
3M
Science.
Applied to Life.™
The importance of filter change
Filters do not last forever.
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#3MScienceOfSafety

Why and When to replace your 3M filters?

The use of respiratory protection filters can be confusing and complicated and there are a number of common questions and issues that arise regularly. The questions and answers below try to briefly cover these.

What regulations and standards govern the design and use of filters and reusable respirators?

Two main regulations pertain to respiratory protection.

Regulation (EU) 2016/425 of 9 March 2016 covers the design, manufacture, and marketing of personal protective equipment.

Directive 89/656/CEE of 30 November 1989 is on the minimum health and safety requirements for the use by workers of personal protective equipment at the workplace.

EN 529 is a standard call “Respiratory protective devices – Respiratory protective devices — Recommendations for selection, use, care and maintenance” could help you in selecting, cleaning, and maintaining respiratory protective device.

Many standards define requirements, testing and marking for facepieces and filters:

EN 136: Respiratory protective devices – Full face masks

EN 140: Respiratory protective devices - Half masks and quarter masks

EN 143: Respiratory protective devices – Particle filters

EN 405: Respiratory protective devices — Valved filtering half masks to protect against gases or gases and particles

EN 14387: Respiratory protective device – Gas filter(s) and combined filter(s)

Guidance is also available from your local 3M representative or from the 3M Helpline.

What types of filters are there?

Particulate Filters

Protect only against particles i.e. dust, mists and fumes, aerosols, smoke, mould, bacteria and so on.

Gas/Vapour Filters

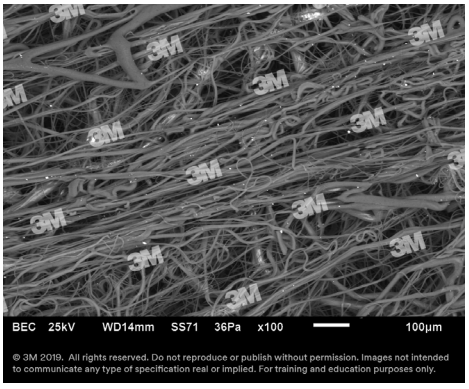
Protect only against gases and vapours. There are different kinds of gas & vapour filters for different kinds of gases.

Combination Filters

Protect against both particles and gases. Different combination gas, vapour and particulate filters are used depending on the gas or vapour present in the air.

Why do I need to replace my filters regularly?

Particulate filters get clogged up and become harder to breathe through placing an increased physiological burden on the wearer. Gas and vapour filters start to let contaminant through once their sorbents become saturated. This is called breakthrough. Important: The selection of filters must be carried out by a competent person with a full knowledge of the respiratory hazards in the workplace.



Example of a layer from a P2 reusable respirator filter.

How do particle filters work?

A bed of randomly oriented fibres is used to create the filter. Treated fibres can be used to attract and trap particles as they flow into and through the filter material. Increasing the thickness and capture effectiveness of the filter material increases the filter efficiency at capturing particles.

Particle filters are tested according to EN 143. The physics of particle capture indicates that the particle size range 0.02-0.2 micron equivalent diameter and has a mass median particle diameter of approximately 0.3 to 0.6 µm as this is the most difficult size range to capture. The particulate filter is tested with a sodium chloride challenge aerosol consisting of particles mainly of this size. There are four common mechanisms of filtration being interception capture, inertial impaction and diffusion capture and electrostatic attraction.

In practice, particle filters designed for respiratory protection will capture particles of all sizes – the major difference is the relative performance in the range between ~0.1 and 1 um. Each class of filter must perform above a certain level against the test aerosol to be then classified under EN 143 as explained below.

EN 143 uses a classification system to identify the efficiency of particulates these filters will capture e.g. P1, P2, P3.

What's a P1, P2, P3 rated filter?

Particle filters are classified according to their filtering efficiency. There are three classes of particle filters:

P1, P2 and P3 in ascending order of the filtering efficiency.

P1: It must be at least 80% efficient to the most penetrating particle size.

P2: It must be at least 94% efficient to the most penetrating particle size.

P3: It must be at least 99.95% efficient to the most penetrating particle size.

What is a N95 filter level?

N95 is the United States National Institute of Occupational Safety and Health (NIOSH) classification that is similar to the P2 rating under EN 143. N refers to sodium chloride and the 95 refers to these products being at least 95% efficient to the sodium chloride test aerosol. NIOSH also have R and P type particulate filters for oily particulate. In Europe, it is common in healthcare environments for P2 respirators to be used.

