**Alarm system**

2 alarm levels: level 1 is an early warning to the user that there is a cause for concern that should be remedied. A level 2 alarm is triggered when a gas level has become concentrated to the point of causing harm in a short period of time. To end alarm Arduino Mega must be reset manually via its reset button, but the alarm will simply trigger again if the source of the alarm has not been addressed.

**CO**

<https://www.co2meter.com/en-uk/blogs/news/carbon-monoxide-levels-chart> displays a chart conveying that no more that 9ppm or 0.0009% should be in an indoor space (figure from WHO). Physical symptoms can occur after 6-8 hours exposure to 35ppm or 0.0035% and symptoms can arise rapidly in environments over 200ppm or 0.02%. The DFRobot SEN0466 sensor can detect 0-1000 ppm at a resolution of 1ppm.

A level 1 alarm will be triggered if a CO level of 0.0035% has been detected for 1 hour. A level 2 alarm will go off when a CO level of 0.02% has been detected for 5 minutes.

**CO2**

<https://youriaq.com/acceptable-levels-of-co2-in-home/> explains that, in a well-ventilated room, CO2 levels should be below 600ppm. Levels above 1000ppm for an extended period of time can cause physical harm such as headaches and fatigue.

A level 1 alarm will sound off if over 1000 ppm of CO2 has been detected continuously in a 1-hour period. Level 2 alarm at 5000ppm for 10 minutes

**PM**

<https://www.c40knowledgehub.org/s/article/WHO-Air-Quality-Guidelines?language=en_US#:~:text=The%20WHO%20guidelines%20state%20that%20annual%20average%20concentrations,more%20than%203%20-%204%20days%20per%20year> explains WHO guidelines. PM2.5 overall should not be over 5ug/m3, and maximum in 24 hour period should not be above 15ug/m3. For PM10, which is less dangerous, limits are tripled at 15ug/m3 overall on average and a maximum of 45ug/m3.

Level 1 alarms 15ug/m3 for PM2.5 and 45ug/m3 for over 1 hour and level 2 alarms for 25ug/m3 for PM2.5 and 75ug/m3 for PM10 for 10 minutes.

**H2S**

<https://www.cdc.gov/niosh/idlh/7783064.html> says 300ppm is max which can be endured in 1 hour without serious consequences.

Level 1 alarm at 100 ppm for 30 minutes. Level 2 alarm at 300 ppm for over 5 minutes.

**VOC**

On a farm, the most common VOCs which the PID counter will detect is NH3, CH4, H2S and BTEX compounds (compounds with benzene, toluene, xylene, etc.). Ammonia can be dangerous above 100ppm for an extended period. Benzene is most lethal, limit is only 1ppm in a work week.

The sensor can detect a range of 0 – 40 ppm.

**CH4**

<https://inspectapedia.com/sickhouse/Gas_Exposure_Limits.php#:~:text=Methane%20%28Natural%20Gas%29%20gas%20exposure%20limit%20-%20500ppm,-%205ppm%2C%20Methanol%20gas%20exposure%20limit%20-%2050ppm> exposure limit for CH4 is 500ppm

level 1 alarm at 1% for 30 minutes, level 2 at 5% for 10 minutes.