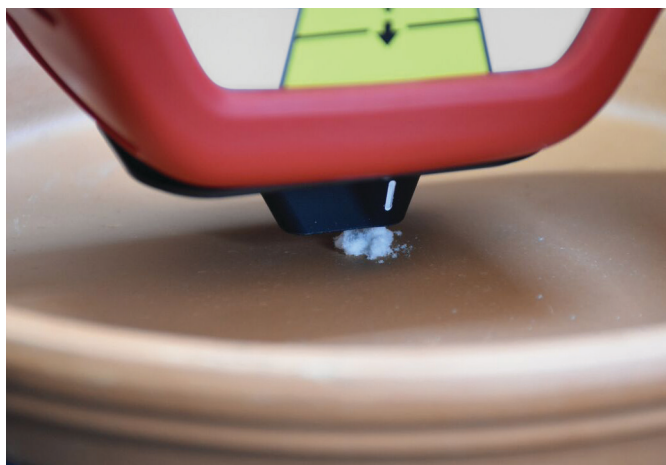**Agilent**

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# Screening for Sensitive Explosives with Agilent Resolve—a Handheld SORS System

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## Abstract

Analyzing sensitive materials (such as primary explosives and black powders) with laser-based handheld Raman devices can present a significant risk of detonation or deflagration of the material. This procedure presents a safety risk to the user. Detonation or deflagration can be caused by localized heating of the material due to the high-power density in the laser spot of most Raman systems. Laser spots are typically tens to hundreds of microns in diameter, whereas, due to a unique optical design, Resolve's laser spot is much larger.

## Introduction

The unique optical geometry of Agilent proprietary spatially offset Raman spectroscopy (SORS) technology means the power density of the laser spot on the sample is reduced (by orders of magnitude) compared to other handheld Raman devices. Together with the shorter exposure times used by the Agilent Resolve system, this results in a significantly reduced risk of detonation/deflagration, which improves user safety when working with sensitive explosives.

## Experimental

To conduct a Resolve system measurement, simply select the container type. The tests described are point-and-shoot (Clear bag or none selected) or vial measurements (Figure 1).
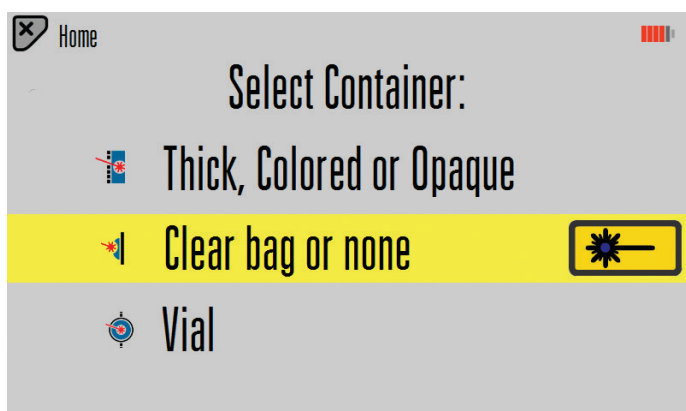


**Figure 1.** Selections for through-barrier, point-and-shoot, or glass vial measurements.

Exercise care and caution when scanning sensitive explosive materials. Resolve can be operated using a scan delay or remote trigger. The laser power can also be reduced (Figure 2).



**Figure 2.** Risk assessment screen for setting a time delay or reducing laser power.

Sensitive explosives (approximately 2–5 g in each case) were either scanned directly in point-and-shoot mode or contained within a vial.

All materials were scanned under explosive range conditions at Alford Technologies Broadmead Quarry facility (Somerset, UK).

Maximum laser power (475 mW) was used in each case, and a timer delay was used to allow the operators to retreat to a safe distance.

