the air flow of particles due to *particle bounce* (3.2.112) and reentrainment effects and to the release of fibres or *particulate matter* (3.2.139) from the filter or filtering material

3.2.160
smoke
solid or liquid aerosol resulting from combustion of organic materials including fossil fuels, wood and cigarettes

3.2.161
soot
deposits of agglomerated carbonaceous particles formed by incomplete combustion

3.2.162
suspension
two-phase system in which one phase, the disperse phase, is distributed throughout the other, known as the continuous phase

3.2.163
system efficiency
removal efficiency (3.5.26) of a filter system where upstream and downstream particle count measurements may be across several filter banks or other system components

3.2.164
total particle count method
particle counting method in which the total number of particles in a certain sample volume is determined without classification according to size

EXAMPLE 1 By using a *condensation particle counter* (3.2.118). [SOURCE: ISO 29463-5:2011]

EXAMPLE 2 By using a condensation nucleus counter. [SOURCE: ISO 29463-4:2011]

3.2.165
transmission
ratio of the quantity of particles leaving a *filter* (3.1.16), *dust separator* (3.2.158) or *droplet separator* (3.2.157), to the quantity entering it

3.2.166
undersize
percentage of particles smaller than a specified *particle size* (3.2.133) in a *particle size distribution* (3.2.135)

Note 1 to entry: Undersize measurement can be *particle number* (3.2.130) or concentration.

3.2.167
user nominal air volume flow rate
air volume flow rate specified by the user, at which the *filter element* (3.2.77) is tested in situ

Note 1 to entry: This flow rate may be different from the one specified by the manufacturer.

3.2.168
user nominal filter medium velocity
air volume flow rate specified by the user divided by the *effective filter medium area* (3.1.22)

3.2.169
zero count rate
number of counts registered per unit time by the particle counter when air, which is free of particles, is passed through the measuring volume

3.3 Air intake particulate filters for rotary machines

NOTE Some of the terms for this type of filter are used in the same way in other documents managed by ISO/TC 142. Such terms are defined in 3.1 or 3.2.

3.3.1
test aerosol
aerosol used for determining the *particulate efficiency* (3.3.6) of the filter

3.3.2
test air flow rate
volumetric airflow rate used for testing

3.3.3
average gravimetric efficiency
ratio of the total amount of loading dust retained by the filter to the total amount of dust fed up to *final test pressure drop* (3.3.15)

Note 1 to entry: This definition is the same as the one used for "arrestance, average" in 3.2.

3.3.4
gravimetric efficiency
weighted (mass) removal of loading dust after 50 g of dust load

3.3.5
minimum efficiency
lowest *particulate efficiency* (3.3.6) of initial, conditioned or dust loaded efficiencies

3.3.6
particulate efficiency
percentage particulate removal efficiency of the filter at specified particle sizes measured with a particle counter in the range of 0,3 µm to 3,0 µm

3.3.7
depth loading filter
filter in which particles penetrate into the *filter medium* (3.1.20) and are collected on the fibres in the depth of the filter medium

3.3.8
low efficiency filter
air filter (3.1.16) with an *initial particulate efficiency* (3.2.60) at 0,4 µm particles in the range $E < 35$ %

3.3.9
medium efficiency filter
air filter (3.1.16) with an *initial particulate efficiency* (3.2.60) at 0,4 µm particles in the range 35 % $\leq E \leq$ 85 %

3.3.10
high efficiency filter
air filter (3.1.16) with an *initial particulate efficiency* (3.2.60) at 0,4 µm particles in the range $E \geq 85$ %

3.3.11
pulse jet filter
cleanable air filter, that typically is cleaned with air jet pulses to provide a longer service life

3.3.12
static filter
air filter (3.1.16) that will be removed (exchanged) after it has reached its *final test pressure drop* (3.3.15) and that is not cleaned with jet pulses or other means in order to fully or partially, retrieve its initial performance (pressure drop and efficiency)

3.3.13
surface loading filter
filter in which the dust is collected on the surface of the *filter medium* (3.1.20)

3.3.14
untreated filter
air filter not submitted to conditioning

3.3.15
final test pressure drop
maximum pressure drop of the filter up to which the filtration performance is measured

3.3.16
recommended final test pressure drop
maximum operating pressure drop of the filter as recommended by the manufacturer at rated airflow

3.3.17
initial pressure drop
pressure drop of the clean filter operating at the test airflow rate

