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14. ABSTRACT
This report is a survey of current off-the-shelf (COTS) products for field detection of synthetic opioids, drugs of abuse, and pharmaceutical based agents (PBA). Biological and vapor collection systems are not within the scope of work. Specific performance, operational, and physical criteria were developed to narrow the focus of the survey to those products best suited for field detection scenarios. The technical approach for compiling product information was to review the open literature (including market surveys compiled by other groups), conduct internet searches, and contact vendors, users, and subject matter experts in the area of field-portable chemical detection products. This market survey provides information that covers 14 sample collection categories, 24 sample introduction accessories, and 34 sampling methodologies. This is a companion study to the PBA Detection Market Survey published on 9 January 2019.

15. SUBJECT TERMS
Aerosol collectors, environmental sample collectors, pipettes, syringes, capillary tubes, point-samplers, vials, bottles, jars, scoops, spoons, spatulas, scoopulas, scrapers, knives, swabs, tape lifts, tongs, tweezers, wipes, sample collection kits, probes, standoff attachments, collection accessories

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PBA Sample Collection Market Survey

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Chemical, Biological, Radiological,
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Acronyms

ASTM	American Society for Testing and Materials
CBRND	Chemical, Biological, Radiological and Nuclear Defense
CBRNE	Chemical, Biological, Radiological, Nuclear, and Explosive
CDC	Centers for Disease Control and Prevention
COTS	Commercial Off-the-Shelf
CRDEC	Chemical Research Development and Engineering Center
CWA	Chemical Warfare Agent
DC	Direct Current
DHS	Department of Homeland Security
DOJ	Department of Justice
ECBC	Edgewood Chemical Biological Center
EPA	Environmental Protection Agency
FTIR	Fourier Transform Infrared
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
GOTS	Government Off-the-Shelf
HDPE	High Density Polyethylene
IMS	Ion Mobility Spectrometry
IPA	Isopropanol
IR	Infrared
JPEO	Joint Program Executive Office
LDPE	Low Density Polyethylene
MASS, MS	Mass Spectrometry
MCE	Mixed Cellulose Ester
NATO	North Atlantic Treaty Organization
NIOSH	National Institute for Occupational Safety and Health
NIR	Near Infrared
OSHA	Occupational Safety and Health Administration
PBA	Pharmaceutical Based Agents
PE	Polyethylene
PET	Polyethylene Terephthalate
PP	Polypropylene
PPE	Personal Protective Equipment
PTFE	Polytetrafluoroethylene (Teflon)
PVC	Polyvinyl Chloride
SERS	Surface Enhanced Raman Spectroscopy
SPME	Solid Phase Micro Extraction
TIC/TIM	Toxic Industrial Chemical/Toxic Industrial Material
VOA	Volatile Organic Analytes
VOC	Volatile Organic Compound
WMD	Weapons of Mass Destruction

Abbreviations

ft.	foot
g	gram
h	height
hr.	hour
in	inch
kg	kilogram
L (l)	liter, liquid, length
lb.	pound
mL	milliliter
mm	millimeter
s	solid
v	vapor
w	width
“	inch

Executive Summary

This report is a survey of current off-the-shelf (COTS) products for field collection of synthetic opioids, drugs of abuse, and pharmaceutical based agents. Biological and vapor collection systems are not within the scope of work.

Specific performance, operational, and physical criteria were developed to narrow the focus of the survey to those products best suited for field detection scenarios. The technical approach for compiling product information was to review the open literature (including market surveys compiled by other groups), conduct internet searches, and contact vendors, users, and subject matter experts in the area of sample collection and field-portable chemical detection products.

This market survey provides information that covers 14 sample collection categories, 24 sample introduction accessories, and 34 sampling methodologies. Appendix 1 provides additional sample collection product information. Appendix 2 contains additional sample introduction accessory product information.

Section 1.
Introduction

The objective of this survey is to provide the reader with a comprehensive review of available commercial off-the-shelf (COTS) collection products for the safe collection and subsequent analysis of pharmaceutical based agents (PBA) and other related chemicals of interest. This Market Survey includes:

- Sample collection tools, including swabs, wipes, sample containers, and enclosures.
- Sample introduction accessories that are applicable to the analytical devices contained in the PBA Detection Baseline Market Survey.
- Sample collection and analysis methodologies published or in-use by other organizations, with PBA specific recommendations.

MRIGlobal has identified available collection product types, please note not all available products by all manufacturers or vendors have been included. Varieties of products are shown that have distinct features. Also note the number of products represents a product type or one line item, but each equates to more than one individual product when accounting for multiple sizes and materials available for a given product type, as displayed in the product information tables in the Appendices. Table 1 shows the sample collection categories and Table 2 shows the sample introduction accessories represented in this survey.

Table 1. Sample Collection Categories

Category	# Products
Aerosol Collectors	11
Collector Containers	10
Environmental Sample Collectors	21
Pipettes, Syringes & Capillary Tubes	11
Point Samplers	10
Powered Collectors	5
Sample Vials, Bottles & Jars	25
Scoops & Spoons	20
Spatula, Scoopulas, Scrapers & Knives	14
Swabs	53
Tape Lifts	3
Tongs and Tweezers	14
Wipes	39
Sample Collection Kits	18
Total Products	254

Table 2. Sample Introduction Accessories Summary

Category	# Products
Probes	14
Standoff attachments	2
Collection accessories – ATR	1
Collection accessories – Raman	3
Collection accessories – Thermal Desorption	4
Total Products	**24**

1.1 Approach

The approach for developing this market survey consisted of the following steps:

- Establish selection criteria for products to include in the survey
- Identify sources for product information
- Compile product information using a common reporting format
- Establish safety ranking

1.2 Selection Criteria

Thresholds for selection of sample collection products to include in the survey were as follows:

- Currently available COTS/GOTS devices
- Devices are received in clean/sterile packaging, individual packaging preferred but not required
- Ability to operate without power or on DC (battery) power only
- Devices are able to collect solids, liquids, and/or aerosols

Thresholds for selection of sample introduction accessories to include in the survey were as follows:

- Permanent instrument accessory, analysis consumables, or a combination
- Ability to operate without power or on instrument power only (no external power)
- Must be applicable to at least one instrument included in the PBA Detection Baseline Market Survey

1.3 Information Sources

Product information was obtained from a variety of sources, including:

- Published surveys from other authors
- Vendor contacts
- Internet websites
- Open literature

The survey team predominately used information on product vendor websites. A supplementary PDF document of product vendor brochures and specification sheets is available, along with a table of manufacturer contact information.

Section 2.
Results

2.1 Collection Products

The authors identified 254 COTS collection products matching the guidelines described in Section 1.2; see Table 3. Appendix A provides more information on collection products.

Table 3. Collection Products Summary

Category	Sub-Category	# Products	Solid	Liquid	Aerosol	Individual Packaging	Sterile Packaging	Power Req'd
Aerosol Collector	Vacuum	4			•			•
	Filter	7			•	•	•	•
Collector Containers	--	10	•	•		•	•	
Environ-mental Collectors	Corer	6	•			•	•	
	Dipper	10		•		•	•	
	Bailer	3		•				
	Other	2	•	•		•		
Pipettes, Syringes & Capillary Tubes	Pipettes	6		•		•	•	
	Syringes	4		•		•	•	
	Capillary Tube	1						
Point Samplers	Multi-point	1	•			•	•	
	Single Point	9	•	•		•	•	
Powered Collectors	Solid	3	•		•	•		•
	Liquid	2		•				•
Sample Vials, Bottles, & Jars	Vials	7	•	•				
	Bottles	13	•	•				
	Jars	5	•	•				
Scoops & Spoons	Scoop	14	•	•		•	•	
	Spoon	6	•	•		•	•	
Spatulas, Scoopulas, Scrapers & Knives	--	14	•	•		•	•	
Swabs	--	53	•	•		•	•	
Tape Lift	--	3	•			•		
Tongs and Tweezers	Tongs	7	•			•	•	
	Tweezers	7	•			•	•	
Wipes	Dry	25		•		•		
	Pre-wetted	14	•	•		•		
Collection Kits	--	18	•	•	•	•	•	•

2.1.1 Safety Ranking

MRIGlobal scored each collection category (not product), based on six safety factors, as indicated below:

a. Sampling Distance – distance between the user and the target using the collection product
b. Containment – how well the collection device encloses the target
c. Durability – the device being rugged versus fragile
d. Capacity – how much volume target the collection device can hold
e. Sampling Duration – how long it takes to collect a sample using the device
f. Material Compatibility – whether or not the product material is known/expected to interact with a target

Each safety factor was assigned a score of 1 to 3, see Table 4. For example, within the Sampling Distance criterion, a collection product that allows the user to be within a distance greater than 12 inches of the target was given a score of 3 for that criterion. A collection device where the user is within 6 inches of the target was given a score of 1 for that criterion.

Table 4. Safety Assessment Criteria

Scoring Level	Sampling Distance	Containment	Durability	Capacity	Sampling Duration	Material Compatibility
Score 1	< 6 in	None	Fragile: Glass	Bulk: > 15 mL	> 1 minute	Poor: Reactive
Score 2	6 to 12 in	Holds sample but no closure	Extreme Temp Tested	5-15 mL	15 sec-1 min	Medium: HDPE, PET
Score 3	> 12 in	Container with closure, or stand-off	Rugged Tested & Extreme Temp	Trace: < 5 mL	< 15 sec	Good: Glass, Stainless Steel, Teflon

The safety ranking results for all collection categories are shown in Table 5. The maximum safety score achievable is 18. The following trends were observed:

- The powered collectors and collector containers are the highest safety ranked categories (both scoring 16 out of 18). Both of these categories collect and contain the sample, therefore decreasing the chance of exposure to the user.
- Aerosol collectors rank next (15 out of 18) and function similarly to the powered collectors by collecting and containing, but these systems typically require longer collection periods.
- Typical sample collection tools (pipettes, syringes, capillary tubes, sample vials, bottles, jars, spoon, scoops, spatulas, scrapers, knives, tongs, tweezers, and wipes) scored 13-14. These products are available in a variety of materials, which could influence the score in either direction slightly. For PBA samples material selection is not critical, but for more reactive samples, these products are all available in stable (less reactive) forms.
- Swabs and tape lifts ranked near the bottom (both scoring 12 out of 18). This is mainly due to the user needing to be very close to the uncontained sample during collection, and

these collectors are primarily available in plastics, which are not compatible with all sample or solvent types.

- Point collectors and environmental collectors also ranked at the bottom (scoring 11 and 12 out of 18). These are typically large collectors for bulk industrial or environmental samples. They do not contain the sample well, can be messy, and do not come in a wide variety of material options.

Collection Kits were not ranked, as the ranking would vary greatly on the item selected from the kit chosen.

Table 5. Product Category Safety Ranking Summary

Category	Sampling Distance	Containment	Durability	Capacity	Sampling Duration	Material Compatibility	Safety Ranking (Max 18)[a]
Aerosol Collector	3	3	3	3	1	2	15
Collector Containers	2	3	3	3	3	2	16
Environ-mental Collectors	2	2	3	1	2	2	12
Pipettes, Syringes & Capillary Tubes	1	2	2	3	3	2	13
Point Samplers	2	2	2	1	3	1	11
Powered Collectors	3	3	3	3	2	2	16
Sample Vials, Bottles, & Jars	1	3	2	2	3	3	14
Scoops & Spoons	1	2	2	3	3	3	14
Spatulas, Scoopulas, Scrapers & Knives	1	2	2	3	3	3	14
Swabs	1	2	2	3	3	1	12
Tape Lift	1	2	2	3	3	1	12
Tongs and Tweezers	3	1	3	2	2	3	13
Wipes	1	2	2	3	3	2	13

[a] Safety ranking will vary slightly depending on the specific product material type.

Regardless of a high or low score, the use of Personal Protective Equipment (PPE) is the most important factor to consider for user-safety. Additionally, combining the tools/techniques (i.e., tongs with wipes) will enhance the safety scores for a situation.

2.2 Sample Introduction Accessories

In total, 24 sample introduction accessories associated with previously identified PBA detection instrumentation matched the guidelines described in section 1.2.[1] Of these, 14 are probes and two (2) are standoff attachments, both allowing analysis from an increased distance, one (1) is a collection device that can be analyzed directly by FTIR (ATR), three (3) are substrates for the collection and subsequent analysis by Raman spectroscopy (SERS), and four (4) use thermal desorption (TD) as a method for introducing the sample into the instrument. A summary of the products and the selection criteria comparison are displayed in Table 6. None of the accessories required additional power, and none are available in individual or sterilized packaging. Detailed product information is provided in Appendix B.

Table 6. Instrument Accessory Summary

Category	# Products	Solid	Liquid	Consumables Necessary
Probe	14	•	•	No
Standoff Attachment	2	•	•	No
ATR Accessory	1	•	•	Yes
SERS Accessory	3	•	•	Yes
TD Accessory	4	•	•	Yes

2.2.1 Safety Ranking

For the introduction accessories, the safety assessment is based on the same criteria as the collection tools (Section 2.1.1). The safety ranking results for all introduction accessories are shown in Table 7. The maximum safety ranking achievable is 18, and the following trends were observed:

- The standoff attachments are the highest ranked accessories (scoring 15 out of 18). The standoff attachments allow users to analyze samples without contact. The downside is the user not collecting a sample for additional analysis.
- The ATR ClearSampler and Acu-Swab-R accessories rank next (14 out of 18). Both accessories collect a small sample for analysis, the ClearSampler for ATR FTIR and Acu-Swab-R for Raman.
- All of the thermal desorption accessories ranked the same, scoring 13 out of 18. They all require the user to come into close proximity with the sample for collection. They collect sample, but do not contain the sample.
- The probe accessories ranked near the bottom scoring 12 out of 18. They do increase the distance of analysis, but most still need direct sample contact and do not contain the sample.
- Ranking at the bottom were the SERS H-Stick and the Metrohm SERS attachment (scoring 12 and 11 out of 18). These accessories require the user to be in close contact with the sample, and perform some manipulation. These kits also have a limited target compatibility list. These kits are designed to detect very low concentrations, so they are not designed for bulk analysis.

