



User Guide & Technical Information

Morphix Technologies TraceX[®] Explosives Detection Kit

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For more information, please contact:



Virginia Beach, VA 23454
P +1.757.431.2260
F +1.757.431.2255
www.morphotec.com
email: customerservice@morphotec.com

Warning

While the TraceX[®] Explosives kit is designed to keep all chemicals within its plastic enclosures, human contact with kit chemicals is possible. Do not disassemble kit, reopen kit after use, or ingest any chemicals contained in the kit. If chemicals contact skin or eyes, wash with water and seek medical attention. The kit utilizes ampoules containing solutions (total volume < 2 mL) which may contain strong mineral acids or bases. Dispose of kit following applicable regulations and your organization's disposal policy. Use of the TraceX is subject to the Terms and Conditions of Use and any Warnings printed on the operating instructions.

Overview

The TraceX[®] Explosives kit is designed to help identify bombers, bomb-makers and their bomb-making facilities. With a single swab, the TraceX Explosives kit allows users to quickly and easily identify the most common homemade explosive materials (HMEs) and their precursors. The kit operates by using a collector to extract compounds from surfaces. The collector is then assayed for explosive-related materials via delivery of detection chemistries to the collector. A color change in the kit window indicates the presence of an explosive-related material.

This guide provides information regarding the TraceX Explosive kit, including:

- Detection capability
- Technical information
- Sample collection
- Field use guidelines
- Interferents

Additional training tools and videos are available by request and can also be found at www.morphtec.com.

Detection Capability

The TraceX Explosives kit can detect nine families of explosive materials and their precursors (see Table 1), and has been tested against more than 20 specific explosives or precursor materials. While the kit is highly sensitive to explosive related materials at trace levels, it can also be used for bulk detection. The TraceX Explosives kit detects levels at or below 250 nanograms for all HME classes, with the exception of peroxides; sensitivity to peroxides is 750 nanograms.

Table 1. Detection Capabilities

HME Class	Representative Chemicals
Nitroaromatics	TNT, DNT, Tetryl, picric acid
Nitramines & Nitrate Esters	RDX, HMX, PETN, EGDN, nitroglycerin
Inorganic Nitrates	urea nitrate, ammonium nitrate, black powder
Chlorates & Bromates	potassium chlorate, potassium bromate
Peroxides	TATP, HMTD
Precursor Class	Representative Chemicals
Acids	nitric acid, sulfuric acid, hydrochloric acid
Bases	potassium hydroxide, sodium hydroxide

