Filter Industry Definitions

ABSOLUTE – An arbitrary term once used to describe high efficiency particulate air filters, based on minimal penetration of 0.3 micron particles. In air filtration, there are no absolutes.

ABSOLUTE FILTER – This term has been applied to air filters of high efficiency—greater than 95% against submicron particles—but is now less frequently used. Modern terminology prefers the term HEPA filter (High Efficiency Particulate Air).

ABSORB – To intercept, or drink in, as a sponge sucks in water.

ABSORPTION – A physio-chemical process in which one substance associates with another to form a homogeneous mixture that presents the characteristics of a solution.

ACFM – Actual Cubic Feet Per Minute. Airflow measured at operating temperature and pressure.

ACID – Any of a class of substances whose aqueous solutions are characterized by a sour taste, the ability to turn blue litmus to red, and the ability to react with bases and certain metals to form salts. Acids will yield hydrogen ions when dissolved in water.

ACTIVATED ALUMINA – A highly porous and granular form of aluminum oxide having preferential adsorptive capacity for moisture from gases, vapors, and some liquids.

ACTIVATED CARBON – Any form of carbon characterized by high adsorptive capacity for gases, vapors, or colloidal solids. The carbon or charcoal is produced by destructive distillation of wood, peat, lignite, nut shells, bones, vegetable, or other carbonaceous matter, but must be activated by high temperature steam or carbon dioxide, which creates a porous particle structure.

ACTIVATED CHARCOAL – *See activated carbon.*

ADHESION – Intermolecular forces which hold matter together. Also applied to the sticking together of a particle to a surface, a fiber or another particle. The main factors affecting adhesion of particles are 1) London-van der Waals forces, which are electrical in origin, 2) electrostatic forces, and 3) surface tension, due to films of moisture on particles or on the surface. Other factors influencing adhesion are the nature of the surfaces, surface contaminants, particle size, shape and roughness, and time of contact.

ADSORB – The physio-chemical phenomenon involved to attract and hold a gas, vapor, or liquid on the surface of a solid, particularly on a finely divided material.

ADSORBATE – The material which is adsorbed; i.e., the gas, vapor, or liquid which adheres, or is chemically attracted to, the surface of the solid.

ADSORBENT – The material which adsorbs; i.e., the solid which attracts and holds on its surface the gas, vapor, or liquid. Activated carbon and activated alumina are all adsorbents.

ADSORPTION – The natural phenomenon of a gas, vapor, or liquid being attracted to, and held on, the surface of a solid. To some extent, adsorption takes place on any solid surface, but certain materials have sufficient adsorbent capacity because they are finely divided and are therefore useful in such industrial applications as the purification and separation of gases and liquids.

AEROSOL – Liquid or solid particles suspended in air, gas, or vapor.

AHRI – Air-Conditioning, Heating, and Refrigeration Institute.

ALKALI – A term that applies to the type of compounds which have basic properties and will neutralize acids. Some alkaline materials are hydroxides, carbonates, or caustics.

AMBIENT – Of the surrounding area or environment.

AMBIENT AIR – The air surrounding a building. The source of outdoor air brought into a building.

AMINE – A class of organic compounds of nitrogen that may be considered to be derived from ammonia. It may be a gas, liquid, or solid. All amines are basic in nature and will usually combine readily with hydrochloric or other strong acids to form salts.

AMMONIA – A colorless gas with a characteristic pungent odor. Used for refrigeration, fertilizer, chemical manufacturing, and many other uses.

ANGSTROM – A unit of length, 10^{-10} meter, or one ten thousandth of a micron.

ANSI – American National Standards Institute.

ARRESTANCE – A measure of the ability of an air-cleaning device to remove ASHRAE loading dust from test air. Measurements are made of the weight of loading dust fed and the weight of the dust passing the device during loading. The difference between the weight of dust fed and the weight of dust passing the device is calculated as the dust captured by the device. Arrestance is then calculated as the percentage of the dust fed that was captured by the device.

AROMATIC COMPOUNDS – Compounds related to six-carbon membered rings as benzene or its derivatives.

ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers.

