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Glossary of Terms Related to Fluid Filters and Filter Testing

RATIONALE

SAE J1124 was reviewed by the technical committee and determined to be current with no need for immediate revision.

1. ***Scope***—Over the years during which fluid filtration systems have been developing, many terms have come into use for descriptions of characteristics of filter media, filter assemblies, test methods, and test materials. Inevitably, some terms have been applied loosely, so that the same term may have different meaning to different people, or in different frames of reference.

   Recognizing the need for clearly defined terms, which can have only one meaning for all persons in all circumstances, so that documents dealing with standard methods of evaluation of filters will have only one interpretation, the Filter Test methods Subcommittee of the SAE Engine Committee has compiled this Glossary of related terms. No attempt has been made to produce an all-inclusive document, containing definitions of all terms related to all types of fluid filters. Instead, the Glossary is confined to the terms likely to be encountered in relation to filters for lubricating oil and fuels. At the same time, we have recognized that some terms are common to all types of fluid filters, and have been careful to avoid conflict with the definitions published by other standardizing groups. If not identical, the definitions of these terms are at least worded to convey an identical meaning, hopefully in fewer, simpler or more precise words.

   We hope that this effort will be effective in helping to eliminate the ambiguities which have resulted from imprecise use of terminology and filtration.

   This Glossary is referenced in the SAE filter test methods documents. Terms used in those documents are intended to have the definitions shown by this Glossary, and no other.

   As new terms and their definitions become associated with the science of filtration and are relevant to the documents prepared by this subcommittee, revisions to the Glossary will be made, either by issuance of addenda or by revision and republication of the entire document.

2. ***References***

2.1 **Related Publications**—The following publications are provided for information purposes only and are not a required part of this document.

Ferret, Assoc., Int pour l'Essai des Mat 2 Group d, Zurich (1931)
Martin, Blyther, Tonque Trans Ceram Soc. England, 23, 6 (1924)
Particle Size Measurement, T. Allen, University of Bradford, 1968, Chapman & Hall, Page 17.
H. Heywood, Loughborough University

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3. *Definitions*

3.1 Anti-Drainback Valve—A check valve used in a filter housing in some spin-on filters to prevent oil drainage from the filter during engine shutdown.

3.2 Base—The foundation or support for the filter which may also contain one or more ports and a by-pass valve.

3.3 By-Pass—An alternate flow path around the filter element. Flow of fluid through the by-pass is usually blocked by a valve until a predetermined differential pressure across the element is reached.

3.4 Cleanable Element—A filter element, which when clogged, can be restored by a suitable cleaning process to an acceptable percentage of its original flow/pressure differential characteristics.

3.5 Clogging Indicator—An indicator which is activated when a predetermined pressure differential across the filter is reached.

3.6 Coalescer—Filter unit whose primary function is to cause finely dispersed droplets in an emulsion to form into larger droplets.

3.7 Combination Medium—A filter medium composed of two or more types, grades, or arrangements of filter media to provide properties which are not available in a single filter medium.

3.8 Crest—The outer fold of a pleat.

3.9 Depth Medium—A filter medium which primarily separates and retains contaminant within tortuous passages within the body of the medium.

3.10 Differential Pressure Indicator—A device which indicates continuously during operation the differential pressure across a filter element.

3.11 Disposable Element—A filter element which is discarded and replaced at the end of its service life.

3.12 Disposable Filter—A filter consisting of a filter element encased in a housing which is discarded and replaced in its entirety at the end of the service life of the element.

3.13 Dual Porosity Element—An element which contains two media of different porosity in parallel.

3.14 Dual Porosity Filter—A filter which contains two media of different porosity offering parallel flow paths to the fluid.

3.15 Edge Medium—A filter medium whose passages are formed by the adjacent surfaces of stacked discs, edge wound ribbon, or single layer filaments.

3.16 Effective Area—The area of a filter medium through which fluid flows.

3.17 Etched Medium—A filter medium having passages produced by chemical or electrolytic removal of unwanted material.

3.18 Filter—A device having a porous medium, whose primary function is the separation and retention of particulate contaminants from a fluid. The major filter components are the housing and the element.

3.19 Filter Drain—A port located near the lowest extremity of a filter through which fluid may be removed.

3.20 Filter Element—A sub-assembly of a filter which contains the filter medium or media.

3.21 Filter Housing—A ported enclosure which contains the filter element and directs fluid flow through it.

3.22 Filter Medium—The porous material which performs the process of particle separation and retention.

3.23 Filter Paper—A porous paper, matted or felted sheet of fibers (usually vegetable, but sometimes mineral, animal, or synthetic).