How long do particle filters last?

As particle filters load up with the contaminant, they actually become more restrictive to the passage of particles and can be a better filter. However, they also become harder to breathe through. The wearer will notice this increased load and at some point, decide that the restriction is too high and will then need to change the filter. How soon this occurs will also be dependent on the amount of particles in the breathing air. A very dusty job will obviously clog the filter up more quickly than a relatively clean job. The change decision point will vary from individual to individual, as some people are more sensitive to the increase in breathing load than others.

When do I replace my particulate filters?

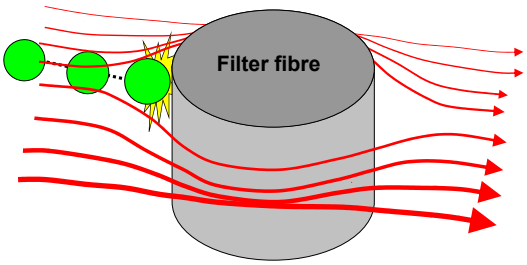
Replace 3M™ Particulate Filters:

- The breathing resistance becomes excessive to the wearer (this will vary from individual to individual).
- The filter has any physical damage
- It becomes unhygienic i.e. it has been coughed/sneezed into and the inside is in an unacceptable condition.
- Some workplaces e.g. healthcare environments, may require masks/filters to be replaced after every use due to infection control procedures.

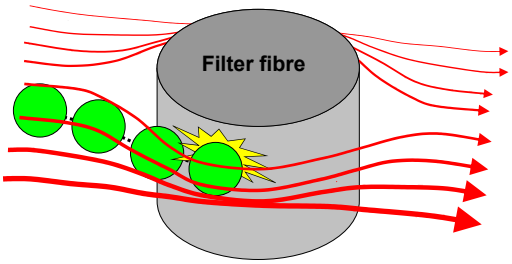
Are there situations where particle filters must not be used?

There are several applications where particle filters should NOT be used:

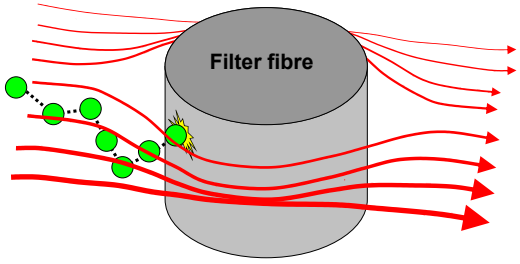
- When the ambient Oxygen level is not guaranteed to be > 19.5%. Filters do not create oxygen.
- For the capture of gases or vapours - these need a specifically rated gas/vapour filter.
- When the airborne particulate contaminant concentrations are high ie greater than the standard allows for that respirator type.
- When local Regulations require use of other specific type of respirator for specific applications.



Inertial Impaction
Dominant for large particles (>0.6µm)



Interception Capture
Operative for particles greater than 0.1 µm



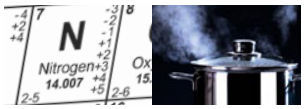
Diffusion Capture
Operative for particles < 0.4 µm, dominant for < 0.1 µm

How a gas and organic vapour respirator filter works.

3M makes gas and vapour respirator filters to help reduce user exposure to many different gases and vapours. To achieve this objective, respirator filters are filled with a material called activated carbon. Activated carbon is typically made from coal or renewable resources like wood or coconut shells. It may be "activated" by heating the material in nitrogen or steam at approximate temperatures of 800 – 900°C. The resulting material has a significant number of micropores that help adsorb various organic vapours. These micropores can be measured and optimized for specific product needs and performance.

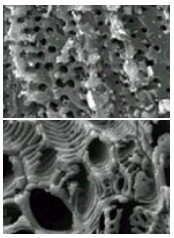
Coal or renewable resources, such as coconut shells

Coal or renewable resources are heated without oxygen



High-temperature steam or nitrogen activation

High-grade activated carbon



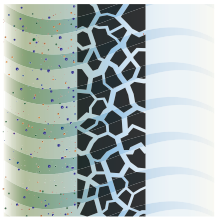
Electron micrographs of activated carbon pores

When gases and vapours are drawn through an organic vapour filter, the air is filtered as vapours condense into the carbon pores. Vapours move through the filter from one pore to the next. This occurs more quickly for small volatile vapours with lower boiling points (e.g., acetone). Some migration of organic vapours can even occur during storage, so care must be taken before reusing the filter. The effective service life is the time until vapours begin to exit the filter.