[1] MRIGlobal for JPEO-CBRND PBA Detection Baseline Market Survey Revision 1.6 April 2019.

Similar to the collection tool results, the use of Personal Protective Equipment (PPE) is of utmost importance for user-safety.

Table 7. Introduction Accessories Safety Ranking Summary

Category	Sampling Distance	Containment	Durability	Capacity	Sampling Duration	Material Compatibility	Safety Ranking (Max 18)
Probe	2	1	2	2	3	2	12
Standoff Attachments	3	3	1	2	3	3	15
ATR ClearSampler	2	2	2	3	3	2	14
SERS H-Stick	2	2	2	3	1	2	12
Metrohm SERS	1	2	2	3	1	2	11
Acu-Swab-R	1	3	1	3	3	3	14
SPME	2	2	1	3	3	2	13
FLIR PSI	1	2	1	3	3	3	13
Twister	1	2	2	3	3	2	13
JCAD SLA	1	2	2	3	3	2	13

Section 3.
Sample Collection Categories

3.1 Aerosol Collectors

Aerosol collectors sample air vapor through a defined orifice for a target particle size onto a filter. The filter is then extracted and analyzed. The aerosol collectors require a pump to pull air through the filter. Some collectors have pumps embedded within the device (sampler assembly), designed to be left in an open area for remote collection and often in a tripod design. Whereas other aerosol collectors are designed more for personal monitoring and can be hooked up to a COTS pump (filter assembly). Eleven (11) aerosol collectors are identified in the survey, four (4) sampler assembly and seven (7) filter assembly. None of the devices included in the survey are available in individual or sterilized packaging.

Advantages: For a sampler assembly, collection is typically automated. Filter assemblies are pocket-size, light-weight and can be clipped onto a myriad of surfaces. Filter types are often interchangeable, allowing the user to choose based on application.

Limitations: The filter assemblies require a vacuum and power for collection. Users have to handle contaminated filters for analysis. The sampler assemblies are person-portable and require power.

Figure 1. Aerosol Collectors Sampler Assembly (left to right): InnovaPrep Bobcat, Research International SASS 2400

Figure 2. Aerosol Collectors Filter Assembly (left to right): MilliporeSigma Aerosol Monitor, TSI Personal Impactors

3.2 Collector Containers

Collector containers are devices providing the means to collect the sample as well as contain, seal, or transport it, removing the need to transfer. A variety of products exists, dependent upon application of solids, liquids, bags, drums, free-flowing or viscous samples, etc. A range of materials (non-inert plastic, HDPE, stainless steel, PVC) and individual packaging are also available. Ten (10) collector containers were identified, including one (1) liquid pumping device, three (3) bulk liquid samplers, three (3) bulk solid samplers, one (1) bulk solid and liquid sampler, and two (2) low-volume samplers.

Advantages: Eliminate the need to transfer samples after collection to minimize contamination, loss in transfer, or handling.

Limitations: Designed primarily for bulk sampling.

Notable Products: The Burkle MiniSampler can collect a liquid sample with only the suction hose and the collection bottle being exposed to the sample. Collection bottles can also be purchased in Teflon for chemical resistance.

Figure 3. Collector Containers (left to right): Burkle MiniSampler and Cole-Palmer Drum Sampler

3.3 Environmental Sample Collectors

Traditional collection from a water, soil, or other environmental source in bulk requires the sample collector to accommodate large sample volumes, and the collectors are typically durable and intended for reuse. Environmental sample collectors in the survey include corers (6), dippers (10), bailers (3), a jumbo pipette, and a sludge sampler.

Advantages: Easy to use.

Limitations: Bulk sample is usually required for sample collection.

Notable Products: The QEC disposable Terra Core Sampler allows the user to collect a core of soil (or other bulk solid sample), and discharge directly into a 40-mL VOA vial for transport.

Figure 4. Environmental Collectors (left to right): QEC Terra Core Sampler, New Star Environmental Dipper

3.4 Pipettes, Syringes & Capillary Tubes

Pipettes and syringes are typically how liquid samples are transferred from a source to a sample container. Both syringes and pipettes allow for semi-quantitative transfers of a broad volume range. Both offer the ability to reach into a small opening to collect a liquid below the surface. These collection tools are usually low cost and disposable items that can be purchased in various sizes and materials. Capillary tubes can also be used as a micro-syringe to collect and dispense material, or simply be used to collect a sample.

Advantages: Allow for quantitative transfers, and help reduce exposure to the sample.

Limitations: Designed to transfer liquid aliquots to a transport container.

Figure 5. Pipettes, Syringes & Capillary Tubes

3.5 Point-Samplers

Point samplers are devices designed for the collection of bulk industrial, agricultural, chemical, or pharmaceutical samples where quantity is not a concern.

Advantages: The majority of the products have extended handles or tubing to provide extra distance between user and target.

Limitations: The collectors are a means to collect and transfer the sample; not a container.

Figure 6. Point Samplers (left to right) Powder Thief, Mono Slot Sampler, PharmaPicker

3.6 Powered Collectors

Powered collectors are battery operated and collect either solid or liquid samples. Some units have internally rechargeable batteries, others accept disposable alkaline batteries.

- Solid sample collectors employ a vacuum to collect solid/powder samples. The sample is collected either onto a filter for retrieval or into a sample container/vial.
- Liquid sample collectors employ a sample pump to collect liquid samples. The sample is collected either into an internally held sample compartment, or into a user-selected container.

Advantages: Easy collection of solids/powders that are in difficult locations (carpets, crevices), or have low quantities. Reduces necessary manipulation of powdered samples.

Limitations: Must have batteries or be charged to operate.

Notable Products: Seacoast Science Bulk Powder Collector pulls powder samples directly into a sample vial, operates on AA batteries, and the contaminated nozzles are easily replaced.

Figure 7. Powered Collectors (left to right): Seacoast Science Bulk Powder Collector, Sirchie Evidence Vacuum

3.7 Sample Vials, Bottles & Jars

Sample vials, bottles, and jars are critical for sample collection. They preserve, store, transport and protect the sample prior to analysis. Material types of Teflon, HDPE and PET are preferable due to being sturdy and non-reactive. Glass can break, and less inert plastics can leach into the sample. Multiple varieties are available in countless size, material, and cap type options from many vendors and manufactures.

Advantages: Sample containment is necessary between collection and analysis.

Limitations: Sampling bottles and containers do not act as a collector themselves.

Figure 8. Sample Bottles and Vials

3.8 Scoops & Spoons

Scoops and spoons are collection devices with a rounded bowl-like feature on the end of a handle. They range in material types of polystyrene, polypropylene, HDPE, and stainless steel and volumes of 1 mL to 4 L. Individual and sterilized packaging is available for most varieties. The main difference between and scoop and a spoon is the volume it can hold; spoons for small volume and scoops for large. Both operate with the same motion for sampling solids or liquids.

Advantages: Sturdy materials built for easy collection and storage of samples.

Limitations: Designed for collecting a sample from an easily accessible bulk storage unit (barrel, bag, etc.). These are not designed for scraping, coring, or collection of small samples.

Notable Products: Polystyrene and plastic scoops with a snap on lid to contain the sample for transport, made by Burkle, Inc. and Bel-Art Products, Inc.

Figure 9. Scoops and Spoons (left to right): Burkle Sampling Scoop, Bel-Art Samplit Scoop and Container System, Bel-Art Sampling Spoons

3.9 Spatulas, Scoopulas, Scrapers & Knives

Spatulas come in multiple shapes, materials, and sizes to sample solid materials. Devices are typically made of stainless steel, polypropylene, and polystyrene. Shapes vary, depending upon application (i.e., scraping or scooping). Some have sidewalls while others have a scoop or bowl-like end to contain the sample, and some have one type at each end. Varieties are available designed specifically for scraping and cutting. They are available in stainless steel reusable, or individually packaged disposable varieties.

Advantages: The sharp edges or points of the devices help scrape or penetrate solid surfaces for sampling.

Limitations: Designed only for solids, and provide a means to transfer the sample to a storage container, with a few product exceptions that contain a lid.

Notable Products: The Burkle LaboPlast Spatula, and the Sampling Systems Disposable Powder Safe devices are a v-shaped scoopulas with a snap on cover/lid to contain the sample for transfer.

Figure 10. Spatulas and Scoopula (left to right): Burkle LaboPlast Spatula, Bel-Art Spoon Spatula

3.10 Swabs

Swabs consist of a handle with head made of a variety of materials including polyester, polypropylene, cellulose, polyurethane, cotton, nylon, or polyvinyl alcohol. The fiber or material type is dependent upon application. After lightly dampening, the flexible applicators can collect residue from any surface before sample is processed for analysis. Using swabs for sampling has fewer released particles and higher sample recovery rates than wipe sampling. Swabs are offered in individual, sterilized packaging available in bulk. Swabs are available from a wide variety of vendors and manufacturers.

Advantages: Compact, lightweight, sterilized, individually packaged, myriad of sizes and materials.

Limitations: Designed for collection on small surface areas. A user needs to be within close proximity to the target to use the swab.

Notable Products: The Snap Swab is a dry foam swab with a handle reservoir of 2 mL IPA. The handle is snapped to release the IPA onto the swab head. The Absorbond micro swab by TexWipe contains a breakaway handle in order to transfer the tip to a sample container.

Figure 11. Swabs (left to right): Snap Swab, Texwipe Absorbond Micro Swab

3.11 Tape Lifts

Tape lifts have been used routinely for the collection of fingerprint, footprint, and tire prints on non-porous surfaces. The adhesive nature of the tape lift makes them a good collector for solid samples, especially trace powders, or powders that are difficult to collect using traditional collection tools (such as from crevices, carpets, etc.). There are several tape lift collectors on the market, only a few representative products are included in the survey.

Advantages: Duct tape is low cost and readily available. The adhesives on any of the tape lifts simplify collecting trace powders. Demonstrated collection ability.

Limitations: The adhesive on any of the tape lift products may cause require additional sample processing and/or analytical method development depending on the analytical finish.

Notable Products: Duct tape has been shown to be more efficient and effective in solid surface sampling in comparison to other tape lift products.[2] It is COTS, low-cost, lightweight, and requires extraction.

Figure 12. Tape Lift Products (left to right) Duct Tape, Lighting Lifts, Footprint Residue Lifters

3.12 Tongs and Tweezers

Tongs and tweezers are tools to use with wipes and swabs to extend the distance from a user's hand from the sample material. They are made of mostly metals (stainless steel, platinum, chrome, nickel) and available in polystyrene and polypropylene for disposable use. The handles range from 4 to 24". Fourteen (14) tongs and tweezers were identified, with only the 4.25" polystyrene option being available as individually packaged and sterilized. Tongs and tweezers are available from a multitude of vendors and price ranges, mostly dependent upon material type. The primary difference between a tong and a tweezer is the shape of the grabbing end. Tweezers are typically pointed, and tongs are flat with a broad base.

Advantages: Long handles provide safer working distance from sample.

Limitations: Most require decontamination between samples unless they are disposable or individually packaged.

[2] Brady, K., et. al. "Tape Lift Sampling of Chemical Threat Agents," J. For. Sci. 62 (4), 2017.

Figure 13. Tongs (Left) and Tweezers (Right)

3.13 Wipes

Sample wipes are used in liquid, solid, trace, and bulk sampling. Wipes are made of a variety of materials including polyester, polypropylene, cellulose, polyurethane, cotton, nylon, and polyvinyl alcohol. They can be acquired as dry material, or pre-wetted with solvents such as isopropanol, or ethanol. Wipes are typically in the form of a square or rectangle contained in bulk packaging.

Advantages: A wipe can accommodate multiple surface types and sample sizes. Wipes are low cost, easy to source, and have well established collection and analytical methods (NIOSH Method 9102, EPA SW-846 Method 3570/8290A Appendix A).

Limitations: A user needs to be within close proximity to the target to use wipes. Tongs or tweezers can be used to limit the wipe contact with the user.

Notable Products: Alcohol wipes, are a pre-wetted, individually packaged 70% IPA wipe, low cost and available from many distributors and manufacturers. Cotton gauze is also individually packaged, low cost and available from many distributors and manufacturers.

Figure 14. Wipes (left to right): Alcohol Wipe, Cotton Gauze, and Ghost Wipe

3.14 Sample Collection Kits

Pre-assembled COTS sample collection kits are available in many varieties for various applications. These kits range from only containing wipes or solid sampling tools, to complex, including air vacuums and multiple containers covering all sampling scenarios.

- Two (2) sample collection kits (BelArt Spoon and Spatula, Thomas Scientific Nutrimenta Kit) contain a reusable set of collection tools.
- Seven (7) sample collection kits (HotZone Sample Collection Kit (Liquid and Solid), SamplingSystems Sample Kit, New Star Environmental Dipper Sampling Kit, QuickSilver Complete Biological Module, Mini Push Pack Bio, SKC Wipe Sample Test Kit) contain a disposable set of collection tools.
- Five (5) sample collection kits (Saab CBRN Sampling Kit, Saab TIC/CBRN Backpack, Sirchie Collection and Identification Kit, Sirchie SEARCH 3-Drawer Storage Evidence Collection Kit, and QuickSilver Residue & Powder Kit) have a mixture of disposable sample collection tools and forensic consumables (evidence labels, markers, flashlights, disposable camera, etc.).
- Three (3) sample collection kits (Sirchie Evidence Collection ID, Sealing Kit and SKC Carpet Sampling Cassette Kit, and HotZone Aerosol Module) are designed for vacuum/aerosol collection of samples.
- One (1) sample collection kit (Saab CBRN Advanced Sampling) contains a comprehensive supply lists that cover most sampling opportunities. This kit includes 16 cases of materials and covers sampling liquids, solids, air, and vegetation for CWA, BWA, TICS, radiological threats, environmental sampling, etc.