3.4 Cleanable particulate filter degradation

3.4.1
aged flat filter sheet
flat filter sheet exposed under simulated hot and corrosive gas (3.4.7) conditions for a preset period of time to evaluate the change of filtration properties

3.4.2
air permeability
gas volume flow rate per unit filtration area at pressure drop of 124,5 Pa

3.4.3
average gas concentration
mean concentration of *test gases* (3.4.26) during the *exposure* (3.6.4)

3.4.4
batch type exposure chamber
chamber in which filter sheets are exposed to stationary *test gas* (3.4.26) mixture

3.4.5
chemical degradation
degradation (3.4.8) of chemical properties of filter media by the interaction with *test gas* (3.4.26)

3.4.6
continuous-flow-method
method of exposing a filter sheet in a continuous flow of *test gas* (3.4.26) mixture

3.4.7
corrosive gas
chemical which reacts with *filter medium* (3.1.20) and change its chemical and physical properties

3.4.8
degradation
change in physical and chemical performance of a *filter medium* (3.1.20) caused by interaction with *corrosive gases* (3.4.7)

3.4.9
elongation
incremental change in length of test specimen determined by tensile test

3.4.10
elongation at maximum load
incremental change in length of test specimen at maximum load determined by tensile test

3.4.11
elongation ratio
ratio of *elongation* (3.4.9) of test specimen to its initial *length between holders* (3.4.16)

Note 1 to entry: It can be expressed as a percentage.

3.4.12
elongation ratio at maximum load
ratio of *elongation* (3.4.9) of test specimen at maximum load in tensile test to its initial *length between holders* (3.4.16)

3.4.13
exposure chamber
chamber to expose test filter sheet to *corrosive gases* (3.4.7)

3.4.14
flow-through type replacement
method to replace test gas in the *batch type exposure chamber* (3.4.4) by introducing *test gas* (3.4.26) continuously to the chamber

3.4.15
initial load
load applied to the test specimen at the start of tensile test

3.4.16
length between holders
length between the jaws of the top and bottom holding chucks as positioned at the start of the tensile test

3.4.17
load
tensile strength (3.4.25) of test specimen observed in the tensile test

3.4.18
non-continuous-flow-method
method of exposing a filter sheet in a stationary *test gas* (3.4.26) mixture

3.4.19
nonwoven fabric
filter medium (3.1.20) manufactured using fabric made from long fibres bonded together with each other by chemical, mechanical, heat or solvent treatment

3.4.20
number of replacement
number of *test gas* (3.4.26) replacement for whole heating space volume of the test chamber

3.4.21
replacement of gas
exchange gas to maintain *test gas* (3.4.26) concentration within certain concentration range

3.4.22
retention of tensile strength
ratio of *tensile strength* (3.4.25) of the test specimen subjected to thermal and/or acid gas exposure to that of the test specimen without the *exposure* (3.6.4)

3.4.23
strip method
method of implementing tensile test with holding whole width of the test specimen with a holding device

3.4.24
tensile speed
speed to pull a test specimen in tensile test

3.4.25
tensile strength
value of the maximum *load* (3.4.17) divided by the width of test specimen

3.4.26
test gas
gas which may cause changes in physical properties of filter media to be used for tensile test

3.4.27
thermal exposure
exposure (3.6.4) of filter medium to an elevated temperature to accelerate the change in its physical properties

3.4.28
vacuum replacement
method to replace *test gas* (3.4.26) in the *batch type exposure chamber* (3.4.4) by the use of vacuum

3.4.29
woven fabric
filter medium (3.1.20) manufactured using a fabric formed by weaving

3.5 Gas phase air cleaners (GPAC)

3.5.1
absorption
the transport and dissolution of a sorbate into an absorbent to form a mixture having the characteristics of a solution

3.5.2
active site
position on an *adsorbent* (3.5.4) surface with the potential to trap an *adsorbate* (3.5.3) molecule

3.5.3
adsorbate
molecular compound in gaseous or vapour phase that may be retained by an *adsorbent* (3.5.4) medium

3.5.4
adsorbent
material having the ability to retain gaseous or vapour *contaminants* (3.1.8) on its surface by physical or chemical processes

3.5.5
regenerable adsorbent
adsorbent (3.5.4) material which, after saturation, may be treated to recover its adsorption properties thereby enabling its reuse

3.5.6
ageing of adsorbent
chemical or physical process which reduces the effectiveness (efficiency and/or capacity) of an *adsorbent* (3.5.4)

Note 1 to entry: Ageing reduces the number of *active sites* (3.5.2).