ASHRAE LOADING DUST – Loading dust for testing air filtration devices composed, by weight, of 72% SAE Standard J726 test dust (fine), 23% powdered carbon, and 5% milled cotton linters.

ASME – American Society of Mechanical Engineers.

ATMOSPHERIC PRESSURE – The pressure of approximately 14.7 pounds per square inch exerted at sea level in all directions by the atmosphere.

BIOAEROSOL – A suspension of airborne particles that contain living organisms or were released from living organisms.

Filter Industry Definitions

BLIND SPOTS – Places in a medium where no filtering occurs. These places are also referred to as dead areas and are the opposite of the effective area.

BREAKTHROUGH – When the downstream concentration exceeds the allowable concentration.

BRIDGING – Where particles being removed from the air form an arch over the individual openings/pleats in an extended surface filter, blocking the narrow air passages between pleats and reducing the service life of the filter.

BROWNIAN MOTION – The random movement of microscopic particles suspended in a liquid or gas, caused by collisions with molecules of the surrounding medium. Also called Brownian Movement.

BTU (BRITISH THERMAL UNIT) – A standard measure of heat content in a substance that can be burned to provide energy.

BYPASS – Condition resulting from the fluid stream flowing through a housing without flowing through the filtering medium. In air filtration, unfiltered air going around the filter.

CAPACITY – Volume of air expressed in cubic feet per minute (CFM), or similar units that a filter is rated to handle.

CFM – Cubic feet per minute.

CHEMISORPTION – The combined process of adsorption, absorption, and oxidation, where gases trapped in chemisorbant media (adsorbent with an impregnant) are changed from gases into harmless solids.

CHIMNEY EFFECT – The tendency of heated air to rise due to lower density in comparison with ambient, also called thermal, updrafts. In cleanroom areas, heat generating equipment may cause severe upward air currents, resulting in unwanted turbulence.

CLEAN PRESSURE DROP – Differential pressure (drop) across a clean filter, typically measured in inches of water column (water gauge) or pascals.

CLEANROOM – A specially constructed enclosed area environmentally controlled with respect to airborne particulates, temperature, humidity, air pressure, airflow patterns, air motion, and lighting.

CLEAN SPACE – A term referring to cleanrooms or work stations within a room.

COALESCING – Action of uniting of small droplets of one liquid, preparatory to its being separated from another liquid.

COMPOSITE MEDIA – Media made up of more than one material.

CONTACT TIME – The length of time an absorbent is in contact with a liquid or gas prior to being removed by the filter.

CONTAMINANT – Synthetic or naturally occurring chemical, particle, or microorganism in air that could have adverse effects.

NON-LAMINAR FLOW CLEANROOM – A cleanroom with no requirements for uniform airflow patterns and air velocities.

CORROSION – Conversion of metals into oxides, hydrated oxides, carbonates, or other compounds, due to the action of air or water, or both. Salts and Sulphur are also important sources of corrosion.

CRITICAL SURFACE – The surface in a cleanroom or work station to be protected from particulate contamination.

DEAD AREAS – Places in a medium where no filtering occurs. Also referred to as blind spots. The opposite of the effective area.

DEGRADATION – The wearing down, or reduction in the efficiency of, the medium.

DELTA (Δ) P – A commonly used symbol denoting the difference in pressure between two points, such as the inlet and outlet of a filter. This difference is often referred to as the pressure drop and is typically measured in inches of water column (water gauge) or pascals.

DEPTH FILTRATION – Filtration accomplished by a progressively denser, deep medium, designed to allow finer particles to penetrate further into the medium, while larger particulates are lodged closer to the surface. A progressive density medium has superior dust holding capacity.

DIFFERENTIAL PRESSURE – Difference in pressure between two points, such as the inlet and outlet of a filter. This difference is often referred to as the pressure drop, and is typically measured in inches of water column (water gauge) or pascals.

DIFFERENTIAL PRESSURE INDICATOR – Indicator that signals the difference in pressure at two points.

DIFFERENTIAL PRESSURE SWITCH – Electrical switch operated by the difference between two pressures and often used to give warning of the end of a filtration cycle.

