

WHITE PAPER

Actionable Information from High Pressure Mass Spectrometry

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Virtually all hazardous materials response teams have been to a possible chemical incident in a high-profile building with multiple illnesses. Nothing else is known except that people are worried and the Incident Commander is under pressure to get answers quickly. That incident commander needs actionable information that will conclude the incident or allow effective actions to minimize danger to the responders and the public. Information is critical to guide the medical treatment of those reporting illness and to provide mitigation options for hazard removal. Conversely or concurrently, *definitive* information is sought that will ease public concern, media hype, and political pressure. Is this incident an act of terrorism, a leaky air conditioning system, an exterminator's errant application of pesticides, or something else?

As minutes pass, the incident takes on a life of its own. Speculation builds, word spreads. Soon, concern and inquiry come from unusual places, such as state and federal agencies or even from high-level operations centers in Washington, D.C. Everyone wants to know *what* is happening and *how* will it be mitigated.

In many hazardous materials response teams, for critical incidents of this nature, a reconnaissance entry (recon) is likely. The objective of a recon is to determine apparent risk and possible immediate cause. A recon is generally conducted by two members in high-level personal protective equipment (PPE) with an array of detection technologies, including pH paper, a radiological survey meter, a multi-gas meter (for detecting flammable vapors and O₂ at a minimum), a photoionization meter (PID), and possibly some version of an ion mobility spectrometer (IMS).

While a recon may begin to point the investigation in one direction or another, it is almost never actionable by itself. The limits of the detection technologies carried in the recon simply don't provide the sensitivity, specificity and detail necessary to make high-consequence decisions. For chemical detection, the responder must consider what information can be derived from these technologies in an unknown environment. The multi-gas meter can tell if there is an elevation or depression of the O₂ concentration, the presence of an uncorrected explosive atmosphere, and even the concentration of other gases based on the configuration of the meter. However, the sensors in the meter may be subject to known interferences and cross-sensitivities. A PID will only provide an uncorrected concentration of a gas or vapor within the ionization potential of the bulb and the detection sensitivity of the meter, so very little actionable information can be deduced. While IMS is quite sensitive, with detection sensitivity for organophosphate-based chemical weapons in the 0.009 - 0.017 parts-per-million (ppm) range in 11 - 30 seconds¹, it is so subject to interferences that it is dangerous (from a risk communication standpoint) to determine the presence of chemical weapons based IMS alone. Thus, it is generally the case that a second, more directed survey mission will need to follow the recon. Depending on the analytical equipment capabilities of the team, a third sampling mission may be necessary if the secondary survey locates a possible causative substance. Each entry adds minutes or hours to the time before actionable information is obtained.

Enter high-pressure mass spectrometry (HPMS). HPMS was developed as a handheld downrange chemical threat detector that is ready for operation in less than one minute. Indeed, the capabilities of HPMS devices are expanding with each new version. The latest embodiment crosses a major threshold by bringing actionable information to a recon-capable package. When used as a recon or survey tool in the vapor mode, the HPMS meter can be carried with hand straps or a shoulder sling while sampling. When a target threat is detected, the instrument produces a visual (and optional audible) alarm. But unlike other meters that can be rapidly deployed, HPMS identifies materials with high certainty. Based on independent testing against the same chemical weapons used



MX908 provides priority threat confirmation for fast incident mitigation.

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to cite the IMS capabilities above, HPMS can detect *and identify* an agent at 0.019 ppm in 5.2 seconds². Similar results can be achieved for precursor, degradation products, and high-consequence toxic industrial chemicals. In its “CW Hunter” mode, the HPMS meter also provides the concentration of the identified chemical agent (in mg/m³).

An added benefit of the HPMS device is that it can be switched from vapor mode to trace mode during down range operations. If a suspect substance is located during recon (or other subsequent entry), a trace sample can be collected and analyzed in the hot zone without having to package the sample or mount a subsequent entry for such purposes. Again, this provides opportunities to develop actionable information earlier, faster and with greater confidence than was previously possible.

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Information provided with mass spectrometry with such speed and sensitivity is truly actionable. The detection and identification of chemicals with HPMS carries sufficient surety to warrant definitive action, medical treatment and communication. Of equal importance is the ability to infer the absence of any threats stored in the HPMS library. Ruling out threats is actionable for narrowing or reducing the level of concern at an incident.

In the face of an ever-growing range of chemical threats and the public concern that they generate, response teams must look to improve strategies, methods, and technologies to maintain an edge. HPMS makes gold-standard detection and analytical capability smaller, lighter, faster and more affordable than ever. Portable devices powered by HPMS are opening the door to help teams improve their ability to protect the public in a range of scenarios, including high-profile incidents.

REFERENCES: 1. Source: Hazmaster G3 Software, Version 21. 2. Source: MRI Global, 908 Devices MX908 System Chemical Warfare Agent Vapor Testing and CWA, Explosives, and Toxic Chemical Thermal Desorption Testing on Instrument 3, May 5, 2017, MRI Global Project No. 311448-Mod 4.

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MX908 serves a broad range of chemical detection and identification missions.



Portable HPMS devices are shelf ready for a variety of downrange operations.



MX908 offers true trace level detection and identification of priority threats.