3.5.7
adsorption
process in which the molecules of a gas or vapour adhere by physical or chemical processes to the exposed surface of solid substances, both the outer surface and inner pore surface, with which they come into contact

3.5.8
activated alumina
aluminium oxide, usually in the form of granules, treated to enhance its surface area and consequent ability to adsorb gases

3.5.9
bed depth
depth of the *adsorbent* (3.5.4) medium through which the gas being processed passes

Note 1 to entry: See 3.1.34.

3.5.10
breakthrough time
time to reach a specified penetration (x)

Note 1 to entry: Relevant breakthrough times may be defined as penetrations of 5 %, 50 % and 95 % (tb5, tb50, tb95)

Note 2 to entry: Breakthrough time is sometimes referred to as breakthrough point.

3.5.11
breakthrough vs. time curve
plot of *contaminant* (3.1.8) penetration versus time for a particular *challenge concentration* (3.5.14) and airflow

3.5.12
adsorbate capacity
amount (mass or moles) of a selected *adsorbate* (3.5.3) that can be contained in the GPAC Medium or Device under given test conditions and end point (termination time)

Note 1 to entry: Capacity can also be negative during *desorption* (3.5.21).

3.5.13
challenge air stream
test *contaminant*(s) (3.1.8) of interest diluted to the specified concentration(s) of the test prior to filtration

3.5.14
challenge concentration
concentration of the test *contaminant*(s) (3.1.8) of interest in the air stream prior to filtration (*challenge air stream* (3.5.13))

3.5.15
challenge compound
chemical compound that is being used as the *contaminant* (3.1.8) of interest for any given test

3.5.16
channelling
disproportionate or uneven flow of gas through passages of lower resistance due to inconsistencies in the design or production of a GPACD, particularly in packed granular beds

3.5.17
activated charcoal
activated carbon
carbon, usually in the form of granules, treated to enhance its surface area and consequent ability to adsorb gases through a highly developed pore structure

Note 1 to entry: Usually produced from coal, carbonized coconut shell or other organic materials.

3.5.18
chemisorption
chemical adsorption
trapping of gaseous or vapour contaminants on an *adsorbent* (3.5.4) involving chemical reaction on the adsorbent surface

3.5.19
close valve time
time when the challenge gas(es) are initially turned off or when switching from upstream to downstream monitoring

3.5.20
decay time
time required for the gas contaminant monitoring instrument to record a reduction from an initial value greater than 95 % of the *challenge concentration* (3.5.14) to a final value of less than 5 % of the challenge concentration at the downstream sampling point for a specific test, challenge gas and gas flow, after stopping the injection of the *contaminant* (3.1.8) with no GPAC Media or Device present

3.5.21
desorption
process in which *adsorbate* (3.5.3) molecules leave the surface of the *adsorbent* (3.5.4) and reenter the air stream

Note 1 to entry: Desorption is the opposite of adsorption.

3.5.22
efficiency vs. capacity curve
plot of the GPACD *removal efficiency* (3.5.26) against the integrated capacity over the duration of a challenge test for a particular *challenge concentration* (3.5.14) and airflow

3.5.23
efficiency vs. time curve
plot of the GPAC Medium or Device *removal efficiency* (3.5.26) against time over the duration of a challenge test for a particular *challenge concentration* (3.5.14) and airflow

3.5.24
end efficiency
removal efficiency (3.5.26) calculated from the concentrations at the end of the test

3.5.25
initial efficiency
efficiency of an unexposed filter or GPACD calculated as soon after the start of a test as is possible

3.5.26
removal efficiency
fraction or percentage of a challenge contaminant that is retained by a GPAC Medium or Device at a given time

Note 1 to entry: Removal efficiency is also known simply as “efficiency”.

