

Application Brief AB-086

Hand-held FT-IR: Touch-Sample Technology for Portable Chemical Identification

Introduction

Chemical identifiers based on Fourier transform infrared (FT-IR) spectroscopy are now commonly used in hazardous materials response. With their simplified sample interfaces and sophisticated data processing methods, these systems changed how responders deal with white powders, drugs, explosives, and other suspicious solids and liquids. Despite their capabilities, conventional table-top style FT-IR systems may not be ideal for certain missions. As a result, hand-held FT-IR identifiers are becoming available to address the diverse needs of various emergency response teams. This application note discusses how the HazMatID Ranger™, a hand-held FT-IR system, compares to its table-top predecessor and how users can decide which is right for them.



Figure 1. Smiths Detection's HazMatID Ranger

What is the HazMatID Ranger?

The HazMatID Ranger is a smaller version of the popular HazMatID™, as illustrated in Figure 2. While both are FT-IR systems designed for identifying solids and liquids, the Ranger is 7 times smaller and 4 times lighter than the HazMatID. Table 1 lists some of the key comparison points between the two units. Both obtain molecular fingerprints of samples in contact with a diamond sensor, and both identify unknowns using digitized library spectra. Both have simple-to-navigate touch screen interfaces that allow users to view results for visual confirmation. As shown in Figure 3, the systems produce nearly identical results, and they exhibit comparable sensitivities to components in mixtures. And of course, both instruments are backed by Smiths Detection's unsurpassed 24/7/365 ReachBack™ service. The key difference is that the Ranger can be carried directly to a sample and operated with one hand. To analyze a sample with the Ranger, its diamond sensor tip is brought into contact with the material. If the sample is a powder on a flat surface, the tip is pressed directly into the pile. If the sample is an open pool of liquid, the tip is touched to the liquid surface. For white powders, liquid spills, and most samples with easily accessible surfaces, the analysis is straightforward.

However, certain samples present challenges for hand-held FT-IR systems. Hard or granular materials may not easily achieve sufficient contact with the diamond tip to produce good results. As seen in Figure 3, the similarity index (S) between the Ranger and HazMatID spectra for sugar (a coarse, crystalline solid) is slightly lower (0.97) than the S values for sodium bicarbonate (a soft powder) and ethylene glycol (a liquid). Difficulties with solids are especially evident when the materials are present in small amounts or are located on irregular surfaces like asphalt or carpet. Liquids which are contained in bottles and not easily accessible by the diamond tip also present problems, particularly when the liquids are highly volatile. For challenging samples such as these, a portion of the material must be applied to the sensor tip by the user. This requires the system to be placed on a surface as shown in Figure 4. The Ranger's dual capacity offers greater flexibility in this scenario than other hand-held systems. The PDA computer is detached from the base unit, which is then placed on its back as shown in Figure 4. The Ranger then operates like a table-top system. Solids are easily handled using the solids press accessory and liquids are placed directly onto the diamond tip and, if necessary, contained within a liquids well.



Figure 2. The Ranger is a hand-held version of the popular HazMatID chemical identifier.

Which FT-IR Fits the Mission?

In the world of hazardous materials response where entry teams have seemingly countless meters to carry into a hotzone, smaller may logically seem better. Sometimes it is, but not when it means sacrificing needed capability. As discussed above, certain samples are problematic for hand-held FT-IR systems. Although the Ranger is configurable to address these issues, they are not concerns for the HazMatID. Furthermore, the HazMatID offers a larger 5.25 x 4 in. display for reviewing spectral results. And its greater processing power means that over 32,000 library spectra can be searched within seconds directly on the system computer. With the Ranger, the standard 5,000 spectra can be searched on the PDA at a comparable rate; processing the additional libraries requires a separate computer. Also, combined analysis with Raman data from the Responder can be performed directly on the HazMatID, while the Ranger data must be exported to a separate computer for this advanced function.

	HazMatID	Ranger
FT-IR/diamond ATR technology	X	X
4000-650cm ⁻¹ coverage @ 4cm ⁻¹ resolution	X	X
5,000 library spectra standard	X	X
27,000 additional library spectra available	X	X*
Combined analysis with ResponderR Raman data	X	X*
One-handed operation		X
Touch-sample technology		X
Integrated solids press	X	
Wireless control by command laptop	X	
Smiths Detection 24/7/365 ReachBack™	X	X

* These advanced capabilities require a separate laptop computer.

Table 1. Side-by-side comparison of HazMatID and Ranger capabilities.

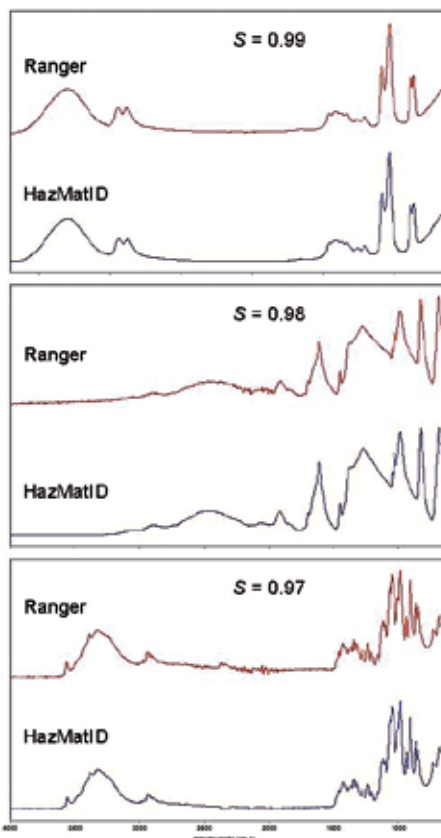


Figure 3. Comparison of data obtained on the Ranger and HazMatID: (top) ethylene glycol, (middle) sodium bicarbonate, (bottom) sugar. The S values indicate the similarity between each set of spectra.

So which system is best? It depends on the mission and capabilities of the team. For large city and regional HazMat teams who encounter a wide variety of sample types, the more broadly applicable table-top FT-IR makes more sense. For smaller teams who typically face white powder and liquid spill calls, the hand-held FT-IR can be a better solution. Likewise, military personnel who require maximum portability and primarily deal with liquids and relatively soft explosive solids, hand-held FT-IR may be ideal. On the other hand, any team who regularly deploys both FT-IR and Raman and needs to readily perform combined searching, the more powerful table-top unit fits the bill. In any case, equipment purchasing decisions are based on various criteria including organizational priorities, budgetary constraints, and tactical responsibilities. When it comes to chemical identification for emergency response, the HazMatID Ranger offers another alternative to ensure that, whatever the mission, the right tool is chosen.



Figure 4. The Ranger (shown with its solids press accessory) is easily configurable as a table-top workstation for challenging samples.