### Examples of materials tested

- Silver fulminate
- Mercury fulminate
- Sodium azide
- Lead azide
- Silver azide
- Lead styphnate
- HMTD
- TATP
- MEKP
- Nitrocellulose
- Nitroglycerine
- PLX
- Hydrogen peroxide 80 % + dark fuel

## Measurements and Results

The plots in Figures 3 and 4 illustrate the typical high data quality for a range of sensitive explosives either in vials or point-and-shoot mode. The total measurement times in these modes were approximately 30 to 40 seconds. The high signal-to-noise ratio means that these sensitive materials can be accurately identified from libraries of many thousands of chemicals.
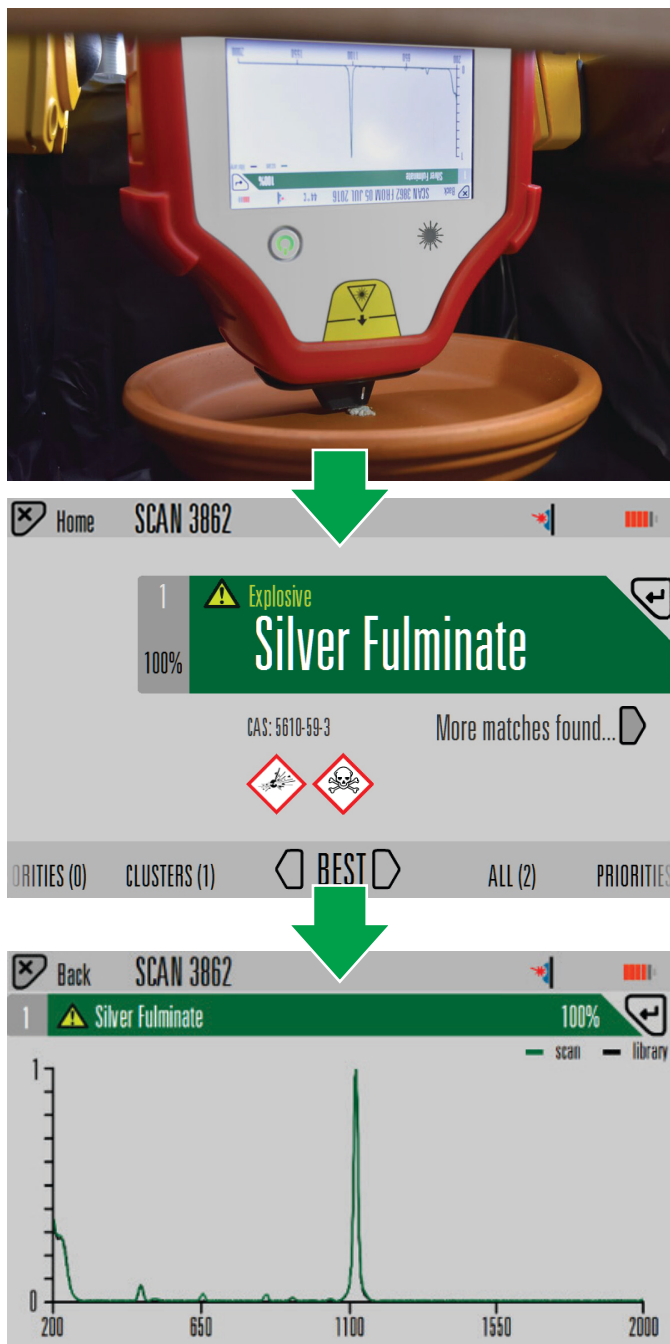


**Figure 3.** Range testing example: point-and-shoot identification of silver fulminate powder using the Agilent Resolve system.

The Resolve system did not cause detonation or deflagration during the range trials in this study. However, care and caution should always be used when scanning sensitive explosive materials. Conduct a thorough risk assessment, and follow normal safe operating procedures.



**Figure 4.** Example Raman spectra of nine primary and sensitive explosive materials, obtained during the Agilent Resolve system range testing. Measurements use point-and-shoot and vial modes.

## Conclusions

All materials could be identified correctly. The unique SORS optics result in a larger laser spot size than is typical for conventional Raman spectrometers. The high optical throughput of the system means that the system never has to acquire spectra for an excessive period of time. Combined, these two factors mean that the chance of accidental detonation or deflagration is greatly reduced.

The Agilent Resolve system is the only handheld Raman system using SORS, and enables exceptional data quality to be recorded even for the most sensitive explosives.

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