Advantages: Time and cost efficiency in ordering one kit instead of multiple orders for contents. Often kits are contained in a transport case ready for use.

Limitations: Kits may contain extra items not needed or applicable.

Figure 15. Saab TIC/CBRN Backpack (left) and QuickSilver Residue & Powder Kit (right)

Figure 16. Vacuum/Aerosol Sample Collection Kits (left to right): Sirchie Evidence Collection ID, Sealing Kit, SKC Carpet Sampling Cassette Kit, and HotZone Aerosol Module

Section 4.
Sample Introduction Accessory Categories

4.1 Probes

Sampling probes are a common accessory, particularly to handheld Raman systems, providing extended sample reaching capabilities. The probe optics are within the tip of the probe to preserve sensitivity. None of the probe accessories included in the survey require a separate power source, as they are plugged into the associated handheld unit. None of the probes are available in individual packaging or sterilized. Consumable sleeves are available to minimize sample-to-sample contamination. The probe differences include being submersible, or attached to a long cable in order to provide greater distance between sample and instrument.

Advantages: Probes allow for greater distance between the sample and collection personnel.

Limitations: At minimum the probe tip needs cleaning between samples.

Figure 17. Probe Accessories (left to right): Metrohm Mira Contact Probe, InPhotonics Raman Probe

4.2 Standoff Attachments

Two standoff attachments were identified, both designed for attachment to Raman systems:

- Metrohm Standoff Attachment snaps onto the end of the Mira DS, and allows for the collection of Raman spectra from a distance of 0.25 to 1.5 m from the sample.
- Horiba SuperHead probes attach to the MacroRAM system. These are customizable to excitation wavelengths, cameras available, and length options.

Advantages: Standoff capability allows the analyst to place additional distance between the sample and themselves.

Limitations: Standoff capabilities are only available for a limited number/type of instruments.

Figure 18. Standoff Attachments (left to right): Metrohm Stand-off Attachment, Horiba SuperHead

4.3 Collection Accessories

The collection accessories included in the survey consist of:

- FTIR ATR ClearSampler Accessory
- Surface Enhanced Raman/Reduced Sample Required Substrates
- Thermal Desorption Accessories

These items are used to collect a sample and are then directly analyzed by the instrument.

4.3.1 FTIR ATR Sample Accessory

Smiths Detection produces the ClearSampler discs and handle for the collection and subsequent FTIR analysis of samples. The ClearSampler is purchased with a handle and a set of 6 sample collection discs. The sample collection discs can be used to collect solids or liquids from any surface (porous, clothing, packaging, liquids, etc.). These were designed for FTIR analysis with the HazMatID Elite, but could be used in conjunction with any FTIR ATR attachment.

Figure 19. ClearSampler

4.3.2 Surface Enhanced Raman/Reduced Sample Required Substrates

Three substrates are included in the survey that reduce the amount of sample required for a detection using Raman spectroscopy.

- The H-stick is a SERS kit designed by ThermoFisher to detect certain pharmaceuticals (including fentanyl and heroin) by the Gemini and TruNarc Raman systems. The H-stick kit includes a test stick and an ethanol vial. The test stick has two ends, one end has a scoop to collect a small sample amount and place the sample into the ethanol vial. The other end has the SERS substrate to dip into the ethanol vial for sample collection and testing. The H-stick does not require an attachment for analysis using the TruNarc Raman system, but does require a Gemini H-Stick adapter for analysis with the Gemini system. The Adapter

Figure 20. H-Stick Kit

simply snaps onto the end of the Raman probe, and the test stick slides into the adapter for analysis.

- Metrohm SERS attachment and swabs are designed for use on the Metrohm Mira DS Raman system. The SERS attachments snaps onto the end of the Mira DS, and then has a slot to slide in (or has a door to open and close around a SERS substrate). The SERS substrates are sold separately as packages of slips of paper with the gold (SERS substrate) on one tip. This tip is dipped into the sample, or the sample is place onto prior to placing into the SERS attachment for analysis.

Figure 21. Metrohm SERS Attachment

- The Acu-Swab-R vials is designed to be analyzed in a custom attachment "sidecar" that is attached to the Thermo Defender RMX. The Acu-Swab-R vials contain a swab that is attached to the vial cap. The swab is used to collect a small amount of sample and placed back into the vial. The vial hold the swab at the correct placement, when in the sidecar, for the Raman focal point for analysis by the Defender RMX. The goal of the Acu-Swab-R is to reduce the amount needed for detection by preferential sample placement.

Figure 22. Acu-Swab-R Attachment

4.3.3 Thermal Desorption Accessories

Thermal desorption accessories are separated for two main instrument types. The main thermal desorption accessories are dependent of the system having a standard GC/MS inlet for desorption. Only one system in the survey has a standard GC/MS inlet, the FLIR G510, and therefore, can accept the majority of these accessories. These accessories include:

- Solid Phase Micro-Exaction (SPME) is a commonly used field collection method. It is a sorbent-coated fiber that is used for the collection of volatiles and semi-volatiles from air or water. The fiber is housed in a syringe needle that can be inserted into a liquid injection inlet and desorbed into a GC/MS inlet for analysis. SPME accessories can be purchased in many different sorbent varieties, needle sizes, and syringe holders. The FLIR G510 is the only system in the PBA Market Survey that comes with a standard liquid GC inlet that can accept SPME.

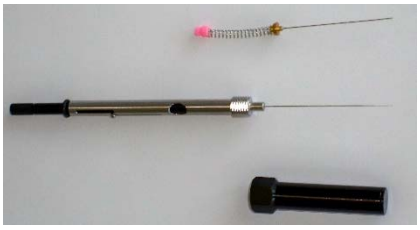

Figure 23. Standard SPME Syringe Attachment

- Prepless Sample Injection (PSI) is an accessory available for purchase with the FLIR G510. This accessory easily replaces the standard liquid inlet injector by unscrewing the injector weldment, and replacing with the PSI attachment. The PSI attachment allows the user to collect a very small amount of sample with a capillary tube, place this tube into a micro vial, and insert this micro vial directly into the inlet of the GC of the G510 for analysis.

Figure 24. G510 PSI Syringe Attachment

- The Gerstel Twister is a sorbent coated magnet that can be used as a stir bar to be mixed into a liquid (aqueous sample) or a solid (soil) sample for the collection of volatile and semi-volatile analytes. Similar to SPME fibers, these magnets can be purchased in the sorbent that is best for the application. Once the sample has been collected, the twister can be placed into the PSI for desorption into the FLIR G510.

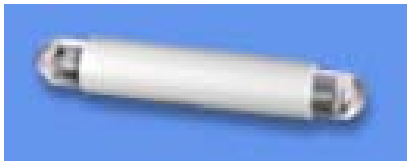

Figure 25. Gerstel Twister

- The last thermal desorption accessory makes it possible for an instrument that was previously not included in the PBA Detection Baseline Market Survey to detect PBA materials. The Solid Liquid Adapter (SLA) from Smiths Detection makes it possible for the JCAD to detect PBAs. The JCAD fits into the SLA, the SLA has a sampling wand that is used to wipe surfaces or areas, then is attached to the SLA and is desorbed into the JCAD for analysis.

Figure 26. JCAD SLA Attachment

Section 5.
Collection Methodologies

MRIGlobal identified several sample collection and analysis methodologies that have been published or are in-use by other organizations. The procedures identified in Table 8 are organized by publication year, and include reporting agency, sample phase addressed (solid, liquid, vapor), and a brief summary.

Table 8. Published Sample Collection and Analysis Methodologies

Reporting Agency	Title	Solid, Liquid, Vapor	Summary	Year
EPA	Sample Collection Information Document for Chemicals, Radiochemicals and Biotoxins	s, l, v	A comprehensive document of specific procedures, tools, and apparatus used to sample CW agents in the field.	2017
EPA	Selected Analytical Methods for Environmental Remediation and Recovery (SAM)	s, l, v	A comprehensive document of specific procedures, tools, and apparatus used to sample CBR contaminants in the field.	2017
University of South Florida - Scholar Commons	A Literature Review of Wipe Sampling Methods for Pesticides in Published Exposure Measurement Studies in the United States	s	A comprehensive overview of wipe sampling methods from 18 studies for pesticides	2016
EPA	Verification of Methods for Selected Chemical Warfare Agents (CWAs)	s, l	Wipe, Water, and soil extraction methods to analyze CWAs	2013
EPA	Selected Analytical Methods for Environmental Remediation and Recovery (SAM)	s, l, v	A comprehensive document of specific procedures, tools, and apparatus used to sample CBR contaminants in the field.	2012
ASTM International	Standard Specification for Wipe Sampling Materials for Lead in Surface Dust	s	Method for sampling for lead with a wetted wipe	2011
EPA, NIOSH	Surface Analysis Using Wipes for the Determination of Nitrogen Mustard Degradation Products by Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)	s	Wipe sample and LC/MS/MS method for detecting Nitrogen Mustard	2011
NIOSH	Methamphetamine and Illicit Drugs, Precursors and Adulterants on Wipes by Liquid-Liquid Extraction	s	Wipe sampling and liquid extraction methods for illicit drug analysis	2011
NIOSH	METHAMPHETAMINE and Illicit Drugs, Precursors, and Adulterants on Wipes by Solid Phase Extraction	s	Wipe sampling and solid phase extraction methods for illicit drug analysis	2011
ASTM International	Standard Practice for Field Collection of Organic Compounds from Surfaces Using Wipe Sampling	s	Method for using a solvent-wetted wipes to sample surfaces for organic compounds	2010
ASTM International	Standard Practice for Collection of Settled Dust Samples Using Wipe Sampling Methods for Subsequent Lead Determination	s	Method for collecting a wipe sample of dust to be analyzed for lead	2010
EPA	Rapid Screening and Preliminary Identification Techniques and Methods	s, l, v	List of potential identification and analysis techniques for chemicals in SAM	2010
ASTM International	Standard Practice for Selection of Sorbents, Sampling, and Thermal Desorption Analysis Procedures for Volatile Organic Compounds in Air	v	Description of method, sorbent selection rules, and apparatus for sampling vapor	2009
ASTM International	Standard Practice for Sampling Atmospheres to Collect Organic Compound Vapors (Activated Charcoal Tube Adsorption Method)	v	Sampling certain organic vapors by adsorption onto an activated charcoal tube using a small pump worn by a person	2008
ASTM International	Standard Practice for Sampling Single or Multilayer Liquids, With or Without Solids, in Drums or Similar Containers	s, l	A description of various sampling methods for drums of liquids	2008
EPA	Testing and Quality Assurance Plan for the Evaluation of Wipe Sampling Methods for Collecting Chemical Warfare Agents (CWAs), CWA Degradation Products, and Toxic Industrial Chemicals from Various Surfaces	s	Evaluation of multiple wipe sampling methods	2008

Table 9. Published Sample Collection and Analysis Methodologies (Continued)

Reporting Agency	Title	Solid, Liquid, Vapor	Summary	Year
EPA	Persistence of Toxic Industrial Chemicals and Chemical Warfare Agents on Building Materials Under Conventional Environmental Conditions: Investigation Report	s	Extracting 3 TICs and 3 CWAs off of absorptive, porous, and nonporous surface coupons	2008
ASTM International	Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants	s	Preparation and analysis procedures for soil samples for particle size and plasticity tests.	2007
EPA	Polychlorinated Dibenzo-*p*-dioxins (PCCDs) and Polychlorinated Dibenzofurans (PCDFs) by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS)	s, l	Method for detecting PCCDs and PCDFs in multiple matrices down to ppt detection limits via HRGC/HRMS	2007
EPA	A Literature Review of Wipe Sampling Methods for Chemical Warfare Agents and Toxic Industrial Chemicals	s	Overview of various methods used to wipe sample CWAs and TICs	2007
EPA	Collection of Undisturbed Surface Sediments: Sampler Design and Initial Evaluation Testing	s	Comparing the Undisturbed Surface Sediment (USS) sampler and Ponar sampler for collecting surface sediment with precision	2005
EPA	Volatile Organic Compounds in Various Sample Matrices Using Equilibrium Headspace Analysis	s, l	Method for preparing VOCs in solid or liquid samples for GC or GC/MS	2003
NIOSH	Elements on Wipes	s	Wipe sampling, sample prep, and ICP-AES elemental analysis	2003
EPA	Microscale Solvent Extraction (MSE)	s	Method for extracting organic compounds from solids	2002
EPA	Methods for the Determination of Total Organic Carbon (TOC) in Soils and Sediments	s	Determining the best methods to analyze TOC levels in soil/sediment	2002
EPA	Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	s, l	Method to determine concentration of SVOCs in multiple matrices by GC/MS	1996
NIOSH	Lead in Surface Wipe Samples	s	Wipe sampling method for lead analysis	1994
Royal Norwegian Ministry of Foreign Affairs	Research Report on Verification of a Chemical Weapons Convention	s, l, v	Comprehensive document of procedures, tools, and apparatus used to sample and analyze CW agents	1992
EPA	Preparation of Soil Sampling Protocols: Sampling Techniques and Strategies	s	Comprehensive document of soil sampling methods	1992
CRDEC	Chemical Weapons (CW) Treaty Verification Technology Research and Development	s, l, v	Comprehensive document of procedures, tools, and apparatus used to sample and analyze CW agents	1991
EPA	Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup	s	Methods for creating a sampling grid and collecting, handling, and preserving various samples for analysis	1986
NATO	NATO Handbook for the Sampling and Identification of Chemical Warfare Agents: Volume 1 Sampling and Identification Procedures and Techniques	s, l, v	A comprehensive document of specific procedures, tools, and apparatus used to sample CW agents in the field.	1983
EPA	Handbook for Sampling and Sample Preservation of Water and Wastewater	l	Comprehensive document of procedures, tools, and apparatus used to sample and preserve water	1982
Ministry of Supply Directorate of Chemical Defense Research and Development	The Chemical Sampling and Analysis of CW Agents Used in Field Experiments	s, l, v	A comprehensive document of specific procedures, tools, and apparatus used to sample CW agents in the field.	1956