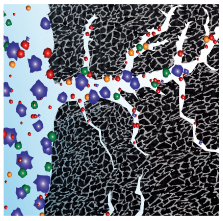
Unlike particle filters, service life is not indicated by change in breathing resistance. Instead, filters must be changed according to local regulations; or irritation from the contaminant; or according to 3M™ Service Life Software calculation, whichever comes first.

Activated carbon by itself cannot absorb other types of gases or vapours such as acid gases, ammonia, formaldehyde, etc. In some cases, additional metals and salts are added to the carbon to selectively remove these compounds. For this reason, 3M offers a variety of filters and facepieces to help protect workers in different environments and satisfy personal preferences.

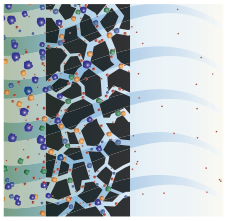
EN 14387 uses a classification system to identify the different types of contaminants these filters capture. 3M Filters follow this marking and colour coding system.



Unfiltered organic vapours are drawn into the filter.



Activated carbon absorbs organic vapours on molecular level.



Service life continues until vapours begin to escape the filter.

Factors that influence service life:

- Exposure concentration
- Temperature
- Humidity (water vapour takes up space in carbon pores)
- Rate of breathing
- Class of filter

How do Gas & Vapour Filters Work?

These filters rely on sorbent material to "soak up" the gas and vapour molecules. Typically, the sorbent is carbon grain, which has been specifically treated. Depending on the chemical treatment of the carbon surface, this material will absorb different types of gases or vapours.

EN 14387 uses a classification system to identify the different types of contaminants these treated carbon grains will capture e.g. A, AX, B, E, K and Hg.

How long do Gas/Vapour filters last?

Gas/Vapour filters are rated according to their absorbent capacity. In increasing capacity, the ratings are: Class 1, 2 or 3. This means we can have an A1 or a B2 or a multigas type filters like an A2B2E2K1.

The service life (ie how long will it perform) of any Gas/Vapour filters is affected by many factors – concentration and identity of contaminants, breathing rates, humidity levels, ventilation, temperature, type of carbon etc.

To get an estimate of the life of 3M Gas/Vapour filters, using 3M™ Service Life Software allows calculation of the estimated expected service life under the applicable workplace conditions. Please contact your 3M representative for assistance with this process.

What is the difference between an A and AX filter?

An A filter is for Organic gases and vapours with boiling point >65°C. eg. Toluene, Xylene, MEK, Benzene, Alcohols.

An AX filter is for Highly volatile organic solvents with boiling point <65°C. e.g. Methanol, 1.3-Butadiene, Acetaldehyde. These types of chemicals migrate through the carbon bed over time. This is why EN 14387 specify AX filters must be changed after every shift. Manufacturers also specify maximum use concentrations and maximum usage times, so be sure to follow manufacturer guidance. AX are tested against different gases to A filters and have additional desorption tests per EN 14387.

When do I replace my Gas/Vapour filter?

Replace 3M™ Gas & Vapour Filters:

- When the expiry date stamped on the sealed packet has elapsed.
- If an odour or taste is perceived, when the wearer coughs or experiences discomfort. This indicates filters are not being changed often enough and the filter change schedule should be adjusted. The sense of smell should not be relied upon as the primary indicator.
- Or in accordance with your established Filter Change Schedule.

To avoid smelling or tasting the contaminant when using 3M™ Gas & Vapour Filters, take the following steps:

- When you get a new pair of 3M Gas & Vapour Filters, check the expiry date on the back of the pack.
- Write the date on the filters when first removed from the pack.
- Use the filters on your respirator in your normal work environment.
- If at any time you smell or taste the contaminant or irritation is detected, the filters need replacing straight away.
- Take note of how long the filters lasted by comparing the date recorded on the filter and the current date.
- If work practices remain the same and the levels of vapours/gases are consistent, replace your filters on a more regular timescale.
- Or in accordance with your established Filter Change Schedule.

Why can't I use smell or taste to determine when a Gas/Vapour filter should be changed?