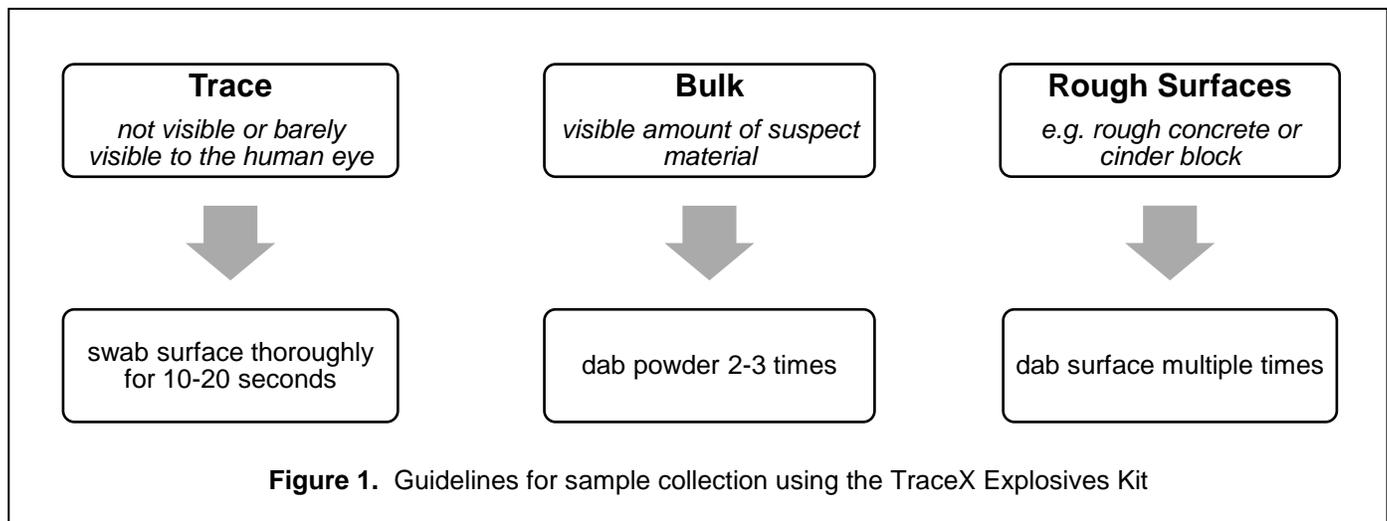
Technical Information

The TraceX[®] Explosives kit was developed by Morphix Technologies under contract from the US Department of Defense, and meets their demanding requirements. Rigorous testing was conducted under simulated field conditions to verify operational performance.

<i>Shelf Life</i>	Two year shelf life is based on storing product at room temperature (i.e. 20°C – 25°C) Short term excursions between 2°C – 50°C are acceptable for up to 2 weeks
<i>Operating Conditions</i>	Kit is operational at temperatures of 2°C – 50°C and humidity levels of 10% – 95% RH
<i>Field Ruggedness</i>	Kit enclosed in protective case
<i>Contamination Avoidance</i>	Sample plugs on collector are protected from contamination by cover
<i>User Safety</i>	No heat source required Chemicals are contained within the test kit minimizing the risk of user exposure

Sample Collection

For best results, evaluate the suspect surface to determine the most effective sample collection technique. If the suspect surface is rough, such as cinder block or rough concrete, dab or pat the collector multiple times on the surface. While the collector is made of rugged materials, repeatedly rubbing the collector on a rough surface may damage the collector plugs. If there is visible powder (i.e. bulk powder), gently dab the collector onto the powder two to three times. The TraceX kit is very sensitive to trace levels and too much powder could clog the collector. If the suspect surface is smooth with little to no visible powder, thoroughly swab the surface for 10 to 20 seconds. Morphix recommends using a figure-eight pattern when swabbing. Guidelines are illustrated in Figure 1.



Field Use Guidelines

The Trace X[®] Explosives kit was designed to give an unambiguous color change to alert the user of the presence of any materials listed in Table 1 of this guide. The color change will occur in the indication pads located in the kit top. When the kit is operated, all pads will show a slight wetting effect, resulting in the pads changing from white to off-white or light gray; this wetting effect is normal and does not indicate the presence of an explosive. Below is an example of the color change after sampling Nitrates (Figure 2). Although it is not necessary for the user to know the specific color for a positive indication, the typical color for each class at trace levels is included on the kit label and shown in Table 2. The intensity and shade of color can change based on the amount of analyte detected.



Figure 2. Close up view of TraceX showing Nitrates indication.

Table 2. Typical Color Change by Analyte

HME Class	Analyte Detected and Expected Color
Nitroaromatics	<ul style="list-style-type: none"> ● (purple) TNT ● (blue) DNT ● (orange) Tetryl, picric acid <p>Note: other nitroaromatics or mixtures may cause different colors (e.g. green)</p>
Nitramines/Nitrate Esters	● (pink) RDX, HMX, PETN, EGDN, nitroglycerin
Inorganic Nitrates	● (pink) urea nitrate, ammonium nitrate, black powder
Chlorates/Bromates	● (yellow) potassium chlorate, potassium bromate
Peroxides	● (yellow) TATP, HMTD
Acids	● (purple) nitric acid, sulfuric acid, citric acid, hydrochloric acid
Bases	● (blue) potassium hydroxide, sodium hydroxide