A few of these procedures address the collection and/or analysis of pharmaceutical based agents:

- EPA, Sample Collection Information Document for Chemicals, Radiochemicals and Biotoxins (2017) includes fentanyl, carfentanyl, 3-methyl fentanyl and BZ in the target list.
- EPA, Selected Analytical Methods for Environmental Remediation and Recovery (SAM) (2017) includes fentanyl, carfentanyl, 3-methyl fentanyl and BZ in the target list.
- EPA, Selected Analytical Methods for Environmental Remediation and Recovery (SAM) (2012) includes fentanyl, carfentanyl, 3-methyl fentanyl and BZ in the target list.
- NIOSH, Methamphetamine and Illicit Drugs, Precursors and Adulterants on Wipes by Liquid-Liquid Extraction (2011) includes fentanyl and ketamine in the target list.
- NIOSH, METHAMPHETAMINE and Illicit Drugs, Precursors, and Adulterants on Wipes by Solid Phase Extraction (2011) includes fentanyl and ketamine in the target list.
- EPA, Rapid Screening and Preliminary Identification Techniques and Methods (2010) includes fentanyl, carfentanyl, and BZ in the target list.

Some of these procedures cover how to collect wipes, and what materials are recommended to collect samples (wipe materials, bottles, containers, etc.). A few of the procedures dictate that a health and safety plan should be in place, and that these plans should cover the safety information, training and specific PPE that should be employed. However, none of these procedures specifically discusses the safety or PPE that should be associated with the collection of PBA materials.

MRIGlobal recommendations for using pre-existing sample collection procedures include a combination of the procedures/guides shown in Table 9.

Table 10. Recommended Existing Procedures and Guidelines

Reporting Agency	Title	Notable Sections	Reference
EPA	Sample Collection Information Document for Chemicals, Radiochemicals and Biotoxins (2017)	**Section 3** "Health and Safety Considerations" discusses the need for a Safety Plan, PPE, and training. **Section 4** "Preparation for Sample Collection" discusses having sample kits ready, documentation that should be completed, and equipment operation and calibration. **Section 5** "Preparation of Sample Containers" discusses labeling, packaging, and shipping preparations. **Attachment 5** "Sample Collection Information" give the following information (analyte specific): recommended analytical method, sample size, sample container, hold time, preservation, packaging requirements, and shipping label.	EPA/600/R-17/389/ September 2017 www.epg.gov/homeland-security-research
NIOSH	METHAMPHETAMINE and Illicit Drugs, Precursors, and Adulterants on Wipes by Solid Phase Extraction	**Appendix B** "Equipment" discusses the wipe media recommended and shipping containers. Appendix C "Sampling" gives the wipe sampling procedure.	NIOSH Manual of Analytical Methods (NMAM), Fifth Edition

Table 11. Recommended Existing Procedures and Guidelines (Continued)

Reporting Agency	Title	Notable Sections	Reference
EPA	A Literature Review of Wipe Sampling Methods for Chemical Warfare Agents and Toxic Industrial Chemicals	**Chapter 3** "General Wipe Sampling Information" compares wipe material, reporting agency, targets, and surfaces. **Chapter 5** "Wipe Sampling Methods for CWAs and TICs" compares wipe material, wetting solvent, surface, and analytical finish for CWAs and TICs.	EPA/600/R-07/004 January 2007
OSHA	General description and discussion of the levels of protection and protective gear	Entire Appendix B covers determining the PPE required based on the hazard present	CFR 1910.120 Appendix B
CDC	Recommendations for PPE against fentanyl and its analogs	PPE section gives example for minimal, moderate and high risk situations for exposure and recommended PPE	https://www.cdc.gov/niosh/topics/fentanyl/risk.html

The EPA Sample Collection Information Document for Chemicals, Radiochemicals and Biotoxins (2017) is a good overall procedure to adopt. It outlines safety information and plans that should be in place prior to sample collection. It also gives good packaging and shipping information. It does not include the specific safety and PPE information or sample collection procedural steps. The NIOSH and EPA reports give procedural information on how to collect wipe samples with recommended media for different targets. The OSHA and CDC references give access to the safety information that will allow the user to make an informed safety assessment and PPE selection. Even with these procedures and guidelines in place there are several topics left open to the end user:

- Step-by-step procedures to collect solid, liquid and aerosol samples (other than wipe samples)
- PPE selection based on situation or sample collection type
- Decontamination

In addition, some of the procedures include recommended analysis methods (analyte specific), but it is all benchtop instrumentation, no field analysis is covered. We recommend preparing field collection and analysis procedures that include specified PPE requirements, sample collection step-by-step procedures, and field analysis appropriate procedures.

MRIGlobal prepared a Chemical Threat Agent Sampling Guide for the Department of Homeland Security in 2014 and would be able to amend, update, and alter per JPEO specifications. The current guide includes solid, liquid, vapor pre-sampling considerations (including environmental), sampling procedures for trace and bulk material, describes sampling approaches for different surface types, solvent compatibilities, storage and shipping recommendations, and other program specific target analyte properties. The current guide is focused on 75 specific chemical threat agents including CWA and PBA, see example pages in Figure 27.

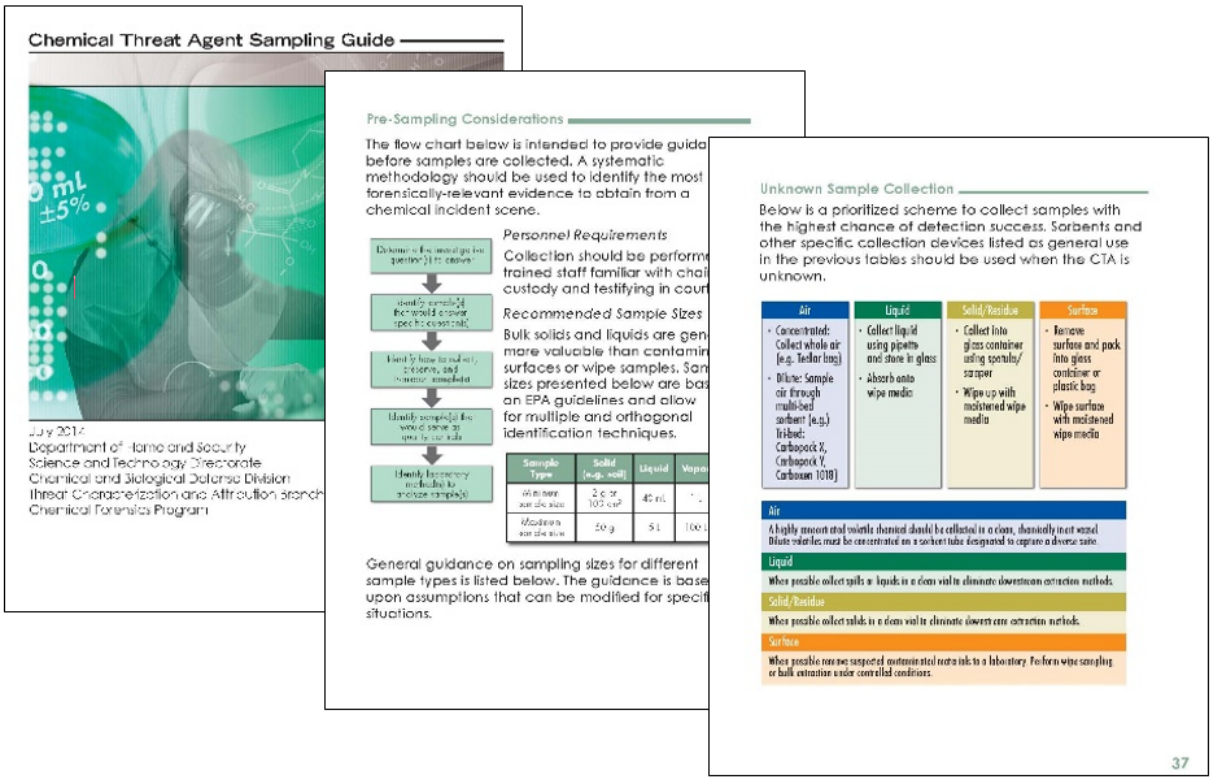

Figure 27. Chemical Threat Sampling Guide Excerpt Pages

MRIGlobal also developed and delivered the RElevant Accrued Chemical Threat Studies (REACTS) database for the Department of Homeland Security. The REACTS database contains 604 unique chemical entries, 265 synthesis reactions, along with 218 FTIR, 203 Raman, 29 XRD, and 141 GC/MS profiles of CAS amenable to the given techniques, as well as over 385 CTA-specific reference documents. In addition to the synthesis pages, MRIGlobal included optical spectral files, important ions for mass spectrometry and chromatographic methods. We include literature references that provide useful chromatographic information such as mobile phase, gradient, column chemistry, and mass transitions (for liquid chromatography) and/or column chemistry, oven temperature program, and specific ions of interest (for gas chromatography). In addition, and most applicable to the current effort – sample collection and transportation information is available for each chemical in the database.

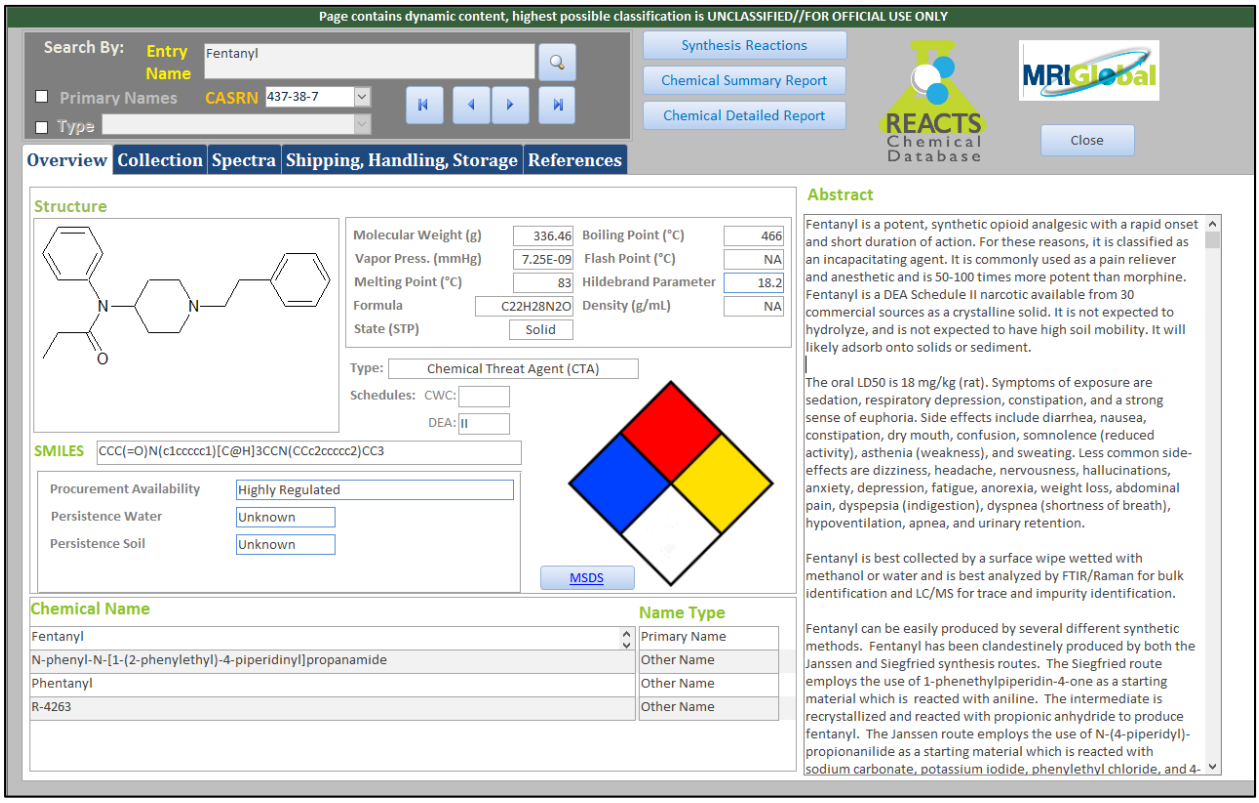

Figure 28. REACTS Database Overview Screen

Section 6.
Conclusions

The PBA Sample Collection Market Survey provides a review of COTS collection products for the safe collection and subsequent analysis of pharmaceutical based agents (PBA) and other related chemicals of interest. This Market Survey covers 254 sample collection tools, including swabs, wipes, sample containers, and enclosures; 24 sample introduction accessories that are applicable to the analytical devices in the PBA Detection Baseline Market Survey; and several sample collection and analysis methodologies published or in-use by other organizations, with PBA specific recommendations.