DIFFUSER – An air distribution outlet specifically designed to mix conditioned air with room air by induction. Mixing is accomplished by venture action, as the high velocity airstream leaving the diffuser aspirates ambient air toward the device.

DIFFUSION – A method of filtration that is effective on particles 0.1 micron and smaller, whose direction and velocity are influenced by molecular collisions (called Brownian Motion). Particulates of this size do not follow the airstream, but behave more like gases than particulate. Their dwell time in the media is longer as they are battered across the direction of flow in a random “helter skelter” fashion. When a particle strikes a fiber, it is retained by the inherent adhesive forces between the particle and fiber (van der Waals forces).

DISPOSABLE – Describes an expendable component which is to be discarded after use and replaced with an identical component. This means that the component is replaceable, not reusable.

D.O.P. (DIOCTYL PHTHALATE) – An oil-like plasticizer which is readily atomized to form the test aerosol which was once used in the overall penetration and scan tests of HEPA filters. This test aerosol is now rarely used and has been replaced with PAO (poly-alpha-olefin).

DOWNSTREAM – Portion of the system located after a filter. Also, the leaving air or the clean air side of a filter.

DUAL LAYER MEDIA – Media in a filter element that has a coarse layer followed by a fine layer, to enhance dust holding capacity.

DUST HOLDING CAPACITY (DHC) – The total weight of ASHRAE test dust a filter can hold before reaching a given final resistance. This amount will vary, depending on the size and design of the filter and airflow rate. Typically reported in grams, DHC is used to provide a relative measure of filter service life.

EFFECTIVE AREA – Area of the medium exposed to flow and usable for its intended purpose (filtering). This term means the opposite of blind spots or dead area.

EFFICIENCY – Degree to which a filter will perform in removing solids, in accordance with the chosen test method.

EFFICIENCY CURVE – Graph showing the performance of a filter when challenged by specified contaminants under controlled conditions. Usually will be plotted against particle size at a given face velocity.

ELECTRET MEDIA – Filter media containing an electrostatic charge.

ELECTROSTATIC PRECIPITATION – A method of filtration that imparts a positive charge to airborne particulate matter and collects the particles on negatively charged collection plates.

EXFILTRATION – Outward air leakage from a space through openings, caused by pressure differences across these openings.

EXTENDED SURFACE FILTER – A category of filter that is designed with pleats or pockets to increase the amount of media exposed to the airstream within a given face dimension. Greater filter surface area reduces media velocity and increases efficiency and dust holding capacity.

FACE AREA – The area of a filter perpendicular to the flow direction.

FACE LOADING – The phenomenon by which contaminants in the air load up on the surface of the filter, causing an abnormal rise in resistance.

FDA – U.S. Food and Drug Administration, which is responsible for protecting and promoting public health through the regulation and supervision of food safety, tobacco products, dietary supplements, prescription and over-the-counter pharmaceutical drugs, vaccines, biopharmaceuticals, blood transfusions, medical devices, electromagnetic radiation emitting devices, cosmetics, animal food and feed, and veterinary products. The FDA enforces Current Good Manufacturing Practices (CGMPs).

FIBER – Fundamental unit comprising a textile raw material such as cotton or wool.

FIBERGLASS – A term used to describe a variety of filter media made with glass fibers.

FILTER – A term generally applied to a device used to remove contaminates from the air. A filter may be one of a number of types, such as panel, automatic self-renewable, extended surface, HEPA, electrostatic, or gas phase. The term filter is sometimes erroneously used to describe the media used inside the device.

FILTER MEDIUM – The porous material mounted in the filter through which air is passed to remove the contaminants.

FILTRATION – The process of removing contaminants from liquid or gas by forcing them through a porous medium.

FINAL FILTER – The last and usually most efficient filter in a multi-stage filtration system.

FPM – Feet Per Minute. This term refers to the speed at which air moves through an area.

FRESH AIR – Term used for outdoor air.

GAS – The state of matter in which molecules move freely, causing matter to expand indefinitely, occupying the total volume available.

GAS-PHASE FILTER – Air cleaning device that uses the adsorption and/or chemisorption removal process. Typical filter mediums are activated carbon, alumina, and zeolite, with and without chemical impregnants.