Warning properties such as odour, eye irritation, and respiratory irritation were relied for indicating when chemical filter breakthrough was starting. However, warning properties rely upon human senses that are not as foolproof as:

- There is considerable variation between individuals
- Sense of smell shifts due to simple colds and other illnesses
- The odour of the contaminant may be masked by other smells
- Olfactory fatigue, where over a period of time the sense of smell tires and will fail to detect high concentrations and particularly where concentration build up gradually e.g. Hydrogen sulfide
- The threshold of odour for some chemicals exceed the levels at which may be considered hazardous
- Some gases have no odour and therefore will not be detected e.g. carbon monoxide
- Some chemicals have a low odour threshold concetrations but do not represent a health hazard at these concentrations e.g. methyl mercaptain

Given the variability among people with respect to detection of odours and differences in measuring odour thresholds, a better practice is to establish a filter change schedule.

What is a Filter Change Schedule?

A filter change schedule is a specified time period after which the chemical filter will be replaced. This time period may be established after consideration of the service life estimate, workplace conditions such as contaminant concentration, relative humidity, temperature, work activities, respirator use pattern (e.g., continuous or intermittent use), presence of other materials, potential for contaminant migration/desorption, health effects of the gas or vapor, and quality of warning properties, if any.

The filter change schedule must be based on objective information that will ensure that the gas/vapour filters are changed before the end of their service life.

The purpose of a change schedule is to establish the time period for replacing respirator filters. The data and information relied upon to establish the schedule should be included in the respiratory protection program.

Are there situations where Gas & Vapour filters must not be used?

There are several applications where G&V filters should NOT be used:

- When the Oxygen level is not guaranteed to be > 19.5%.
- For capture of particles e.g. dusts, mists, fumes or fibres.
- Where the contaminant(s) present cannot be captured by the G&V filter.
- When airborne Gas & Vapour contaminant concentrations are very high.
- When local regulations require the use of other specific type of respirators for certain applications.

Frequently asked questions.

What is the shelf life of 3M™ Filters?

Provided they are stored unopened in the original packaging, filters will last three or five years (depending on the product) from manufacture date.

How should I store my 3M™ Reusable Respirator and filters?

When not in use, your 3M™ Respirator and Filters should be kept clean and dry, and away from oil and sunlight and corrosive atmospheres to avoid deterioration. A storage container or bag that can be sealed, can be utilised for this purpose.

Why do I need to use a Particulate Filter with my Gas & Vapour Filters for some applications?

There are many situations where both a particulate hazard and gas/vapour hazard are present at the same time. The particulate filter removes the tiny droplets or particles in the air (e.g. mists from spray painting). The gas and vapour filters do not filter these particles. If no particulate filter is used, they could be breathed in.

There are many factors such as exposure level, other controls, work rate, breathing rate etc that contribute to how long a filter lasts and when it should be should be changed. Some indicators for when this are:

- For particulate filters or masks when the breathing resistance becomes excessive to the wearer.
- Any damage occurs eg. broken strap, hole burnt in mask etc.
- It becomes unhygienic i.e. it has been coughed/sneezed into and the inside is in an unacceptable condition.
- For combination filters (particulate and Gas & vapour), the capacity of each will depend on the airborne concentrations being filtered – it will fill at its own rate and need to be changed when full. This may be at a different rate to the other.
- The service life (ie how long will it perform) of any Gas & Vapour (G&V) filter is affected by many factors – capacity, concentration and identity of contaminants, breathing rates, humidity levels, ventilation, temperature, type of carbon etc.
- Some workplaces e.g. healthcare environments, may require masks/filters to be replaced after every use due to infection control procedures.

Therefore, there is no specific timing involved and the frequency of replacement of products varies from task to task, situation to situation and product to product.

Every workplace is unique and needs to assess their specific situation to determine an adequate filter change schedule.

Filter selection guide.

