MSA
The Safety Company

Sensor Technologies for Ammonia Detection

Technical Guide

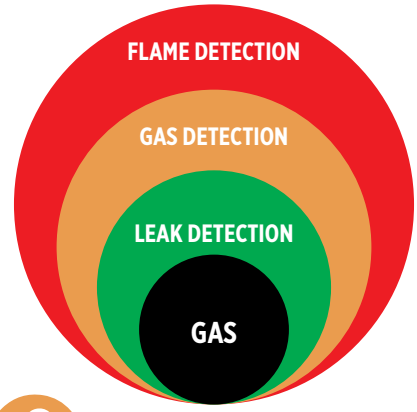
SAFEGUARDING PEOPLE,
PLACES & THE PLANET.

Protection Layers for Ammonia Leaks

A layered fire and gas detection approach for ammonia facilities involves integrating leak, gas, and fire detection systems to help achieve comprehensive safety by identifying potential hazards at every stage of operations.

Layer 1: Leak Detection

Ultrasonic gas leak detection provides the earliest possible response to pressurized gas leaks. Ammonia is often compressed to high pressures to ease transportation, utilization, and storage. Ultrasonic gas leak detection helps prevent potential escalation to hazardous levels, as ammonia leaks can pose significant safety and environmental risks if undetected.



Layer 3: Flame Detection

Flame detectors provide a fast response layer to the presence of flame, minimizing the risk of fires from various ammonia processes and storage locations. Fire hazards arise from a combination of gas leaks, high pressure, and high temperatures that can ignite the gas cloud. This approach helps prevent fires from spreading and causing further damage, protecting equipment and personnel.

Layer 2: Gas Detection

Point, multi-point, and laser open-path gas detection technologies aid in risk mitigation based on location and application. Point detectors provide quantitative measures in ppm or %LEL at specific locations. Additionally multi-point sampling systems can provide accurate local ppm detection while reducing installation and maintenance costs. Finally, open-path detectors extend protection across large areas, delivering long-range detection of expanding gas clouds with proven ppm·m sensitivity.

Layer 1: Leak Detection
Ultrasonic gas detection helps provide the earliest possible response

Expanding Gas Clouds

Localized Gas Clouds
Single and Multi-point

Layer 2: Gas Detection
Multiple advanced technologies aid in risk mitigation based on location and application

Layer 3: Flame Detection
Optical flame detectors assist in the prevention of fire hazard escalation and explosions

General Ammonia Sensing Technologies Characteristics

Sensor Characteristics	Technology Pros	Technology Cons	Applications	MSA Products
Ultrasonic Leak Monitoring				
• Typical detection ranges: 17-28m, depending on microphone technology[1] • Detects the sound pressure of a gas leak • Varying microphone life[1] • Calibration required if out of tolerance[1]	• Instant leak detection with processing algorithms[2] – at the speed of sound • Reliable for outdoor or ventilated areas • Not affected by changing wind or direction of the leak • Complements point and open-path gas detectors	• Doesn't indicate the gas concentration • Only suitable for pressurized installations from 2 bar (29 psi) or more	• Pressurized installations in compressor rooms, machinery spaces, tank farms, or transfer skids • Energy conversion plants, such as ammonia-to-hydrogen cracking units • Marine engine rooms using ammonia as fuel, for monitoring fuel injection line leaks • Ammonia synthesis processes within reactors, compressors, and exchangers	• **Observer® i**
1. 28m detection range, with long-life electret microphone and capability for on-site microphone replacement and calibrations. 2. ANN – artificial neural network algorithms help prevent false alarms and offer plug-and-play installation without the need for site surveys.				
Laser Open Path				
• Measuring range: up to 0-15000 ppm.m (parts per million meters) • Path lengths: 5-40m, 40-120m • Very specific to ammonia[1] • Long laser source life • Not affected by poisons • Non-consuming	• Reliable detection in outdoor or ventilated large areas • Unaffected by rain, fog, and snow • Immune to cross-interferents • No need for calibration	• Limited use for areas with dense installations • Does not measure point concentration	• Large industrial sites, including fertilizer and chemical manufacturing plants • Ammonia production units with downstream storage or bunkering • Green ammonia energy export hubs and maritime fuel terminals	• **Senscient ELDS™**
1. Enhanced Laser Diode Spectroscopy (ELDS) - patented detection technology that uses multi-point harmonic verification to eliminate false alarms and verify the presence of the target gas.				
Point Catalytic Bead				
• Detects various explosive gases • Typical measuring range: 0-100 %LEL (lower explosive limit)[1] • Varying sensor life depending on application	• Provides reliable %LEL gas measurement • Easy to install and maintain • Optional remote sensor mounting[2]	• Cannot always identify gas detected, as it responds to many combustible gases in LEL range	• Suitable for spaces with large inventories where a release could approach LEL levels • Compressor rooms, machinery spaces, tank farms, or transfer skids • Green ammonia plants handling high-volume renewable hydrogen feed • Electrolyzer equipment requiring combined hydrogen and ammonia monitoring	• **ULTIMA® X5000** • **General Monitors® S5000** • **TG5000** • **PrimaX® P *** • **Series 47K*** **Available in select regions*
1. XCell® sensor with extra-large beads, supported by mechanical posts offering > 5-year life. 2. Dual sensor configuration (local or remote) available with ULTIMA X5000 / General Monitors S5000 for catalytic bead and electrochemical sensors.				
Point Electrochemical				
• Typical measuring range: 0-100 ppm and 0-1,000 ppm • 1-2 year sensor life[1]	• Very low concentration measurement in ppm • Easy to install and maintain • Optional remote sensor mounting[2]	• May experience cross-sensitivity to other gases	• Used for direct measurement of ammonia at occupational exposure levels • Compact format allows deployment in confined or occupied spaces • Compressor and pump rooms with dense installations, including valves and flanges • Specific areas within tank farms, such as pump bays, valves, dike walls, and access points	• **ULTIMA X5000** • **General Monitors S5000** • **TG5000** • **PrimaX P*** • **PrimaX I*** **Available in select regions*
1. >5-year sensor life for XCell® ammonia sensor due to non-consuming electrolyte design. 2. Dual sensor configuration (local or remote) available with ULTIMA X5000 / General Monitors S5000 for catalytic bead and electrochemical sensors.				