6.1 Recommended Collection Tools

MRIGlobal recommends the products listed in Table 10 for inclusion into a field sample collection kit. The kit includes disposable, individually sterilized packaged items for those routinely used and reusable stainless steel items for occasional situation necessity that can be cleaned. The following sample types and situations were considered when selecting these products:

- Bulk Powders:
  - If the collector has access to adequate PPE, spatula and bottles/vials would be sufficient, however, if they were in a situation without proper PPE, a powered collector that collects and contains the sample would be a safer alternative.
- Trace Powders:
  - Trace powders maybe difficult to collect with a spatula, but could be easier with a tape lift or a wetted swab. Similar to bulk powders, a powered collector may provide a safer alternative.
- Bulk Liquids:
  - Pipette and bottles/vials is the recommended collection of bulk liquids.
- Trace Liquids:
  - A wipe with tongs or a swab (depending on the sampling area) is the recommended collection of trace liquids.
- Aerosols:
  - An air pump with replaceable aerosol cartridges is recommended for the collection of aerosols.

Table 12. Recommended Collection Products

Category	Name	Manufacturer	Type	Purpose
Aerosol sampler	Carpet Sampling Cassette Kit & LeLand Legacy Pump	SKC	Aerosol	For aerosol collection, is battery powered and has a large flow range.
Pipette	Transfer Pipette	Sigma Aldrich	Liquid	Can be used as a transfer pipette, but also can be tilted upside down to contain the sample temporarily before sample transfer.
Powered Collector	Portable Bulk Powder Collector	Seacoast Science	Solid	For the collection powder samples into a collection vial.
Sample Bottle	Teflon Nalgene Bottles, 30 mL	ThermoFisher	Solid, liquid	Sample containment for large volume samples or for a wipe/swab sample. Teflon material allows compatibility with any hazardous substance.
Sample Vials	Glass Vials	Ace Glass	Solid, liquid	Sample containment for low-volume solid or liquid samples.
Spatula	LaboPlast Spatula	Burkle	Solid	Contains the solid sample, with the snap on lid. Is disposable to provide clean collection for each sample, but sturdy enough to provide scraping or poking support if needed.
Spatula	Micro Spatula	Burkle	Solid	Sample collection of powders.
Swab	Alcohol Swabs	Superbrush	Solid	Collect trace solid samples or to clean non-disposable collection devices or instruments between uses.
Tape Lift	Duct Tape	3M	Solid	Adhesive side can collect residue solids
Tweezer	Tweezer 12"	VWR	Solid, liquid	Use in wipe sampling or picking up contaminated items. Stainless steel option allows for reuse, compatible with any material type and is sturdy.
Wipe	Alpha Wipe	Texwipe	Solid, liquid	Collect low-volume solid or liquid samples. Can be used dry or wetted.
Wipe	Alcohol Wipe	VWR	Solid, liquid	Collect trace solid samples or to clean non-disposable collection devices or instruments between uses.

6.2 Recommended Introduction Accessories

The introduction accessories included in this survey are specific to enhancing the detection or the safety aspects of analyzing PBA materials. We recommend using any of these accessories, if these instruments are part of the fielded equipment suites.

- ClearSampler for use with the Smiths Detection HazMatID (FTIR) provides a handle and sampling distance between the analyst and the sample.
- H-Stick for use with the Thermo TruNarc or Gemini (Raman) provides enhanced detection limits for specific PBAs.
- SERS attachment and substrates for the Metrohm Mira DS (Raman) provides enhanced detection limits for specific PBAs.
- Acu-Swab-R with Sidecar for the Thermo FirstDefender RMX (Raman) provides enhanced detection limits to most Raman active targets.
- SPME is only amenable to the FLIR G510 (GC/MS) from Detection Baseline Market Survey Revision 1.6 April 2019. SPME will allow users to test aqueous samples or solvent spikes for PBA chemicals of interest.

- Preparation-less sample introduction (PSI) is also only amenable to the FLIR G510 and allows for the introduction of any solid material for GC/MS analysis.
- The Gerstel Twister uses the PSI for introduction into the FLIR G510 (GC/MS). The Twister can be used as a stir bar in aqueous, solvent, or solid samples, and then desorbed in the PSI for GC/MS analysis.
- The Solid Liquid Adapter (SLA) for the Smiths Detection JCAD (IMS) allows PBA materials to be thermally desorbed into the JCAD for detection. The JCAD was not in previous versions of the Detection Baseline Market Survey, but will be in future versions because of the SLA.

6.3 Recommended Sample Collection and Analysis Methodologies

MRIGlobal recommendations for using pre-existing sample collection procedures include a combination of the procedures/guides shown in Table 8.

The EPA Sample Collection Information Document for Chemicals, Radiochemicals and Biotoxins (2017) is a good overall procedure to adopt. It outlines safety information and plans that should be in place prior to sample collection. It also gives good packaging and shipping information. It does not include the specific safety and PPE information or sample collection procedural steps. The NIOSH and EPA reports give procedural information on how to collect wipe samples with recommended media for different targets. The OSHA and CDC references give access to the safety information that will allow the user to make an informed safety assessment and PPE selection. Even with these procedures and guidelines in place there are several topics left open to the end user:

- Step-by-step procedures to collect solid, liquid and aerosol samples (other than wipe samples)
- PPE selection based on situation or sample collection type
- Decontamination

In addition, some of the procedures include recommended analysis methods (analyte specific), but it is all benchtop instrumentation, no field analysis is covered. We recommend preparing field collection and analysis procedures that include specified PPE requirements, sample collection step-by-step procedures, and field analysis appropriate procedures.

MRIGlobal prepared a Chemical Threat Agent Sampling Guide for the Department of Homeland Security in 2014 and would be able to amend, update, and alter per JPEO specifications. The current guide includes solid, liquid, vapor pre-sampling considerations (including environmental), sampling procedures for trace and bulk material, describes sampling approaches for different surface types, solvent compatibilities, storage and shipping recommendations, and other program specific target analyte properties

Appendix A.
Sample Collection Product Information

Table A-1. Aerosol Collector Product Information – Sampler Assemblies

Product Name	Manufacturer	Cost	Filter Material	Power	Particle Size (µm)	Notable Safety Features	Synopsis
ACD-200 Bobcat	InnovaPrep	$13,900	Electret filter (positively and negatively charged fibers).	Battery (18hrs continuous, > 4 days intermittent mode)	< 1	Remote trigger availability. User-friendly operation in full NBC gear. Disposable sampling kit prevents contamination.	A tripod portable dry filter air sampler (200 LPM). Suited for collection of bioaerosols, sub-micron sized particles, and airborne molecular contamination. A rapid filter elution kit for instant sample recovery from the filter is available. Following aerosol collection, filter is removed from the collector, snapped into the sample cup and fitted with elutor cap. Additional Single-use kits available for $20/ea.
SASS® 4000 Aerosol Concentrator	Research International, Inc.	$25,500	Unknown	160 watts at 24 V DC	0.5 to 10	Stand-off operation and sample collection.	A high-volume aerosol concentration device that continuously transfers particulates from primary air stream to a smaller secondary airflow to reach concentrations of up to 15 times higher than the incoming air. Primary airflow: 4,000 LPM, Secondary airflow: 30-325 LPM at +0.4 cm of water static head maximum; aerosol concentrate typically delivered to a wet or dry sampler such as the SASS 2300 or SASS 3100, respectively.
SASS® 3100 Dry Air Sampler	Research International, Inc.	$9,000	Electret dry filter media 1.7 ”	BA-5590/U primary battery; UBI 2590 rechargeable battery	0.5	Water-tight design allows decon with 1 to 5% bleach solution. Option of SASS 3010 particle extractor to avoid filter handling.	A compact, rugged microprocessor-controlled portable air sampler designed for use with an electret filter media. It is highly suited to the collection of biological and radioactive aerosols. Uses an adjustable air flow of 50-300 LPM (biological) 10-49 LPM (radiological).
SASS® 2300 Wetted-Wall Air Sampler	Research International, Inc.	$16,000	Unknown	BA-5590/U primary battery; or UBI 2590 rechargeable battery	0.5 to 10	May operate unattended for extended time periods.	Multi-stage wetted-wall cyclone with air collection rate 325 LPM. Particulates collection range 0.5-10 µm; Packaged in lightweight two-piece molded plastic shell with swivel-style carrying handle. It is automated, portable, and automated. A low-volume model (SASS 2400) is also available, pulling 40 LPM with range of 1 to 10 µm.

Table A-2. Aerosol Collector Product Information – Filter Assemblies

Product Name	Manufacturer	Cost	Filter Material	Power	Particle Size (µm)	Notable Safety Features	Synopsis
Button Aerosol Sampler	SKC	$275	Glass, PTFE, PVC, MCE, or Polycarbonate 25mm	Connect to pump	0.8 to 5.0	Able to be autoclaved	A personal monitoring device using a 4 LPM flow rate to enhance sensitivity. The design minimizes wind sensitivity and can be used in any orientation. The device is aluminum with a stainless steel support screen and sampling inlet.
Personal Nanoparticle Respiratory Deposition (NRD) sampler	Zefon International	$200 per 50	Foam or nylon	None	< 0.3	Device is disposable does not require preloading or cleaning.	Designed to size-selectively collect nanoparticles with an efficiency that matches their deposition in the respiratory tract system. It can be used with a standard COTS sampling pump capable of drawing 2.5 LPM. The Sampler does not require preloading or cleaning.
Aerosol Monitor	MilliporeSigma	$147-448 per 50	Polystyrene; Cellulose 37 mm	Connect to pump	0.45, 0.8	None	The three-part design holds the filter in-place when the top section is removed for open aerosol sampling.
Aerosol Filter Holders	MilliporeSigma	$726-982	Cellulosic, PVC, PTFE, nylon, or silver 47 mm	Connect to pump	0.3 to 0.8	None	Aerosol filter holders are available in two formats: open-type for open atmosphere sampling and a standard design with a closed connection and inlet dispersion chamber.
Aerosol Monitor; Polystyrene	MilliporeSigma	$228 per 50	Polypropylene; Cellulose 25 mm	Connect to pump	0.8, 5.0	None	The polystyrene aerosol monitor requires a tubing adapter and is available without filters.
Aerosol Monitor; Polypropylene	MilliporeSigma	$213 per 50	Polypropylene; Cellulose 25 mm	Connect to pump	0.8, 5.0	None	The carbon-filled polypropylene conductive monitor comes with a 50 mm extension cowl and barbed hose vacuum connection eliminates need for tubing adapter.
Personal Impactors 200 Series	MSP	$700	Any 37 mm filter	Connect to pump	2.5, 10	None	Personal samplers for collection of airborne particles between 2.5 and 10 um. They can be operated with a personal sampling pump at 2, 4, 10 L/m flow rate.

Table A-3. Collector Container Product Information

Sub Category	Application	Product Name	Manufacturer	Material	Size	Cost	Synopsis
Liquid Pump Sampling	Manually pumping liquid into container from a depth up to 5m	MiniSampler, Pump Sampler	Burkle Inc., Sampling Systems Ltd.	PE, PTFE, Stainless Steel	Bottle: 100, 180 mL Hose: 13, 16 ft.	$200-350	A manual liquid vacuum sampler pumping directly into the sample container. The sample only is exposed to PE hose and sample bottle. The sampling system includes transport case, manual pump, 10 bottles; 10 m suction hose, 1 hose cutter, 1 stainless steel hose weight, and 20 seal-it bottle seals.
Bulk Liquid Sampling	Drum or well	HDPE Liquid Samplers, Drum and Liquid Sampler	Fisherbrand, Cole-Palmer	HDPE, PP	Handle: 3, 6 or 8 ft. Bottle: 100mL or 500 L	$200	The sampler has a bottle screwed into the end of the handle and is filled via four ports in the handle. The bottle is removed and capped after sampling. The handle is supplied in two pieces and is reusable.
	Bulk liquid sampling	Kemmerer Bottle	WildCo	Silicone, stainless steel, or PTFE	0.4 to 8.2 L bottles	1.2L kit $740 8.2L kit $1,100	The kit includes a bottle, messenger, 100 ft. line, and carrying case. The bottle body available in silicone, stainless steel or PTFE and the seals are silicone. The bottles sizes range from 0.4 L to 6.2 L
	Drum or well	Bottle Sampler	Sampling Systems Ltd.	Stainless Steel, Glass	Bottle: 500 mL Handle: 40”, 59”	$395	The sampler takes samples straight into the bottle. The spring-loaded mechanism allows the liquid to flows in only when the handle is squeezed allowing samples to be taken from set locations. The sampler is available with a cover that goes over the bottle to stop the bottle from getting wet.

Table A-3. Collector Container Product Information (Continued)

Sub Category	Application	Product Name	Manufacturer	Material	Size	Cost	Synopsis
Bulk Solid Sampling	Sampling directly from a bag of free-flowing powders/grains	DispoLance	Burkle Inc.	HDPE	12”, 20”	$113 per 20	The sampler pierces into a bag with the sturdy tip and the sample flows through the open inner tube directly into the container or bag that is held underneath. Individual and sterilized packaging available.
	Representative 3-zone sampling	ZoneDispo	Burkle Inc.	HDPE	Handle: 20”, 40” Volume: 100 mL, 200 mL	$225 per 10	The sampler is used in sampling to collect a representative all-layer sample from three different layers. Suitable for free-flowing powders and small-grain granulates. The collected sample can be secured and transported in the closed sampler. The device contains three slits spaced horizontally along the long rod with an outer and inner tube. The rod is inserted into the sample; each slit collects samples from that layer or spot, then the handle twists, allowing the outer tube to close over the slits on the inner tube for transport. A stainless steel reusable equivalent device is also available as well as individual and sterilized packaging options.
	Core soil sampling	Core N’ One™ Handle and Capsule	GeoTech	Plastic	5 g	$13 per handle; $120 per 20 capsules	The Core N’ One™ is both a sample collection and transport container. The screw threaded septa closure insures airtight seal. Each Capsule comes in a heavy gauge zip lock bag with attached ESS Sample label.