Application	Hazard	Typical Protection
Painting, Spraying, Varnishing, Coating	Solvent-Based Paint**	A2P3 R
	Anti-Fouling Paint Spraying / Grinding	A2P3 R
	Water Soluble Paint	A1P2 R
	Solvents, Resins, Synthetic Resins**	A2P3 R
	Latex-Paint, Residual Solvents	A2P3 R
	Wood Preservatives	A1P2 R
Maintenance	Disinfection, Cleaning*	ABEK1P2 R
Decoration	Spray-On Glue, Foam, Varnish, Adhesive	A1P2 R
Waste Removal	Bacteria, Spores, Odours	A1P2 R
Agriculture	Pesticides, Insecticides	ABEK1P2 R
Wood Treatment	Bonding, Spray-On Glue	A2P3 R
	Tarring	A2P3 R
Construction, Grinding, Cutting, Drilling	Sealing	A1P2 R
	Spray Foam Insulation	A1P2 R
	Organic Solvent/with boiling point less than 65 C	AXP3 R
	Ammonia Based Paint Remover	ABEK
Coating	Polyurethane Coating**	ABEK1P3 R
	Solvent Based Varnish	A2
	Water Based Varnish	A1
Bonding	Solvent containing Adhesives	A1
	Sulphur Dioxide	ABE
	Hydrochloric Acid	ABE
Handling	Liquid Manure	ABEK
	Ammonia	K
	Formaldehyde	A1 + Form
	Hazardous goods storage/transport	ABEK1P3 R

Warning:
This guide is only an outline. It should not be used as the only means for selecting a respirator. Details regarding performance and limitations are set out on the respirator package and user instructions. Before using any of these respirators, the wearer must read and understand the user instructions for each product. Specific country legislation must be observed.
Where a Class 1 filter is shown, a filter of a higher class may be needed, depending upon specific exposure environment.
* excluding Formaldehyde
** for occurance of Isocyanates, please contact the 3M Customer Helpline +44 (0) 870 60 800 60 or your local 3M office

What types of filters are there?

Filter Type	Colour	Main area of application
P	White	Solid and liquid particles
A	Brown	Organic gases and vapours with boiling point >65°C.
AX	Brown	Highly volatile organic solvents with boiling point <65°C.
B	Grey	Acid gases
E	Yellow	Inorganic gases
K	Green	Ammonia and organic ammonia derivatives
Hg	Red	Mercury (vapour) and mercury compounds

Filter Classification	NPF* with 3M Half Mask	NPF* with 3M Full Face Mask
P1	4	5
P2	12	16
P3	48	1000
Class 1 Gas and Vapour filters	50 or 1000ppm (whichever is lower)	2000 or 1000ppm (whichever is lower)
Class 2 Gas and Vapour filters	50 or 5000ppm (whichever is lower)	2000 or 5000ppm (whichever is lower)

AX-Filter for low boiling point (organic composition with a low boiling point under 65 °C). AX-Filter should only be fitted to 3M™ Full Face masks. AX filters may only be used for a single shift.
A1 and A2 Filter for organic vapour with a boiling point above 65 °C.
* Country APF should be used where available.
Nominal Protection Factor (NPF) - a number derived from the maximum percentage of total inward leakage permitted in relevant European Standards for a given class of respiratory protective devices.

Select the right respirator and filter.

3M™ Bayonet Filter Series

3M™ Reusable Respirators and Filters at a glance

3M™ Full Face Mask 6000 Series

6035 P3 R

or

2125 P2 R

2135 P3 R

Particulate protection only

3M™ Half Mask 7500 Series

6038 P3 R-HF

or

2128 P2 R

2138 P3 R

Particulate protection with relief from nuisance odours

3M™ Half Mask 6500QL Series

6051 A1
6055 A2
6054 K1
6057 ABE1
6059 ABEK1
6075 A1+ formaldehído

Gas and vapour protection only

3M™ Half Mask 6000 Series

6091 A1P3 R
6092 A1B1E1K1P3 R + formaldehído
6095 A2P3 R
6096 A1E1HgP3 R
6098* AXP3 NR*
6099* A2B2E2K2HgP3 R + formaldehído

or

6051 A1
6055 A2
6054 K1
6057 ABE1
6059 ABEK1
6075 A1+ formaldehído

and

5911 P1 R
5925 P2 R
5935 P3 R

and

501

Combined particulates + gas and vapour protection

* Filters only to be used with full face mask.