Sensor Technologies for Ammonia Detection

Sensor Characteristics	Technology Pros	Technology Cons	Applications	MSA Products
Multi-Point Photoacoustic IR				
• Measuring range: 0-1,000 ppm • Multiple sampling points possible[1] • Very specific to ammonia • >5-year sensor life	• Unaffected by interference gases or corrosive environments • High stability and sensitivity, even if frequently exposed to ammonia • Less consumable parts compared to electrochemical sensing	• Longer gas sample transport time when using maximum allowable line length	• Multiple point monitoring for health and environmental leak hazard detection • Machinery and pumps to identify leaks around gaskets and flanges caused by wear and tear • Green ammonia energy hubs with fuel feed systems, injection, and handling • Traditional warehouses and cold storage refrigeration facilities	• **Chillgard® 5000 Ammonia Monitor**
1. Maximum 16 points useful for areas requiring sampling at multiple, difficult-to-access locations.				
UV/IR Flame Detection				
• Fast response time • Medium detection range • Typical 90° - 125° field of view	• UV and IR radiation used to activate alarm • Large coverage area optimal for short-range and wider physical spaces • Independent output notification – typically UV – 12 mA & IR – 8 mA	• Can be impacted by dirt, soot, oil, as well as water, ice[1] • IR heat source presence can falsely trigger the IR sensor portion[2] • UV energy can be detected at very long distances due to reflectivity[2]	• Suitable for areas requiring the detection of both ammonia and invisible hydrogen fires • Ammonia storage and handling areas • Industrial plants, including fertilizer and chemical production • Green ammonia or hydrogen production sites	• **FL500-H2**
1. Continuous Optical Path Monitoring (COPM) checks optical path integrity every 2 minutes. 2. Advanced flicker discrimination circuitry helps prevent false alarms caused by lightning, arc-welding, hot objects, and other sources of radiation.				

MSA's Layered Ammonia Gas & Flame Monitoring

A layered system that combines multiple ammonia gas and flame detection solutions can provide more robust protection tailored to each facility's unique layout and operating conditions. Each detection technology offers specific advantages depending on the application environment, and each also has inherent limitations.

Layered detection helps reduce the likelihood of hazard propagation by identifying leaks or ignition events early, thereby limiting the potential for escalation. By applying complementary detection technologies, facilities can improve the overall effectiveness of their fire and gas detection systems.

Our Mission

MSA's mission is to see to it that men and women may work in safety and that they, their families, and their communities may live in health throughout the world.

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