GASKET – Material inserted between contact surfaces of a joint to ensure a seal.

HEPA FILTER – High Efficiency Particulate Air filter, which is capable of removing a minimum of 99.97% of 0.3 micron particles (typically PAO) of other gases from air.

HYDROCARBON – Any one of a large number of compounds composed primarily of the elements carbon and hydrogen. As they increase in molecular weight and boiling point, these compounds may be respectively gases, liquids, or solids.

HYDROPHILIC – Water accepting, or water wetting. Having an affinity for water, the opposite of hydrophobic.

HYDROPHOBIC – Non-water wetting. Having an antagonism for water, the opposite of hydrophilic.

IEST – Institute of Environmental Sciences and Technology, whose mission is "To globally expand and communicate the knowledge of contamination control, nanotechnology facilities, and test reliability. This is accomplished through the development of Recommended Practices and Standards by a community dedicated to professional collaboration, training, and education."

Filter Industry Definitions

IMPINGEMENT – A method of filtration that is effective on particles with sufficient inertia to cause them to leave the airstream and collide with a fiber. Often referred to as "viscous impingement," when the fibers are coated with an adhesive.

INCHES W.G. – Abbreviation for "inches water column gauge." This is a method of reporting filter resistance (or pressure drop) across a filter.

INFILTRATION – Inward air leakage from a space through openings, caused by pressure differences across these openings.

INITIAL RESISTANCE – Differential pressure (drop) across a clean filter, typically measured in inches of water column (water gauge) or pascals. Synonymous with initial pressure drop, or clean pressure drop.

INTERCEPTION – A special case of the impingement method of filtration that does not depend on the inertia of the particles to bring them in contact with a fiber. Interception occurs when a particle follows the airstream but touches a fiber as it attempts to flow around it. The particle is held by the inherent adhesive forces between the particle and fiber (van der Waals force).

INTERSTICES – Spaces or openings in a medium, such as the spaces between intersecting fibers. Also referred to as pores or voids.

KNIFE-EDGE SEAL – A narrow, pointed ridge on the peripheral sealing surface of a filter or filter frame, which provides a seal by the impression of a sharp edge into a gasket or gel.

LAMINAR AIRFLOW – Airflow in parallel flow lines with uniform velocity and minimum eddies.

LAMINAR FLOW CLEANROOM – A cleanroom with a requirement for laminar airflow. Airflow velocities are usually not greater than 90 FPM.

LIFE EXPECTANCY – The service life or change-out interval of a filter cartridge. Even with known dust holding capacity, the useful life will vary according to the type and size of contaminants entering the filter, particularly on makeup air or 100% outside air systems.

LIFE CYCLE COSTS (FILTER) – Sum of all costs associated with operating a filter system, including product, energy, labor, transportation, and disposal costs.

MAKEUP AIR – Outside air introduced to the HVAC system for ventilation, pressurization, or to replace exhausted air quantities.

MASS TRANSFER ZONE – Area of the adsorbent bed where contaminants are removed from the airstream. The mass transfer zone will move away from the inlet of the bed to the discharge until breakthrough occurs (end of useful life of the medium).

MAXIMUM DIFFERENTIAL PRESSURE – The highest pressure differential which a filter is required to withstand without structural failure or collapse.

MAXIMUM RECOMMENDED PRESSURE DROP – Published final pressure drop by manufacturer.

MEDIA – Plural of medium. This is the material that performs the actual separation of contaminants from the air stream.

MEDIA VELOCITY – Speed of the air flowing perpendicular to the media, calculated by dividing the total airflow through a filter by the effective media area.

MEDIUM – The porous material through which air is passed to remove contaminants (particulates or gases). It is usually confined within a frame or cell sides and is generally referred to as a filter or filter cartridge.

MERV – Minimum Efficiency Reporting Value is a single number that is used, along with the air velocity at which the test was performed, to simplify the extensive data generated by the ASHRAE Standard 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. MERV is expressed on a 16 point scale (MERV 1 through MERV 16) and is derived from the particle size removal efficiency measured in the test.