Table A-3. Collector Container Product Information (Continued)

Sub Category	Application	Product Name	Manufacturer	Material	Size	Cost	Synopsis
Solid or Liquid Grab Samples	Sampling using a dipper	Dispodipper SteriPlast®, Gosselin™ Dipper, Dippas, Safety Samplers	Burkle Inc., Corning®, Dynalon, Bel-Art	Plastic Stainless steel Polypropylene Polystyrene Polyethylene	30 to 500 mL	$28-60 per 20 (Burkle) $242-400 per case of 100-250 (Corning) $115-230 per 50 (Dynalon)	All four-dipper models are ideal for sampling solids or liquids from barrels, canisters and other containers with an immersion depth of 270 mm (10.63in.). Sampling tube is manufactured in a clean room specially designed for disposable use. The scaled sample container can be used for an exact measurement. After sampling, the container can be closed and is leak-proof. Cap is attached to the container. Individual and sterilized packaging available. The Safety Samplers are suited for acidic or caustic sample types.
Low Volume Solid Grab Samples	Grab samples	U-D Cohesive Sampler	Sampling Systems Ltd.	Stainless Steel	Sample Collection: 0.25, 0.5, 0.75, 1.0 mL Handle: 40”	$590 for whole set; $380 per handle; cells $36 ea.	The sampler is a stainless steel rod with a collection tip. Different sample volumes can be taken by changing the tip. Special tip volumes and sampler lengths available on request.
	Sampling directly from a bulk solid sample	AccuPod Sample Thief	Sampling Systems Ltd.	HDPE	1 mL	$90 per 50 pods; $790 per device	Sample Thief is a sampling rod with slits to collect samples. HDPE pods are inserted into the slits. Once the ~1 mL sample is collected, the pod lids are applied, and the pods are removed for sample transport. The pods are consumable, and the sample thief device is reusable. Available sizes of 600 to 2000 mm and either multi zone or mono zone samplers. Individual and sterilized packaging available.

Table A-4. Environmental Collectors

Sub Category	Product Name	Manufacturer(s)	Solid, Liquid, Aerosol	Material	Size	Cost	Individual Packaging	Sterilized Packaging	Features
Corer	Deluxe Soil Probe	Nasco	Liquid	Stainless Steel	36"	$93	No	No	Has a foot stand to penetrate hard soils
	Multipro Sector Probe 55G	Bioscience International	Solid	Aluminum	3 × 20 mL slots	$595	No	No	Multi-sectored
	T-Handle Soil Sampler, Terra Core Sampler	Environmental Express, QEC	Solid	Polypropylene	5 g	$180 per 100	Unknown	No	T-handle
	Corer, Qualirod	Sampling Systems, Burkle Inc.	Solid	Stainless Steel	7.5", 9.25", 11.4"	$45	No	No	Short curved blade
	EasyDraw® Syringe and PowerStop® Handle	QEC	Solid	Plastic	5, 10, 13 g	Unknown	No	No	Power stop handle
	Tapered Plug Sampler	Bel-Art Products, Inc.	Solid	Stainless Steel	7.5”	$111	No	No	Sharp end of the satin finish sampler will cut through a bag or box
Dipper	Ladle	Sampling Systems	Solid, Liquid	HDPE	50 mL	$45 per 40	Yes	Yes	Ladle available in white or blue. Has stainless steel reusable equivalent
	Long-Handled Dippers, Dipper Large	Bel-Art Products, Inc., Global Water, New Star Environmental	Solid, Liquid	HDPE	500, 1000 mL beaker, 3,6,12 ft. handle	$58-404	No	No	Long handle, large beaker. New Star has two spouts and graduated beaker
	Adjustable Handle Water Sample Dipper, Telescoop Water Sampler, Sludge Nabber	Bel-Art Products, Inc., Sampling Systems, Nasco	Solid, Liquid	Aluminum handle, Polypropylene , polyethylene bottle	600, 750, 1000, 2,000 mL beaker, 3 to 14 ft. adjustable handle	$172	No	No	Long adjustable handle, large beaker. Sampling Systems accessories include angular beaker, bottle, or net.
	Dispoladle	Burkle Inc.	Solid, Liquid	Polystyrene	200 mL beaker, 20”, 40” handle	$160-215 per 20	Yes	Yes	Two spouts
	PTFE Dippers, Dipper Sampler	Fisherbrand, New Star Environmental	Solid, Liquid	PTFE	100, 250, 500, 1000 mL beaker, 2 ft. handle	$217-378	No	No	Extendable screw-in shafts have a steel core for rigidity

Table A-4. Environmental Collectors (Continued)

Sub Category	Product Name	Manufacturer(s)	Solid, Liquid, Aerosol	Material	Size	Cost	Individual Packaging	Sterilized Packaging	Features
Dipper	Dipper, Mini Dipper, Chemical Dipper	Sampling Systems	Solid, Liquid	PTFE, polypropylene	10, 100, 250, 500, 1000 mL	$30-150	No	No	Handle Extension available
	Reusable Polyethylene Dippers	Fisherbrand	Solid, Liquid	Polyethylene	500 mL beaker, 3, 6, 12 ft. handle,	$69-104	No	No	Graduated beaker, two spouts
	Reusable Polyethylene Ladles	Fisherbrand	Solid, Liquid	Polyethylene	50, 100, 250, 600, 1000 mL beakers 10.5", 10.75", 12.43", 13", 16.12" handles	$24-84 each	No	No	Welded solid handle
	Swing Sampler	Global Water, Nasco	Solid, Liquid	Fiberglass pole; Polyethylene bottle	6-12 ft. extendable handle, 500, 960 mL bottle	$162	No	No	Sampler swings
	Cup Sampler	Sampling Systems	Solid, Liquid	Stainless Steel	100, 500 mL volume, 2, 3.3, 5 ft. length	$230-485	No	No	Collects sample directly into stainless steel cup
Bailer	Disposable, Weighted Bailers, Water Bailer	Cole-Parmer, Global Water, Environmental Express	Liquid	Polyethylene, FEP, CPVC,	12", 36", 48"	$155-555 per 12/24	Yes	No	Weighted for increased sink rate
	Weighted Poly Bailer	Environmental Express	Liquid	Polyethylene	1.5" × 36"	$134 per 24	No	No	Weighted. Solvent free construction with joints welded 360 degrees
	Disposable Bailer	Environmental Express	Liquid	PVC	1 2/3" × 36"	$42	No	No	Not Specified
Other	Jumbo Pipette, Liquid Master, Sample Thief	Sampling Systems, Bel-Art Products, Inc.	Liquid	HDPE, Polypropylene, Silicone, PTFE/FEP	400 to 1500 mL volume, 1 to 6 ft. length	$190 per 50	Yes	Yes	No bulb, Large volume. Use thumb or cap to pull up liquid
Other	Sludge Judge	Cole-Parmer	Solid, Liquid	Plastic	15 ft. length; 0.75", 1.25" diameter	$104-160	No	No	Three 5-ft (1.5-m) sections that screw together

Table A-5. Pipettes, Syringes & Capillary Tubes

Sub Category	Product Name	Manufacturer	Material	Size	Cost	Individual packaging	Sterilized Packaging	Features
Pipette	Bellows Samplers	Bel-Art Products, Inc.	Polyethylene	20, 50 mL	$64 per 5	No	No	Bulb attached
	Transfer Pipette	Sigma-Aldrich, Quick Silver analytics	Polyethylene	3.3 mL	$178 per 500	No	Yes	Bulb attached; fine tip
	Extra Long Pipettes	QuickSilver Analytics	Polyethylene	23 mL volume, 12" length	$8 per 3	No	No	Long length
	Gosselin™ Straw Pipets	Corning®	Polypropylene	1, 2.2, 5 mL	$222 per 3,600	No	No	No bulb
	DispoPipette, LiquiDip Mono & Duo	Burkle Inc., Sampling Systems	HDPE	80, 100, 200 mL	$107-155 per 20	Yes	Yes	No bulb
	Sampler Syringe	Bel-Art Products, Inc.	Polypropylene	100 mL volume 12" length	$24	No	No	Sample container
Syringe	Disposable LiquiThief, ViscoThief, LiquiDispo	Sampling Systems, Burkle Inc.	HDPE, Polypropylene, Silicone	100, 190, 290 mL 19.6, 39" length	$160-250 per 20	Yes	Yes	Large volume, Long handle
	SteriPlast® Syringe	Burkle Inc., Millipore Sigma, Quick Silver Analytics	Polypropylene	1, 5, 10, 30, 50, 60, 100 mL	$20-60 per 100	Yes	Yes	Small Volume
	Norwell® Mucksuckers	Saint-Gobain	PTFE	200, 475 mL	Unknown	No	No	Not Specified
	Fluid Point Sampler	Sampling Systems	Stainless Steel	160, 300, 450 mL	$350	No	No	Not Specified
Capillary Tube	Capillary tubes	Fisherbrand	Glass	70 µL volume, 3" length	$14 per 100	No	No	Snap-lock caps

Table A-6. Point Sample Collectors

Product Name	Manufacturer	Solid, Liquid, Aerosol	Material	Size	Cost	Individual Packaging	Sterilized Packaging	Features
MultiDispo, Slot Sampler, Pocket Sampler	Burkle, Sampling Systems	Solid	HDPE, Stainless steel	100, 200 mL volume, 20", 40" length	$265-355 per 20	Yes	Yes	Multi-sectored, Twist outer tube to open/close sample slits.
PowderDispo, DispoPicker	Burkle	Solid	HDPE	60, 100 mL volume, 12", 20" length	$137-174 for a per 20	Yes	Yes	Open tip (PowderDispo), Closed tip (DispoPicker)
TargetDispo, Powder Sampler	Burkle, Sampling Systems	Solid	HDPE	100, 200 mL volume, 20", 40" length	$230-310 per 20	Yes	Yes	Outer tube twists to close sample slit
MicroDispo, Powder Thief	Burkle, Sampling Systems	Solid	HDPE	10 mL volume, 20", 40" length	$170 per 10	Yes	Yes	Traps sample in tube by pulling up on handle
PharmaPicker	Burkle	Solid	Stainless Steel	0.10-2.50 mL volume, 24" to 11.5 ft. extendable handle	$400-1900	No	No	Interchangeable volume heads, extendable handle, transport case
Disposable Mono Slot Sampler	Sampling Systems	Solid	HDPE, Stainless steel	50 mL volume, 24", 38" length	$130-170 per 20	Yes	Yes	Twist outer tube to open/close slit
Cohesive Sampler	Sampling Systems	Solid	Stainless Steel	5, 10, 25 mL	$418-473	No	No	Handle rotates scraper to collect sticky, non-flowing solid sample
Disposable Powder Lance	Sampling Systems	Solid	HDPE	75, 100, 170 mL volume, 15.7, 24, 37.4” length	$70-130 per 20	Yes	Yes	Open tipped, closed ended
Disposable Sack Sampler	Sampling Systems	Solid	HDPE	0.47, 0.98 “diameter; 15.7” length	$180 per 100	Yes	Yes	Open tipped, open ended to sample directly into bag/bottle
Liquid Sampler	Bel-Art Products	Liquid	Nickel-plated Brass	50 mL volume, 20" length	$222	No	No	Center rod with finger ring actuates a valve in the bottom of the cup for emptying when sample is retrieved

Table A-7. Powered Collectors

Product Name	Manufacturer	Solid, Liquid, Aerosol	Size	Power	Cost	Synopsis
Portable Bulk Powder Collector	Seacoast Science, Inc.	Solid	6.4" × 2.0" × 8.6"	AA Batteries	Unknown	Designed for high-efficiency collection of bulk powders. The device has a modular design consisting of a reusable vacuum handle with detachable single-use collection nozzles.
Rechargeable Evidence Vacuum	Sirchie	Solid	19" × 11.5" × 10.5" 7.5 lbs.	110 V or 220 V rechargeable battery	$225	The collection of dry micro particle trace evidence such as hair, fibers, soil particles, pollen, etc. Comes with 2 hermetically sealed filter assemblies and in a copolymer carrying case
PowderProof	Burkle Inc.	Solid	Not Specified	Battery	$2,250	For sampling powders and granules from drums, barrels, bags or sacks. Includes a motor, two rechargeable batteries, LED-lamp, fast charger, clip for holding the bag and cleaning brush. Additional augers available as accessory. The lance is inserted into the sack/container with the spiral screw rotating. The powder or granules are immediately transported through the lance and filled directly into a sample bag or bottle at the lance outlet.
Vampire Sampler	Burkle Inc.	Liquid	16.4 ft. hose 250 mL bottle	Battery	$925	Pumps liquids directly into a sample container. The sample only is exposed to PE hose and sample bottle. Additional hose lengths and sample bottle sizes available for purchase
WS700 Composite/Discrete Water Sampler	Global Water	Liquid	22x 17 × 9 in 20 lbs./9 kg Bottle: 2.5 gallon Pickup hose: 15 ft.	Rechargeable 5 AH battery	$1,506	Collects time-interval samples or grab samples. The device is housed in a rugged carrying case. Sampling is adjustable to take one of 15 individual time-weighted composite sample sizes, from 50 ml to 2 liter, or can set the size control to full-bottle discrete for full-bottle grab samples. Time intervals range from 5 minutes to 12 hours, or an external trigger mode. Equipped with a float switch to automatically turn off the peristaltic sampling pump if the water bottle becomes full. Available in a dual mode: composite and discrete simultaneously (WS750), a refrigerated model (WS700R), a dual bottle model (WS755), or with an improved carrying case model (WS705).