3.24 Final Filter—The last stage of a multi-stage filter system.

3.25 Full Flow Filter—A filter which is designed to filter all of the system fluid flow.

3.26 Inside-Out Flow Element—A filter element designed for flow outward from and perpendicular to its longitudinal axis.

3.27 Multi-Stage Filter—A filter system with two or more filters in series.

3.28 Non-Woven Medium—A filter medium composed of a mat of fibers. Filter paper is one type of non-woven medium.

3.29 Open Area—The total pore area of a filter medium, often expressed as a percent of total area of filter medium.

3.30 Outside-In Flow Element—A filter element designed for flow towards and perpendicular to its longitudinal axis.

3.31 Partial Flow Filter—A filter which filters only a part of the total system fluid.

3.32 Pleats—A series of folds in the filter medium used to increase effective filter area within a given space.

3.33 Pore Size Distribution—The ratio of the number of pores of given sizes to the total number of pores, per unit of area.

3.34 Porosity (Void Fraction)—The ratio of pore volume to total volume of a filter medium.

3.35 Precoat—A filter medium in loose powder or fiber form introduced into the upstream fluid to form a filter bed on the face of an element.

3.36 Primary Filter—The first stage of a multi-stage filter system.

3.37 Root—The inner fold of a pleat.

3.38 Secondary Filter—The second stage of a multi-stage filter system.

3.39 Sintered Medium—A metallic or non-metallic filter medium composed of particles of the medium processed to cause diffusion bonds at all contacting points.

3.40 Spin-On Filter—A disposable filter which mates to a permanent base and is attached by turning it onto a threaded base stud.

3.41 Surface Medium—A filter medium which primarily separates and retains contaminant on the influent surface face.

3.42 Total Area—The entire surface area of a porous medium, whether effective or not, in a filter element.

3.43 Two Stage Element—A filter element assembly composed of two filter media in series.

3.44 Wound Medium—A filter medium comprised of layers of crossed helical wraps of a continuous filament or strand of roving.

4. Contaminant Terms

4.1 Agglomerate (n)—A group of two or more particles combined, joined, or clustered, by any means.

4.2 Aggregate—A relatively stable assembly of dry particles formed under the influence of physical forces.

4.3 Automatic Particle Count—A particle count obtained by an electro-mechanical or electronic device as opposed to visual microscopic counting technique.

4.4 Background Contamination—The apparent contamination concentration determined by analysis of test fluid before addition of contaminant.

4.5 Classified Particle Contaminant—A test contaminant which has been separated and classified to a standard particle size distribution. These are usually hard, non-deformable particles, and are sometimes referred to as abrasive test contaminants.

4.6 Clean Element—A new or re-conditioned filter element which is essentially free of contamination introduced during manufacture, assembly, storage, installation, or use.

4.7 Cleanliness Level—The antonym of contamination level.

4.8 Clogged Element—A filter element which has collected a quantity of contaminant, such that it cannot maintain rated flow without excessive differential pressure.

4.9 Clogging Contaminant—A contaminant which is soft and more deformable than the classified particle contaminants, used to simulate, in the laboratory, the type of filter clogging experienced by filters in service.

4.10 Concentration—Quantity of solid, liquid, or gaseous material related to that of another material in which it is found in the form of a mixture, suspension, or solution.

4.11 Contaminant, Generated—Contaminant generated by the operation of a system or component.

4.12 Contaminant—Any material or substance which is unwanted in a system.

4.13 Contaminant, Built-In—Initial residual contaminant in a fluid system or component.

4.14 Contaminant, Environmental—Contaminant(s) present in the immediate surroundings, introduced into a fluid system or component.

4.15 Contamination Level—A quantitative term specifying the degree of contamination.

4.16 Dissolved Water—Water which is present in a fluid forming a single phase.

4.17 Emulsified Water—Small droplets of water in a stable suspension of water in fuel.

4.18 Feret's Diameter (of a particle)—The distance between two tangents, on opposite sides of the particle profile, that are parallel to some fixed direction. Remark: This dimension is used in visual microscope counting. The fixed direction is to be vertical, that is, from top to bottom, in the field of view that includes the image of the particle. Ferret, Assoc., Int pour l'Essai des Mat 2 Group d, Zurich (1931).