MICRON OR MICROMETER – A unit of length in the metric system. This term means one millionth of a meter, 10^{-4} centimeter, 10^{-3} millimeter, or 0.000039 of one inch. It is commonly used as a measure of particle size or fiber size in filter media. The naked eye can see a particle approximately 10 microns or larger without magnification.

MICROORGANISMS – Living bodies that can be seen only through a microscope.

MIGRATION – Contaminant captured and subsequently released downstream of a filter.

MILLILITER – One thousandth of a liter, equal to one cubic centimeter.

NET EFFECTIVE MEDIA AREA – The amount of media area in a filter that is exposed to airflow and usable for collecting airborne contaminants. The opposite of blind spots or dead area, this term is synonymous with net effective filtering area.

NEGATIVE PRESSURE – Vacuum or suction.

NON-LAMINAR – As applied to cleanroom airflow, this is less desirable than laminar flow because the air supply is introduced at random, causing turbulence and induction that stir the airborne dust particles and keep them in suspension.

NONWOVEN – A filter cloth or paper that is formed of synthetic fibers that are randomly oriented in the media. It is usually held together with a binder or binder fibers.

NON-SUPPORTED FILTERS – Extended-area filters which rely on the airflow to support the media in the airstream. Filters will generally sag or collapse under low or no airflow conditions.

OFFGASSING – Term used to express the release of a gas from a material that was previously captured by an adsorbent. Preferential off-gassing occurs when an adsorbent releases a lighter molecular weight gas in order to adsorb a heavier molecular weight gas.

ORGANIC – Describes the vast number of chemical substances containing carbon, hydrogen, and oxygen.

OUTDOOR AIR – Ambient air that enters a building through a ventilation system, through intentional openings for natural ventilation, or by infiltration.

OXIDE – Combination of oxygen with another element.

OXIDATION – Any chemical reaction in which a material gives up electrons, as when the material combines with oxygen. Burning is an example of rapid oxidation, while rusting is an example of slow oxidation.

PANEL FILTER – A low efficiency filter, consisting of a flat sheet of media that is usually contained within a cardboard frame. An alternative design has an internal wire frame. Panel filters are typically made with fiberglass or synthetic media and are often referred to as throw-away filters.

PARTICLE COUNT – In a cleanroom, the particulate concentration expressed as particles per cubic foot or particles per cubic meter, by particle size, is used to express the Airborne Particulate Cleanliness Class in accordance with Federal Standard 209E or ISO Standard 14644-1. Depending on the cleanliness class, particles are simultaneously measured from 0.1 micron to 5 microns in size.

PARTICULATE MATTER (PM) – Also known as particle pollution, PM is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles.

PENETRATION – The leak rate through the filter, penetration is expressed as a percentage based upon a specific particle size. The percentage of penetration is the reciprocal of the percentage of the efficiency. HEPA filters, for example, have a 0.03% maximum penetration on 0.3 micron (μ) particles.

PLEATED FILTER – A type of extended surface filter where the media is folded back and forth to increase the amount of media exposed to the airstream within a given face dimension. Greater filter surface area reduces media velocity and increases the efficiency and dust holding capacity.

PLEATING – In filters with a paper medium or other sheet material, pleating means the folding processes which provide a large surface area within a given volume of filter.

PREFILTER – A filter placed in front of another filter to remove larger, heavier particles. The primary purpose of this is to extend the life of the final filters. Prefilters are highly recommended in systems requiring high efficiency filtration, especially where a high concentration of lint and larger particles are present.

PRESSURE DIFFERENTIAL – Difference in pressure between two points.

PRESSURE DROP – Difference in pressure between two points, generally at the inlet and outlet of a filter. Pressure drop is typically measured in inches of water column (water gauge) or pascals.

PRESSURE, STATIC – The fan-induced pressure that tends to burst or collapse a duct, which is required to move air through a system. Fans must push or pull air to deliver against resistance from duct friction, filters, coils, and other airflow obstructions.

PRESSURE, TOTAL – The combination of static pressure and velocity pressure within a duct.

PRESSURE, VELOCITY – The pressure required to maintain movement of air through a duct.

RESIDENCE TIME – The theoretical time that a contaminant is within the confines of a media bed.