3M™ Secure Click™ Filterserie

3M™ Secure Click™ Half Mask HF-800 Series

D3125 P2 R

D3135 P3 R

Particulate protection only

D3128 P2 R

D3138 P3 R

Particulate protection with relief from nuisance odours

D8051 A1
D8055 A2
D8059 ABEK1

Gas and vapour protection only

D8094 ABEKP3 R
D8095 A2P3 R

or

D8051 A1
D8055 A2
D8059 ABEK1

and

D7915 P1 R
D7925 P2 R
D7935 P3 R

and

D701

Combined particulates + gas and vapour protection

3M™ DT-Series Filters

3M™ Reusable Full Face Mask FF-300 Series

DT-1135E P3 R

Particulate protection only

3M™ Reusable Full Face Mask FF-600 Series

DT-4001E A2
DT-4005E A2B2
DT-4006E ABEK2
DT-4007E AX

Gas and vapour protection only

DT-4031E A2P3 R
DT-4032E B2P3 R
DT-4035E A2B2P3 R
DT-4036E ABEP3 R
DT-4045E* ABEK2 P3 R
DT-4046E* ABEK2HgP3 R
DT-4047E* AXP3 R
DT-4048E* AXB2P3
DT-4049E* REACTOR HG P3 R
DT-4149E* REACTOR HG P3 R

Combined particulates + gas and vapour protection

3M™ Reusable Half Face Mask HF-300 Series

* Filters only to be used with full face mask.

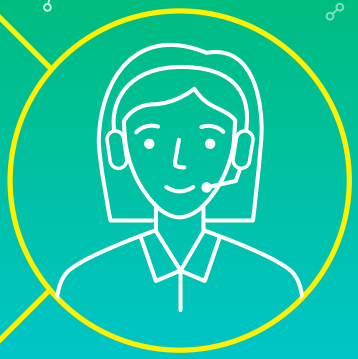
3M Science. Applied to Life.™

Have airborne hazards? Get help.

It's not always obvious what's in your air. But it is worthwhile to find out and establish an effective Respiratory Protection Program. At 3M, we're happy to help you start on the path to protection:

1. Lay the groundwork.

- Consult safety data sheets
- Assess your environment and applications
- Determine who is at risk
- Consider employee schedules, applicable materials and potential exposures



2. Start sampling.

- Collect air samples based on exposures
- Determine your specific course of action. 3M may be able to assist you with this.
- Consider lightweight 3M™ Diffusion Monitors for certain gases and vapors

3. Get your analysis.

- Analyse your samples. An industrial hygiene lab could help you.
- Use your analysis to compare your exposure levels to applicable Occupational Exposure Limits

4. Select your protection.

If you can't eliminate the hazard, or control it with other measures, then use the 3M™ Respirator Selection Guide to find the right respirator for your team.

Choose from a broad portfolio including:

- Disposable respirators
- Reusable respirators
- Powered & Supplied Air respirators
- SCBA

5. Implement and adapt.

Maintain a written respiratory protection programme that may include:

- Continuous review and improvement
- Fit testing
- Continued employee training

The importance of monitoring 3M™ Gas Diffusion Monitors.

Knowing the specific contaminant and exposure levels is important to determine the appropriate respirator and filter for your work environment. This information will also help in estimating the life of selected 3M™ Gas and Vapour Filters. If exposure levels are not known, advice and monitoring is required.

While 3M does not carry out exposure assessments or monitoring, we do offer 3M™ Gas Diffusion Monitors (below) which can be a useful starting point. 3M Gas Diffusion Monitors are simple and effective devices that collect certain airborne contaminants using the principle of diffusion. They assist in the assessment of exposure to workplace contaminants, both personal and background. These monitors are easy to use and simply clip onto the shirt, collar or pocket.

Meet our updated lineup.

Organic Vapour, Ethylene Oxide, and Formaldehyde Monitors

- Easily clips to lapel, collar or pocket
- No batteries, hoses or pumps
- Small and lightweight—won't interfere with employees' activities
- Can be used for area monitoring if sufficient air flow exists

3M™ Badge Monitors

Organic Vapor Monitor 3500+
Organic Vapor Monitor 3501+, high sampling rate
Ethylene Oxide Monitor 3551+
Formaldehyde Monitor 3721+

What is the difference between the 3500+ and the 3501 organic vapour monitors?

The 3501+ has a higher sampling rate for low concentrations or short-term exposure limit (STEL) sampling.

How do I interpret the results?

Monitoring results may be compared to applicable occupational exposure limits (OEL). OELs for many common industrial contaminants may be found in the 3M Respirator Selection Guide.

How do I develop a cartridge change schedule?

The exposure monitoring data may be entered into the 3M Service Life software at www.3M.com/sls to estimate the service life of 3M gas/vapour filters.

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