Table A-8. Sample Vials, Bottles, and Jars

Sub Category	Material	Volume	Manufacturers/ Vendors	Cost range	Closure	Features
Bottle	Teflon FEP, Teflon PFA	30 to 2200 mL	Nalgene™, ThermoFisher	$40-380	Screw cap	Narrow mouth or wide mouth
	Purillex PFA, Purillex FEP	50 to 200 mL	Savillex	$50-330	Screw cap	Not Specified
	HDPE, fluorinated	250 to 4000 mL	Nalgene™, ThermoFisher	$ 4-46	Screw cap	Narrow or wide mouth. Fluorinated inside and out for improved barrier properties and reduced solvent adsorption and permeation. Leak proof.
	HDPE	30 to 4000 mL	Sigma Aldrich	$20-65	Screw cap	Nalgene™ bottles
	HDPE	250, 500, 1000 mL	QEC	$32-35	720° thread, Leak-tight closures with inner sealing ring	Leak-proof. External graduated mL marking
	HDPE	125 to 1000 mL	Sigma Aldrich, Bel-Art Products Inc.	$30-55	Polypropylene screw cap	Precisionware™ Bottle with leak-proof, sturdy, heavy-duty walls. Manufactured to strict DOT-2E specifications. Molded pour lip for easy, no-spill pour
	Polycarbonate	500 to 8000 mL	Nalgene™, ThermoFisher	$10-111	Polypropylene screw caps	Narrow mouth, Nalgene™, impact resistant, leak proof
	Glass, Pyrex	100 to 2000 mL	Sigma Aldrich	$130-375	Screw cap	PYREXPLUS®
	Glass, amber	30 to 120 mL	Sigma Aldrich	$35 per 12	PTFE/silicone septum, black phenolic hole screw cap	Narrow neck storage bottles
	Polypropylene	120 mL	Sigma Aldrich	$88 per 100	Locking cap with thumb tabs	Corning®, Sterile, 100 mL fill line
	Polypropylene	30 mL	Nalgene™, ThermoFisher	Unknown	White polypropylene screw closure and TPE gasket	Nalgene™ Polypropylene Validation Bottles
	PTFE	100 to 2000 mL	Sigma Aldrich	$111-250	Screw cap	BRAND®, Wide-mouth
	PET	120, 150 mL	Easy Vac, Inc., QEC	Unknown	Screw cap	Stress & impact resistant, heavyweight construction that can withstand the use of a vacuum pump and higher sampling temperatures

Table A-8. Sample Vials, Bottles, and Jars (Continued)

Sub Category	Material	Volume	Manufacturers/ Vendors	Cost range	Closure	Features
Vial	Polypropylene	6.5 mL	Sigma Aldrich	$202 per 1000	White Polyethylene screw cap	Scintillation Vials, general purpose
	Polyethylene	6.5 mL	Sigma Aldrich	$202 per 1000	White Polypropylene screw cap	Scintillation Vials, general purpose
	Polyethylene	6 mL	Sigma Aldrich	$185 per 1000	White screw cap	Liquid Scintillation vials
	Glass	20, 40, 60 mL	QEC	Unknown	Polypropylene screw caps	Amber or clear VOA Vials, Pre-cleaned to EPA standards
	Glass	40 mL	Sigma Aldrich	$109 per 72	White polypropylene screw top hole cap with PTFE/silicone septa	Clear or amber. Pre-cleaned. PTFE/silicone septa
	Glass	4, 7 mL	QEC	Unknown	Black Polypropylene screw cap with PTFE/foam liner	Clear storage vials
	Glass	0.3 to 40 mL	Sigma Aldrich, Ace Glass, VWR, others	$112-250 per 200	Black open top screw cap with PTFE/silicone cap liner	Multiple liner and size options
Jars	Glass	60 to 250 mL	ThermoFisher	$103-119 per 24	PTFE-lined white polypropylene closed-top cap	I-Chem™, Wide mouth, Amber Type III soda-lime glass jar; recommended for light sensitive samples
	Glass	30 to 266 mL	Burch Bottle	$10 per 24	Aluminum lined, white metal foil lined, black metal plastisol lined, or gold metal plastisol lined	Straight sided, wide mouth, amber
	Polypropylene	7.4, 30, 60, 118 mL	Burch Bottle	$0.25-0.40 each	White polypropylene smooth P/E Foam lined cap	Double walled
	PET	60, 118 mL	Burch Bottle	$0.31-0.48 each	Black polypropylene P/E Foam lined cap or white metal plastisol lined cap	Straight sided, wide mouth, in clear, blue, or amber
	Polystyrene	118 mL	Burch Bottle	$0.48 each	Black polypropylene P/E Foam lined cap	Wide mouth, single wall, clear

Table A-9. Scoops and Spoons Product Information

Product Name	Manufacturer	Material	Sizes	Cost	Individual Packaging	Sterilized Packaging	Features
SteriPlast® Sampling Scoop with lid	Burkle Inc.	Plastic, stainless steel.	25, 50, 100, 150, 250, 500, 1000 mL	$25-100 per 10	Yes	Yes	Includes a transparent lid to close it immediately after sampling to secure a sterile and contamination-free sample. Due to the special handle construction and the slightly angled edge the scoop stands horizontal and can be laid down without the material trickling out. Production, assembling and packaging acc. to ISO cleanroom class 7
Disposable PharmaScoop	Sampling Systems	Polystyrene, Polypropylene, HDPE	30, 60, 125, 250, 500, 1000, 2500 mL	$64-535 per 100	Yes	Yes	Available in red, white, or blue. Scoop with handle. Available in stainless steel reusable equivalent
Disposable Volumetric Scoops	Sampling Systems	HDPE	1, 1.23, 2.46, 5, 10, 20 mL	$55 per 100	Yes	Yes	Volumetric scoops with handles
Long Handled Scoop	Sampling Systems	HDPE, Stainless Steel	3.54" x 1.6" Scoop, 24" handle	$81-117 per 50	Yes	Yes	Long handle scoop
Telescoop	Sampling Systems	Polypropylene, LDPE	500, 600, 750, 1000, 2000 mL	$20-750	No	No	Can attach angular beaker, pendulum beaker, or bottle onto telescopic rod to collect sample at up to 20 ft. away
Fluo-Kem Teflon FEP Coated Aluminum Scoops	Bel-Art Products, Inc.	Aluminum coated with Fluo-Kem® Teflon®	1, 2, 4 L	$87-116	No	No	Aluminum scoop has anti-stick, corrosion resistant brown Fluo-Kem® Teflon® coating containing FEP. Handle is not coated.
Polypropylene Scoops	Bel-Art Products, Inc.	Polypropylene	22, 60, 75, 125, 250, 1100 mL	$11-35 per 6-12	No	No	60 and 125ml scoops have a longer handle
Sterileware Economy Sampling Scoops	Bel-Art Products, Inc.	Polystyrene	63, 83, 125, 250 mL	$13-23 per 12	Yes	Yes	Flat bottom shape allows them to be used as weighing boats
Sterileware Samplit Scoop and Container System	Bel-Art Products, Inc.	Polystyrene	190 mL	$170-230	Yes	Yes	Scoop that threads into a dedicated leak-proof 190ml (6.5oz) container
Sterileware Sense-able Scoops Metal Detectable, Sterile Sampling Tools	Bel-Art Products, Inc.	Stainless Steel; Polystyrene	60, 125, 250 mL	$180-470 per 100	Yes	Yes	60ml (2oz) and 125ml (4oz) scoops have a long handle; Polystyrene plastic impregnated with stainless steel powder

Table A-9. Scoops and Spoons Product Information (Continued)

Product Name	Manufacturer	Material	Sizes	Cost	Individual Packaging	Sterilized Packaging	Features
Sterileware Sterile Scoop Sampling System	Bel-Art Products, Inc.	Polystyrene	60, 125, 250 mL	$220-255 per 100	Yes	Yes	Scoop and snap on lid to store sample
Sterileware Bent Handle Sterile Scoops	Bel-Art Products, Inc.	Polystyrene	60, 125 mL	$30-33 per 10	Yes	Yes	Flat bottom keeps scoops upright when placed on a flat surface
Disposable Sterile Scoops	Fisherbrand	Polystyrene	60, 125, 250 mL	$227-485 per 100	Yes	Yes	Curved handle; flat top and bottom
Disposable Polystyrene Sterile Scoops	Biomedical Polymers, Inc.	Polystyrene	2, 4, 8 oz.; 7.25, 7.5, 8 in length	per 100	Yes	Yes	Not Specified
Long Handled Spoon	Sampling Systems	HDPE	10, 20 mL	$145 per 100	Yes	Yes	Either straight or angled
Metal Detectable Long Handled Spoon	Sampling Systems	Polypropylene	20 mL	$11 per 4	Yes	No	Long handle, made with chemically resistant grade of Polypropylene. Manufactured in cleanroom conditions and packed in a class 7 (10,000) cleanroom
Disposable Sample Spoons, SteriPlast® Sampling Spoon	Sampling Systems, Burkle Inc.	Polystyrene, Polypropylene	3, 10 mL	$50 per 100	Yes	Yes	Not Specified
Sterileware Economy Sample Spoons	Bel-Art Products, Inc.	Polystyrene	1.25, 2.5, 5.0, 8.0, 20 mL	$89 per 100	Yes	Yes	Flat bottom shape allows them to be used as weighing boats
Sterileware Long Handle Sampling Spoons	Bel-Art Products, Inc.	Polystyrene	1.25, 2.46, 4.93, 14.79, 30 mL Volume, 7" handle	$189-215 per 200	Yes	Yes	Long handle
Stainless Steel Spoons	Bel-Art Products, Inc.	Stainless Steel; Teflon	0.5/2; 0.8/2.8; 1.6/3.0; 1.8/5.8, 2.0/8.0 mL	$46-107 per 2	No	No	Double-Ended with Two Bowl Sizes

Table A-10. Spatula, Scoopula, Scraper & Knife Product Information

Product Name	Manufacturer	Material	Size	Cost	Individual Packaging	Sterilized Packaging	Shape
Disposable Flat Spatula, Micro Spatula	Sampling Systems, QuickSilver Analytics	Polystyrene	0.5"	$67 per 100	Yes	Yes	Flat
Micro-Spatula SteriPlast®	Burkle	Polystyrene, Stainless steel	1.0, 0.25 mL	$67 per 100	Yes	Yes	Flat
Disposable Micro-Spatula	Sampling Systems	Polystyrene, HDPE, Stainless steel	0.3, 0.5, 2 mL volume, 6.7" length	$67-1,010 per 100	Yes	Yes	Flat with sides
Disposable PowderSafe, LaboPlast® Spatula	Sampling Systems, Burkle	Polystyrene	6"	$185 per 100	Yes	Yes	V-shaped shaft with a protective cover
Sterileware Sampling Spatulas, Disposable Powder Spatula	Bel-Art Products Biomedical Polymers, Inc., Sampling Systems	Polystyrene, Polypropylene, Stainless steel (Sampling Systems)	9" , 14"	$25-126 per 12-100	Yes	Yes	V-shaped
Spoon-Spatula SteriPlast®	Burkle	Polystyrene, Stainless steel	0.5 mL spoon 0.7" spoon blade	$67 per 100	Yes	Yes	Flat spoon
Scoopula, Reagent Digger	QuickSilver Analytics, Bel-Art Products	Stainless Steel	6.5"	$45 per 3	Yes	No	Not Specified
Stainless Steel Micro Spatulas	Bel-Art Products	Stainless Steel coated in Teflon	0.15 x 0.7 “	$31-60 per 2	No	No	Straight or tapered blade
Ellipso-Spoon and Spatula Samplers	Bel-Art Products	Stainless Steel	6 to 20 " length 10, 70 mL volume	$26-77	No	No	One flat end, one spoon end
Stainless Steel Lab Spoon and Spatula	Bel-Art Products	Stainless Steel	12"	$57	No	No	One flat end, one spoon end
Stainless Steel Coated Lab Spoon and Spatula	Bel-Art Products	Stainless Steel coated in Teflon	9"	$37	No	No	One flat end, one spoon end
Disposable Spatula	VWR, Biomedical Polymers	Polypropylene, anti-static	5.5", 8.3", 12.2"	$128 per 100	No	Yes	Flexible, blue straw with flat end
Scrapper SteriPlast®	Burkle Inc.	Polystyrene, stainless steel	7.8" × 3.1"	$25 for pack of 10	Yes	Yes	Flat edge
Sterileware Sterile Sampling Knife	Bel-Art Products, Biomedical Polymers	Polystyrene	8.25"	$315.60 for pack of 200	Yes	Yes	Serrated edge