RETENTIVITY – The ability of an adsorbent to resist the desorption of an adsorbate.

SCAN TEST – Technique for disclosing leaks in HEPA and ULPA filters. Tests are performed by introducing a challenge aerosol upstream of the filters and passing the inlet of a sampling probe of an aerosol photometer or discrete particle in a series of parallel, slightly overlapping strokes across the downstream face of the filter (scanning), to detect any leaks.

SCFM – Standard Cubic Feet per Minute. This term refers to airflow that has been corrected to “standardized” conditions of temperature and pressure.

SKIN LOADING – The condition that occurs when collected particles build up on the surface of the media, plugging the spaces between the fibers. This is also known as blocking or surface loading. As a rule, the finer the media, the more susceptible it is to skin loading by “coarse” particles.

SORBENT – A substance that has the property of collecting molecules of another substance by adsorption or absorption.

STATIC TIP – Device used to measure static pressures in ducts or rooms. These devices are frequently installed upstream and downstream of a filter bank and connected to a pressure gauge to measure the pressure differential across the filter bank.

STOKES’ LAW – A physical law which approximates the velocity of a particle falling under the action of gravity through a fluid. The particle accelerates until the frictional drag of the fluid just balances the gravitational acceleration, after which it will continue to fall at a constant velocity known as the terminal or free-settling velocity.

STRAINING – A method of filtration that removes larger particles. Straining occurs when a particle is larger than the space between fibers and cannot pass through them.

SULPA FILTER – Super Low Penetrating Air filter with a minimum efficiency of 99.9999% on 0.12 micron (μ) particles.

Filter Industry Definitions

SURFACE AREA – The surface area of an adsorbent is determined by the BET method and is usually expressed in square meters per gram of adsorbent.

TERMINAL HEPA MODULE – A HEPA filter module that is connected to the end of a duct, most often mounted in the ceiling of a cleanroom.

TERMINAL VELOCITY – Steady velocity achieved by a falling particle when gravitational forces are balanced by viscous forces. *See Stokes' Law.*

UL 586 – Standard for High Efficiency, Particulate Air (HEPA) Filter Units. For this standard, filters are tested for efficiency and penetration and undergo a moisture test, heated air test, a low temperature test, and a spot flame test. A UL 586 label can only be applied to HEPA filters whose designs have been proven to meet the requirements of UL 586 test standard and must be tested for efficiency and resistance.

UL 900 – Standard for Air Filter Units. Filters that are classified to this standard and bear the UL mark meet the requirements of the test for the amount of smoke generated and the combustibility of the air filter unit. Filters meeting the standard are classified as follows: "Air filter units covered by this standard are classified as those that, when clean, burn moderately when attacked by flame or emit moderate amounts of smoke, or both."

ULPA FILTER – Ultra Low Penetrating Air filter with a minimum efficiency of 99.9995% on 0.12 micron (µm) particles.

UNLOADING – Release downstream of trapped contaminate. This can be due to a change in flow rate, mechanical shock, vibration, excessive pressure build-up, or medium failure.

VAPOR – A substance diffused or suspended in the air, especially one that is normally liquid or solid.

VENTILATION – The movement of air to and from a space by mechanical or natural means, including both the exchange of air to the outside, as well as the circulation of air within a building or space.

VOLATILE ORGANIC COMPOUNDS (VOCs) – Organic chemicals that have a high vapor pressure/low boiling point at ordinary room temperature, which causes large numbers of molecules to evaporate or sublimate from the liquid or solid form of the compound and enter the surrounding air. The health effects of VOCs in indoor environments vary, depending on the type and concentration of VOCs, along with the length of time a person is exposed.

Indoor Air Quality (IAQ)

refers to the air quality within and around buildings and structures, especially as it relates to the **health and comfort** of building occupants.

Understanding and controlling common pollutants indoors can **help reduce your risk of indoor health concerns**.

Indoor Air Quality Research

focuses on **improving the techniques** used to measure and model emissions of indoor air chemical contaminants present in free-standing structures.

Research is dedicated to investigating various approaches to **eliminating mold problems** in residence and office buildings.

Source: Environmental Protection Agency (EPA)