3.5.27
carbon filter
filter in which the filtering medium is, or includes, *activated charcoal* (3.5.17) and which is used for the separation of gaseous substances from the passing air

3.5.28
sorption filter
filter that removes gases or vapour contaminants from a gas stream using adsorption or absorptive processes

3.5.29
filtration
separation of *contaminants* (3.1.8) from a fluid stream in which they are suspended through retention of the contaminants (by extension, also the whole of the activities involved in the construction and commissioning of a *filter installation* (3.2.85))

3.5.30
flow rate sampling point
location where the air flow rate is sufficiently stable to permit a reliable flow measurement

3.5.31
test volume flow rate
volumetric air flow rate used for testing

3.5.32
gas phase air cleaning device
GPACD
assembly of a fixed size enabling the removal of specific gas- or vapour-phase contaminants

Note 1 to entry: It is normally box shaped or fits into a box of dimensions between 300 mm × 300 mm × 300 mm up to approximately 610 mm × 610 mm × 610 mm or 2 ft × 2 ft × 2 ft.

3.5.33
GPAC medium or device face area
cross-sectional area of the GPAC Medium or Device also including a header frame or other support structures if so equipped when viewed from the direction of air flow using exact dimensions

3.5.34
gas phase air cleaning medium
GPACM
solid medium or medium configuration used for filtering a *contaminant* (3.1.8)

EXAMPLE A porous film or fibrous layer; a bead shaped, granular or pelletized adsorbent (or chemisorbent); a support structure of fabric, foam or monoliths containing *adsorbent* (3.5.4) in the form of small-sized particles, granules, spheres or powder; a woven or *nonwoven fabric* (3.4.19) completely made from an adsorbent material.

3.5.35
GPACM-LF
adsorbent (3.5.4) in the form of particles of different shape and size intended for e.g. loose fill applications

3.5.36
GPACM-FL
adsorbent (3.5.4) in the form of flat sheet that is flexible, thin and nominally 2-dimensional

EXAMPLE Woven or *nonwoven fabrics* (3.4.19), wet laid papers, smooth pads, felts, etc. normally handled as roll goods.

3.5.37
GPACM-TS
adsorbent (3.5.4) in the form of a three-dimensional structure that is many times thicker than flat sheet and used as a finished element in a device

EXAMPLE Flexible open-cell structures, i.e. of thicker impregnated foam, corrugated pads, etc. and air permeable rigid structures, i.e. of bonded particles, honeycomb trays, extruded monoliths, etc.

3.5.38
gas purifier
apparatus for totally or partially removing one or more constituents from a gas mixture

3.5.39
lag time
rise time
time between initial injection of *contaminant* (3.1.8) and reaching 95% of the *challenge concentration* (3.5.14) for an empty duct measured at the downstream sampling location

Note 1 to entry: Lag/rise time is specific to a particular test, challenge gas and gas flow rate.

3.5.40
molecular contamination
contamination (3.1.9) present in gas or vapour phase in an air stream and excluding compounds in particulate (solid) phase regardless of their chemical nature

3.5.41
molecular sieve
silica-based mineral having a crystalline three-dimensional structure with cavities and channels whose surfaces can adsorb small molecules

3.5.42
open valve time
time at which challenge contaminants are initially injected into the test duct

3.5.43
ppb(v)
parts per billion by volume concentration measure normally used to record ambient levels of outdoor pollution

Note 1 to entry: Units are mm^3/m^3.

3.5.44
ppm(v)
parts per million by volume concentration measure normally used to record pollution levels in, e.g. work place safety

Note 1 to entry: Units are cm^3/m^3 and ml/m^3.

3.5.45
physisorption
physical adsorption
attraction of an *adsorbate* (3.5.3) to the surface, both outer surface and inner pore surface, of an *adsorbent* (3.5.4) by physical forces (Van der Waals forces)

3.5.46
pores
minute passageways through which fluid may pass or that expose to the fluid stream the internal surfaces of an *adsorbent* (3.5.4) medium

3.5.47
macro-pores
largest sized *pores* (3.5.46) (diameter > 50 nm) of *adsorbent* (3.5.4) media

3.5.48
meso-pores
intermediate sized *pores* (3.5.46) (diameter > 2 nm and < 50 nm) of *adsorbent* (3.5.4) media

3.5.49
micro-pores
smallest sized *pores* (3.5.46) (diameter < 2 nm) of *adsorbent* (3.5.4) media

3.5.50
ambient pressure
absolute pressure immediately outside the test rig

3.5.51
purge time
time required for the contaminant sampling system and monitoring instrument to register a change from an initial value lower than 1 % of the *challenge concentration* (3.5.14) to a final value greater than 95 % of the challenge concentration (or vice versa), as when a single instrument is switched from upstream to downstream monitoring and back