The TraceX Explosives kit exhibits a high degree of specificity across all detection channels. There are times, however, when the user may see more than one indication pad change color. This can occur when mixtures are detected or when contamination is present. The following results were observed:

- When urea nitrate is present, the Nitrates indication pad will show color and depending on the composition of the urea nitrate sample, the Acid pad may show color. This may allow the user to differentiate between urea nitrate and other nitrates, such as ammonium nitrate, which will only show color on the Nitrates indication pad.
- Nitroaromatic materials such as TNT, DNT and Tetryl will produce a color change in the applicable pad, as expected. However, these materials may also produce a color change in the Nitramine/Nitrate Ester pad marked HMX, RDX, EGDN, PETN. If color is observed in both pads, a nitroaromatic material is present, but a nitramine/nitrate ester may not be.
- While chlorates or bromates will show a yellow color in the Chlorates/Bromates pad, as expected, they can also cause a browning effect in the pad marked Nitrates or the pad marked HMX, RDX, EGDN, PETN when bulk sampling is performed. This browning effect has been observed only with chlorates and bromates. Additionally, the HMTD, TATP indication pad may produce a color change when sampling bulk levels of a chlorate or bromate.

Interferents

A series of potential interfering substances were sampled using the TraceX Explosives kit. These included common household products and chemicals sometimes associated with the manufacture of explosives. Materials were evaluated for their potential to generate a false negative or false positive result. A list of the field interferents that were evaluated is provided in Table 3.

Table 3. Field Interferents Tested

Field Interferent	Composition (color)
Powdered sugar	food grade: sugar & corn starch (white)
Table salt	food grade: sodium chloride, non-iodized (white)
Urea	reagent grade (white)
Baking soda	food grade: sodium bicarbonate (white)
Baking powder	food grade: corn starch, sodium bicarbonate, sodium aluminum sulfate, monocalcium phosphate (white)
Aluminum powder	reagent grade (gray)
Potassium permanganate	reagent grade (purple)
Wheat flour	food grade: unbleached (tan)
Cumin	food grade (yellow)
Turmeric	food grade: (yellow)
Fertilizer	commercial lawn fertilizer ~18% nitrogen (brown)
Ferric nitrate	reagent grade (off-white)
N,N-Diethyl-meta-toluamide (DEET)	reagent grade (colorless)

- White substances such as sugar, table salt, baking soda, urea, and baking powder showed no impact on the kit.
- When colored substances, such as unbleached wheat flour, aluminum powder, cumin, and turmeric were tested, color was visible in all indication pads due to transfer or solvation of the test material. It is highly unlikely, however, that an explosive or precursor would cause a color change on all indication pads. This means that if the user observes the same color on all indication pads after sampling colored material, it is highly probable that an explosive or precursor was not detected.
 - o Aluminum powder may show a gray color in all of the pads. However, if an explosive material is also present, the user will generally see a color change in the appropriate pad. For instance, if both aluminum powder and chlorates are present, all indication pads will show gray, while the Chlorate/Bromate pad will show yellow with gray.
 - o Similar to aluminum powder, dirt and dust may show a brown-gray color in all of the pads. However, if an explosive material is also present, the user will generally see a color change in the appropriate pad. For instance, if the user swabs a dirty surface that also contains TNT, all indication pads will show brown-gray, while the Nitroaromatic pad will show purple with brown-gray.
- A positive result for Nitrates was observed when nitrate-containing field interferents, ferric nitrate and lawn fertilizer, were evaluated. All nitrate salts are expected to give a positive result.
- A positive result for Nitrates and Nitroaromatics was observed when bulk levels of DEET were tested.
- Potassium permanganate is both highly reactive and highly colored, resulting in variable colors on all indication pads if present.

About Morphix Technologies

Morphix Technologies is a privately-owned, ISO 9001:2008 certified, American business that develops, manufactures and sells colorimetric chemical detection products that are easy to use, lightweight and inexpensive. These sensors save lives of military, law enforcement, emergency response and industrial personnel worldwide.