4.19 Fiber—A fiber is a particle whose length is greater than 100 μm and at least 10 times its width.

4.20 Free Air—Air present as a dispersed phase in a fluid.

4.21 Free Water—Water present in a fluid which may separate as a result of the difference in densities.

4.22 Gravimetric Value—The weight of suspended solids per unit volume of fluid.

4.23 Martin's Diameter (of a particle)—The length of the line that bisects the image of the particle; the line may be drawn in any direction which is to be maintained constant for all the image measurements. Remark: This dimension is sometimes used in connection with electron microscopy. The bisecting line is to be drawn horizontally, that is, from left to right, in the field of view that includes the image of the particle. Martin, Blyther, Tongue Trans Ceram Soc. England, 23, 6 (1924).

4.24 Media Migration—Migration of materials which make up the filter medium.

4.25 Micrometre—Unit of measurement one millionth of a metre long.

4.26 Migration—Movement of particles from the filter assembly into the effluent.

4.27 Non-Combustible Residue—Matter not changed to gaseous state when heated to 815 °C in the presence of air.

4.28 Particle—A minute piece of matter with observable length, width, and thickness; usually measured in micrometres.

4.29 Particle Count Blank—An allowance for the determinable background contamination.

4.30 Particle Size Analysis—The whole of the operation by which a particle size distribution is determined.

4.31 Precipitate (n)—Particles separated from a fluid as a result of a difference in densities and the action of gravitational force.

4.32 Projected Area Diameter (of a particle) (Symbol: d_a)—The diameter of a circle having the same projected area as the particle when it is viewed in a direction perpendicular to a plane of stability. Remark: This dimension is the basis of measurement by the Vickers Projection Microscope and the HIAC automatic counter.

4.33 Raw Particle Count—The actual number of particles counted in each size of a specified size range or above a specified size or sizes.

4.34 Sieve Diameter (of a particle) (Symbol: d_Δ)—The width of the minimum square aperture through which the particle will pass.

4.35 Silt—Fine particulate matter, generally less than 5 μm in size.

4.36 Stoke's Diameter (of a particle) (Symbol: d_{st})—The diameter of a sphere having the same density as the particle and the same free-falling speed as the particle in a laminar flow region (Re 0.2) in a fluid of the same density and viscosity as the fluid concerned. Remark: This dimension is used as the basis for particle size measurement by liquid sedimentation methods of those fractions of powders that pass through a 75 μm sieve.

The particle size terms and definitions above are taken from "Particle Size Measurement," T. Allen, University of Bradford, 1968, Chapman & Hall, page 17. The symbols have general agreement and are in conformity with publications by H. Heywood, Loughborough University.

4.37 Surface Diameter (of a particle) (Symbol: d_s)—The diameter of a sphere having the same surface area as the particle.

4.38 Test Contaminant—Particulate matter of controlled composition and particle size distribution or, water of controlled droplet size, used in the laboratory test of filters.

4.39 Unloading—The release of contaminant that was initially retained by the filter medium.

4.40 Visual Counting of Particles—Any optical counting procedure used to measure the number of particles of specified dimensions.

4.41 Volume Diameter (of a particle) (Symbol: d_v)—The diameter of a sphere having the same volume as the particle. Remark: This dimension is the basis of measurement by a Coulter Counter.

5. Filter Characteristics Terms

5.1 Filter Performance Test Terms

5.1.1 APPARENT CAPACITY—The actual weight (grams) of contaminant injected into a laboratory filter test system before the terminal pressure drop is reached. Also referred to as life in grams.

5.1.2 BASE UPSTREAM GRAVIMETRIC LEVEL—Theoretical upstream contamination level for a filter of 100% efficiency.

5.1.3 BATCH CONTAMINANT ADDITION—A filter test condition under which a specified contaminant is added in batches of spelcified size at specified time intervals.

5.1.4 COMBINED LIFE AND PARTICLE RETENTION TEST—A filter Life Test in which spelcified amounts of inorganic classified contaminant are admitted to the influent stream at specified intervals during the test, to determine the particle separation efficiency of the filter at various stages of clogging.

An organic clogging contaminant may be used in this test, in combination with the inorganic classified contaminant.

5.1.5 CONSTANT RATE OF FLUID FLOW—A filter performance test condition which specifies that test flow rate through the filter is held constant throughout the test, usually by varying the inlet pressure to compensate for increases of pressure drop across the filter.

