Demand Controlled Garage Ventilation

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There are two main reasons for measuring exhaust air in a garage: To optimize the ventilation and hence the energy efficiency to control the fans on demand and to avoid the concentration of hazardous substances.

Carbon monoxide (CO) is a product of incomplete combustion and reduces the blood's ability to carry oxygen; overexposure may be fatal. Nitrogen oxides (NOx) are generated when nitrogen in the air reacts with oxygen at the high temperature and pressure inside the engine. NOx is a precursor to smog and acid rain. NO_2 destroys resistance to respiratory infection.
Carbon monoxide (CO) is typically the residual from petrol engines and nitrogen oxides a residue from diesel engines. They both have in common that they are dangerous to humans.

Gas detectors measure the concentration of potential hazardous concentrations of exhausts in car park garages, road tunnels, pits etc. When the concentration reaches a certain level, the detector automatically starts the fans and stops the fans when concentration has gone back to pre-set levels.

Sometimes it is recommended to measure the concentration of carbon dioxide (CO_2) in garages to get a reference value relative the actual concentration of (CO) / (NOx). It is worthwhile to notice that the relation is not valid when the engines are started cold. Samon's recommendation is therefore always to use both a Carbon monoxide (CO) and a Nitrogen dioxide (NO_2) detector for most accurate measurement.

Hygienic Limit Values (HLV)

An Occupational Exposure Limit (OEL) is the maximum acceptable average concentration (time-weighted average) of pollutants in inhaled air, where the pollutants may be a substance or mixture of substances.

Limit values are laid down throughout the EU, but each EU member state establishes its own national OELs, often going beyond EU legislation.

- Time Weighted Average (TWA): Exposure limit for exposure during a working day (8 hours).
- Short-term Exposure Limit (STEL): A recommended value, consisting of the time-weighted average exposure over a reference period of 15 minutes.

Hygienic Limit Values according to Swedish AFS 2005:17 when the source is exhausts:

Carbon monoxide (CO)

- TWA (Time Weighted Average)	20 ppm
- STEL (Short-term Exposure Limit)	100 ppm

Nitrogen dioxide (NO2)

- TWA (Time Weighted Average)	1 ppm
- STEL (Short-term Exposure Limit)	5 ppm

Design and installation

Carbon monoxide (CO) has the same density as air and mix easily hence creating a poisonous mixture. A Carbon monoxide (CO) detector is recommended to be mounted at app. 180 cm above the floor.
As nitrogen dioxide (NO_2) is heavier than air, detectors should be mounted app. 20-30 cm above the floor.

In a normal garage, you may calculate with one detector (CO & NO_2) for every 200-500 sqm. depending on, among others, if the garage is open (without air pockets) and if there is a continuous air flow.

In spaces like "service pits", a nitrogen dioxide (NO_2) should be mounted in every pit.

When installing the detectors one must take into consideration garage characteristics, supply and exhaust ventilation, etc. to achieve maximum coverage and to avoid false alarms.

Appropriate alarm levels

Carbon monoxide (CO)

- Pre-alarm	50 ppm
- Main alarm	100 ppm

Nitrogen dioxide (NO_2)

- Pre-alarm	2 ppm
- Main alarm	5 ppm

Alarm level function

- Pre-alarm: The speed of the fan increases to full speed and a strategically placed flash-light starts to flash.
- Main- alarm; as pre-alarm alarm plus activated sirens that advices people to leave the garage immediately.

Operation and maintenance instructions

The detectors are to be inspected at least once a year.

To keep in mind:

- The life span of the detectors is dependent on the detection principle in use. Semiconductor based detectors have a life expectancy of 5-6 years and electrochemical sensors 24-36 months.

- Flash lights and sirens should not be activated too early in order to avoid unnecessary disturbances and stress for the public.

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