



# WAREHOUSE OPTIMIZATION: BALANCING EQUIPMENT PERFORMANCE AND WORKER SAFETY THROUGH EMISSIONS MEASUREMENTS AND AIR QUALITY MONITORING

Successful warehouse functionality is dependent on both maximizing equipment performance and providing a safe and healthy environment for workers that encourages productivity. However, these two factors are often at odds with each other as warehouse equipment such as forklifts, burnishers and delivery trucks emit toxic gases that can have the potential to create poor indoor air quality which affects worker respiratory health and overall productivity. Warehouse managers and supervisors should optimize the balance between equipment performance and personnel safety and comfort to achieve maximum production.

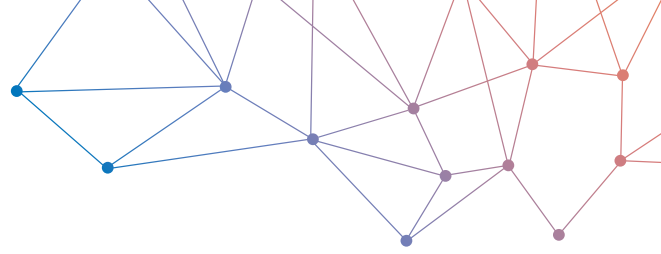


## Warehouse Equipment Emissions and Sources

Three toxic gases that may be present within a warehouse are carbon monoxide (CO), nitrogen oxides (NO/NO<sub>2</sub>/NO<sub>x</sub>) and volatile organic compounds (VOCs). Elevated levels of any one of these gases may result in immediate health issues including shortness of breath, headaches or nausea and long-term effects such as respiratory distress, cancer and, in extreme cases, death. These gases are generated from a variety of causes necessary for successful daily warehouse function, and are exacerbated by poor ventilation, particularly in winter months when warehouses are normally sealed off from cold weather.



Toxic Gas	Possible Cause
Carbon Monoxide (CO) & Nitrogen Oxides (NO <sub>x</sub> )	Forklift Idling and Length of Operation Floor Cleaning and other Combustion Equipment Chemical Emissions from Manufacturing Processes Exhaust Fumes from Diesel Truck Pick up/Drop off Forklift Emissions Forklift Malfunction
Volatile Organic Compounds (VOCs)	Off-Gassing from Packaging Materials Painting Solvents



## Strategies for Optimizing Equipment Performance and Worker Safety/Productivity

Warehouse managers and supervisors have a variety of strategies for optimizing performance of equipment and worker safety and productivity:

### 1) Monitoring Warehouse Equipment Emissions and Efficiency

Periodic monitoring of emissions from gas & diesel powered forklifts and other equipment that emit toxic gases provides information on each machine's contribution to air quality, but also on the vehicle's efficiency. High emissions from Forklifts and other sources may indicate an equipment malfunction requiring maintenance in order to:

- Optimize equipment efficiency & maximize fuel savings
- Identify and quantify the sources affecting the safety & comfort of the work environment.

Emission gas levels should be measured near the tailpipe using a portable gas analyzer and adjustments should be made to the throttle and fuel delivery system in order to ensure a clean burn.

### 2) Indoor Air Quality Monitoring

Even a small amount of exhaust gas can result in a significant build up of CO and NOx in the air. Periodic measurements of air quality at a wide variety of locations of a warehouse provide an understanding of potential safety problems that may be occurring for on the floor personnel. Elevated levels of CO, NOx or other toxic gases will have negative effects on worker productivity and safety.

**3) Determining the objectives associated with emissions and performance** required for Forklifts, Burnishers, and other equipment in the premises Warehouse managers should assess the current conditions and establish targets for the pollutants emitted by the different sources and the acceptable indoor air quality levels of toxic gases such as CO, CO<sub>2</sub>, NOx, and VOCs in order to create and implement air movement/replacement strategies when these levels are exceeded.

**4) Implementing a Long-Term Air Quality Optimization Strategy** (Air Quality/Movement/Replacement) to Avoid Toxic Gas Build Up Warehouse supervisors should consider designing and implementing a long-term air movement and replacement strategy that aims to:

- Maintain the air quality standards required to safely run the warehouse
- Measure and evaluate the performance of all of the contributing factors to warehouse air quality



### Warehouse Air Quality Monitoring Solutions: Si-CA 230 & Si-AQ Expert

Warehouse indoor air quality and forklift emissions monitoring can be performed using the Sauermann [Si-CA 230](#) Portable Emissions monitor, and the [Si-AQ Expert](#) IAQ monitor.

These specialized monitoring instruments allow warehouse professionals to quickly and accurately monitor the levels of dangerous CO, NOx, and VOCs present in warehouses and other industrial facilities.

These monitors include software with real-time continuous data logging, wireless connection and can be customized to monitor different parameters relevant to indoor air quality and/or engine emissions.