5.1.6 CONTINUOUS CONTAMINANT ADDITION—A filter test condition under which a specified contaminant is added to the test fluid at a continuous specified rate for the duration of the test.

5.1.7 CUMULATIVE FILTER EFFICIENCY—A method of calculating filter efficiency based on the total cumulative amount of contaminant presented to the filter from the start of the test to any designated sampling time.

5.1.8 EFFLUENT—The fluid leaving a component.

5.1.9 FILTER CAPACITY FOR CONTAMINANTS—The weight of specified contaminant removed and held from the fluid by a filter at a specified termination point. The termination point is specified as a pressure differential, reduction in flow, filtration efficiency, or fluid contamination level.

5.1.10 FILTER EFFICIENCY—The ability, expressed as percent, of a filter to remove specified artificial contaminant from a specified fluid under specified test conditions.

5.1.11 FILTER LIFE TEST—A type of filter capacity test in which a clogging contaminant is added to the influent of a filter, under specified test conditions, to produce a given rise in pressure drop across the filter or until a specified reduction of flow is reached. Filter life may be expressed as test time required to reach terminal conditions, at a specified contaminant addition rate.

5.1.12 FILTER (OR ELEMENT) PRESSURE DIFFERENTIAL—The drop in pressure due to flow across a filter or element at any time. The term may be qualified by adding one of the words "initial," "final," or "mean."

5.1.13 FILTER RATED FLOW—The maximum flow rate, in litres/hour, of a fluid of specified viscosity, for which a filter is designed. The standard fluid viscosity for flow rating of lubricating oil filters is 20 cst (100 S.U.S.). Suitability of the filter for use at flows and/or viscosities beyond the rated flow is left to the discretion of the user.

5.1.14 FILTRATION RATIO—The ratio of the number of particles greater than a given size in the influent to the number of particles greater than the same size in the filter effluent.

5.1.15 INCREMENTAL FILTER EFFICIENCY—A method of calculating Filter Efficiency based on the total amount of contaminant presented to the filter during any specified segment of the test.

5.1.16 INFLUENT—The fluid entering a component.

5.1.17 INITIAL PARTICLE RETENTION RATING—A test conducted on new filter elements to establish the initial retention characteristics, of particles of a specified size range.

5.1.18 INSTANTANEOUS FILTER EFFICIENCY—A method of calculating filter efficiency based on the ratio of contaminant level of the effluent to that of the influent at an instant of time during the test.

5.1.19 LARGEST PARTICLE PASSED TEST (ABS. PARTICLE RETENTION RATING)—A form of Particle Retention Rating Test in which the largest hard particle that will pass through a filter under defined test conditions is determined. The term largest particle passed is intended to indicate the largest opening in a filter.

5.1.20 MULTIPASS OR RECIRCULATION TEST—Filter performance tests in which the contaminated fluid is allowed to recirculate through the filter for the duration of the test. Contaminant is usually added to the test fluid during the test.

5.1.21 OIL CONTAMINATION LEVEL—The amount of contaminant present in the test fluid at any specified sampling time. The level is usually expressed as the weight of contaminant or particle count per unit of weight or volume of fluid.

5.1.22 PARTICLE RETENTION RATING TEST—A test which determines a filter's ability to separate and retain particles of a specified size. It is usually conducted as a single pass test with Classified Contaminant of a narrow size range, and results are expressed as percent efficiency.

5.1.23 PERMEABILITY—The relationship of flow per unit area to differential pressure across a filter medium.

5.1.24 SINGLE PASS TEST—Filter performance tests in which contaminant which passes through a test filter is not allowed to recirculate back to the test filter.

5.1.25 VARIABLE RATE OF FLUID FLOW (CONSTANT PRESSURE)—A filter performance test condition which specifies that pressure difference across the filter shall be held constant throughout the test, which results in decreasing flow rate as the filter becomes clogged.

5.1.26 VARIABLE RATE OF FLUID FLOW (VARIABLE PRESSURE)—A filter test specification which requires flow rate changes according to a specified time cycle.

5.2 Filter And Element Strength And Integrity Terms—Tests pertaining to strength, seal integrity, and temperature effects on the filters and filter elements.

5.2.1 ADDITIVE REMOVAL TEST—A test conducted by recirculating a specified additive type of oil through a test element for a specified period of time. The amount of ash type additive removed by the element is