Table A-11. Swab Product Information

Product Name	Manufacturer	Swab Tip Material	Handle Material	Size	Cost	Individual Packaging	Sterilized Packaging	Wet or Dry	Tip Shape/Size
152C	Copan Diagnostics	Cotton; Charcoal coated	Wood or plastic	5.2”	Unknown	Yes	Yes	Dry	Not Specified
Critical Swab®, Cotton Head	VWR	Cotton	Wood	6”	$36 per 1,000	No	No	Dry	Not Specified
164C, 165KS01	Copan Diagnostics	Cotton	Wood or Paper	5.2”	Unknown	Yes	Yes	Dry	Mini, regular
Critical Swab® Double Tipped Swab	VWR	Cotton; lint-less, high absorbent	Paper	3.2”	$124 per 1,250	No	No	Dry	Dual cone or dual slim shape
Sterile Cotton STX705W	Texwipe	Cotton; sterile	Wood or polystyrene	6”	$218 ($500 tubes) per 500	Yes; tubes or clear packaging	Yes	Dry	Not Specified
Wrapped Cotton TX705	Texwipe	Cotton; wrapped	Wood	6”	$116 per 5,000	Yes	No	Dry	Not Specified
Foam-Covered Cotton TX700B	Texwipe	Cotton covered with polyurethane	Wood	6”	$482 per 2,500	Yes	No	Dry	Molded around bud core
71-4507	Superbrush LLC	Cotton covered with reticulated polyurethane	Wood, Birch	6”	$23 per 50	No	No	Dry	Narrow or tear drop
159C/164KS01	Copan Diagnostics, Inc.	Polyester	Plastic, Aluminum	5.2”	Unknown	Yes; Peel Pouch	Yes	Dry	Regular or mini
Sterile Dry Collection and Transport Tube STX764T, Sterile Polyester STX763	Texwipe	Polyester	Polystyrene	6”	$441 per 500	Yes; tubes or clear package	Yes	Dry	Not Specified
Sterile, Alpha® Polyester Swab, STX761	Texwipe	Polyester	Polypropylene	5”, 6.4”	$310 per 1,000	Yes	Yes	Dry	Flexible
Low TOC Alpha® TX714K	Texwipe	Polyester	Polypropylene	5”, 6.4”	$1486 per 1,000	Yes	No	Dry	Flat
Polyester Honeycomb TX801	Texwipe	Polyester	Polypropylene	2.7”, 5”	$218 per 600	Yes	No	Dry	Honeycomb

Table A-11. Swab Product Information (Continued)

Product Name	Manufacturer	Swab Tip Material	Handle Material	Size	Cost	Individual Packaging	Sterilized Packaging	Wet or Dry	Tip Shape/Size
Absorbond® TX762	Texwipe	Polyester; Double layer of nonwoven polyester fabric	Polypropylene	2.8”, 5”, 6.2”	$1,238 per 1,000	Yes	No	Dry	Flat tip with breakaway handle
Large Microdenier TX714MD	Texwipe	Polyester microdenier	Polypropylene	5.4”, 6.4”	$328 per 800	Yes	No	Dry	Flat, large or small
Micro Alpha® ESD-Safe TX758E	Texwipe	Polyester	Transplex®	3.6”, 6.5”	$353 per 2,500	Yes	No	Dry	Flexible tip with breakaway handle
Critical Swab®, Small Foam Head	VWR	Polyurethane	Polypropylene	2.3 to 5.8”	$143 per 500	No	No	Dry	Small, micro, medium non-flexible
Foam-Tipped Swab	VWR	Polyurethane	Polystyrene	5.9”	$4 per 12	No	No	Dry	Fine-pore, high absorbency
Critical Swab® Swab, Large Rectangular Foam Head	VWR	Polyurethane	Polypropylene	5.1”	$254 per 500	No	No	Dry	Rectangle
Critical Swab® Swab, Mini Pointed Compressed Foam Head	VWR	Polyurethane	Polypropylene	3.1”	$168 per 500	No	No	Dry	Mini, pointed
Critical Swab® Swab, Medium Foam Head, Wooden Shaft	VWR	Polyurethane	Wood	6”	$165 per 500	No	No	Dry	Medium
Critical Swab® Swab, Paddle-Shaped Foam Head	VWR	Polyurethane	Polypropylene	6”	$176 per 500	No	No	Dry	Flexible, paddle shaped
Sterile Foam STX708A	Texwipe	Polyurethane	Polypropylene	5.2”	$378 per 500	Yes	Yes	Dry	Round
Sterile Foam STX712A	Texwipe	Polyurethane	Polypropylene	5”	$218 per 500	Yes	Yes	Dry	Rectangle
Keyboard TX706A	Texwipe	Polyurethane	Polypropylene	3.2”	$329 per 1,000	Yes	No	Dry	Flexible, rounded

Table A-11. Swab Product Information (Continued)

Product Name	Manufacturer	Swab Tip Material	Handle Material	Size	Cost	Individual Packaging	Sterilized Packaging	Wet or Dry	Tip Shape/Size
Rectangular Head TX712A	Texwipe	Polyurethane	Polypropylene	2.8", 5", 5.2"	$286 per 1,000	Yes	No	Dry	Rigid, rectangle
Foam TX804	Texwipe	Polyurethane	Polypropylene	2.6"	$160 per 1,500	Yes	No	Dry	Precision pick tip
Foam TX805	Texwipe	Polyurethane	Polypropylene	5.2"	$133 per 400	Yes	No	Dry	Large lollipop head
Medium CleanFoam® TX740B	Texwipe	Polyurethane	Polypropylene	2.7", 6.4"	$408 per 2,500	Yes	No	Dry	Flexible in small or medium size
Small CleanFoam® TX742B	Texwipe	Polyurethane	Polypropylene	2.8"	$284 per 2,500	Yes	No; cleanroom processed	Dry	Rigid head core
Micro CleanFoam® TX757B	Texwipe	Polyurethane	Polypropylene	2.7"	$291 per 2,500	Yes	No; cleanroom processed	Dry	Micro, small, or medium tip
Critical Swab® Swab, Rectangular Foam Head	VWR	Polyurethane	Polypropylene	1.97 to 4.17"	$53 per 100	No	No	Dry	Small, medium, large, x-large flexible
53-1001	Superbrush	Polyurethane foam; sterile	Polypropylene .	6"	$20 per 100	Yes	Yes	Dry	Not Specified
71-4505	Superbrush	Polyurethane; reticulated	Polypropylene	2.79 to 8"	$20 per 50	No	No	Dry	Flexi-tip Foam Mitt
71-4554	Superbrush	Polyurethane; reticulated	Nylon	4.06"	$26 per 25	No	No	Dry	Macro Foam Mitt
71-4501	Superbrush	Polyurethane; non-reticulated	Polypropylene	2.83 to 9"	$12 per 50	No	No	Dry	Narrow rectangle
Critical Swab® Swab	VWR	Reticulated foam	Polypropylene	3.3"	$163 per 500	No	No	Dry	Cone-shaped, fine-point, or elongated tip.
All-in-One Swab	QuickSilver Analytics	Dacron swab; 1mL Sterile PBS	PBS	Not Specified	$37 per 5	Yes	Yes	Dry	Not Specified
Micro Foam Swab	QuickSilver Analytics	Microfoam	polystyrene	6"	$6 per 5	No	No	Dry	Not Specified
4N6 FLOQSwabs	Copan Diagnostics	Nylon fibers	Plastic	Varies	Not Specified	Yes	Yes	Dry	Not Specified

Table A-11. Swab Product Information (Continued)

Product Name	Manufacturer	Swab Tip Material	Handle Material	Size	Cost	Individual Packaging	Sterilized Packaging	Wet or Dry	Tip Shape/Size
Precision Nylon TX730	Texwipe	Nylon fibers	Polypropylene	6.6" handle; 0.035" diameter tip	$258 per 500	Yes	No	Dry	Tapered
Medium Flexible Head TX709A	Texwipe	Nylon fibers	Polypropylene	4.1", 4.5"	$303 per 1,000	Yes	No	Dry	Flexible in medium or large size
Dacron Swabs	QuickSilver Analytics	Nylon fibers	Plastic	6"	$4 per 5	No	No	Dry	Not Specified
160C	Copan Diagnostics	Rayon	Aluminum, Wire, Plastic, Wood	5.2"	Not Specified	Yes; in clear tubes	Yes	Dry	Not Specified
167CS01	Copan Diagnostics	Rayon	Plastic	5.2"	Not Specified	Yes	Yes	Dry	Dual tip, Regular
184CS01	Copan Diagnostics	Rayon	Plastic, Aluminum	5.2"	Not Specified	Yes; Peel Pouch	Yes	Dry	Mini, Regular, or Large
Mini Conical Tip ESD-Safe TX750E	Texwipe	Polyester, foam	Transplex®	3.5"	$326 per 2,500	Yes	No	Dry	Precision pointed
Mini Tip ESD-Safe 3.7mm TX753E	Texwipe	Polyester, foam	Transplex®	3.5"	$319 per 2,500	Yes	No	Dry	Rigid
Mini Tip ESD-Safe 3.8 TX757E	Texwipe	Polyester, foam	Transplex®	3.5"	$311 per 2,500	Yes	No	Dry	Flexible
Acu-Swab-R	Acumen Detection	Unknown	Metal	Unknown	$25 each	Yes	Unknown	Dry	Unknown
451C, 456C	Copan Diagnostics	Tip Vegetal protein coated	wood or plastic	5.2"	Unknown	Yes	Yes	Dry	Not Specified
56-4501-SB-25	Superbrush	Polyurethane; non-reticulated	Unknown	5"	$15 per 25	Yes; foil wrapped	No	Wet; 70% IPA	Large rectangle
SNAP Swab, Easy Snap Swab	Fiber Optics for Sale Co.	Foam	Polypropylene Reservoir with 2mL IPA	4.5"	$10 per 20	No	No	Wet; 100% IPA	Flat rectangle

Table A-12. Tape Lift Product Information

Product Name	Manufacturer	Solid, Liquid, Aerosol	Material	Size	Cost	Individual Packaging	Sterile Packaging	Features
Duct Tape	Duck Tape, Gorilla Tape, Scotch Brand, 3M, ipg, ProTapes	Solid	Polyethylene, adhesive, fabric mesh	1.88" × 10 to 60 yards	$3-10	No	No	Low cost COTS item
Footprint Residue Lifters	Sirchie	Solid	Transparent acrylic adhesive	6" × 15 "	$27 per 12	No	No	Available with a white or black background
Lightning Lifts	Safariland Group	Solid	Transparent acrylic adhesive	2" × 2", 2" × 4", 4" × 4"	$21-37 per 100	Yes	No	Lift tape with clear backing. Has a tab to keep fingerprints off of sample area

Table A-13. Tongs and Tweezer Product Information

Category	Material Type	Length	Individually Packaged	Sterile Packaging	Manufacturers/ Vendors	Cost range
Tweezers	Anti-magnetic Nickle or stainless steel	4.2"5, 4.5", 4.75"	No	No	Excelta, ThermoFisher, VWR	$13-114
	Chrome	8", 10", 12"	No	No	Fisherbrand, VWR	$30
	Polypropylene	5"	No	No	Bel-Art, ThermoFisher, VWR	$19 per 6; $4 each
	Polystyrene	4.375"	Option	No	Safariland Group	$6 per 10
	Stainless Steel	4" to 12"	No	No	Integra Miltex, ThermoFisher VWR, Sigma Aldrich	$20-100
	Stainless Steel	4.5"	Yes	Yes	Scientific Device, ThermoFisher, VWR	$98 per 25
	Stainless Steel coated with PTFE	3.87", 4", 4.5", 4.75"	No	No	Bel-Art, ThermoFisher, VWR	$50-100 per 2
Tongs	Stainless Steel	9", 18"	No	No	VWR, ThermoFisher	$20-100
	Polystyrene	4.25"	Yes	Yes	Bel-Art, ThermoFisher, VWR	$67 per 25
	Stainless Steel	9.5", 10", 20", 22", 24"	No	No	Saint-Gobain Chemware, ThermoFisher, VWR	$40-300
	Nichrome	9.5"	No	No	Surgical Design, VWR, ThermoFisher	$50
	Stainless Steel coated with PTFE	9", 18"	No	No	Bel-Art, ThermoFisher, VWR	$80-200
	Platinum	10"	No	No	Fisherbrand, VWR	$1,300
	Nickle	7.8"	No	No	Eisco, ThermoFisher, VWR	$5

Table A-14. Wipes Product Information

Category	Product Name	Manufacturer	Material	Size	Cost	Individual Packaging	Sterilized Packaging	Features	Surface Type
Dry wipes	ProCell™ TX699	Texwipe	35% Polypropylene / 65% Cellulose	9" × 9"	$71 per 1800	No	No	Triple-layer with cellulose being inner layer	Not specified
Dry wipes	Sterile TexVantage™ TX8932S	Texwipe	40% polyester/ 60% cellulose	12" × 12"	$144 per 500	No	Yes	Nonwoven with cut edge	Not specified
Dry wipes	TechniCloth® STX609	Texwipe	45% Polyester/ 55% Cellulose	9" × 9", 12" × 12"	$200 per 500	No	Yes	Nonwoven with cut edge	Not specified
Dry wipes	Sterile VersaWipe® STX624	Texwipe	55% polyester/ 45% cellulose	4" × 4"	$300 per 500	No	Yes	Nonwoven with cut edge	Not specified
Dry wipes	VersaWipe® TX622	Texwipe	55% polyester/ 45% cellulose	12" × 12", 4" × 4", 9" × 9"	$200 per 1,500	No	No	Nonwoven with cut edge	Not specified
Dry wipes	NuCotton® TX329	Texwipe	Cotton	9" × 9"	$333.70 per 1800	No	No	Double sided	Abrasive
Dry wipes	Texwipe® Cotton TX304	Texwipe	Cotton	4" × 4", 6" × 6", 9" × 9", 12" × 12"	$673.98 per 7200	No	No	Cut edge	Abrasive
Dry wipes	Sterile Vertex® Microdenier TX3059	Texwipe	Microdenier polyester	9" × 9"	$769.98 per 500	No	Yes	Not specified	Scratch-sensitive
Dry wipes	MiracleWipe® TX4012	Texwipe	Nylon	10" × 12", 4" × 4", 9" × 9"	$808.38 per 800	No	No	Cut edge	Not specified
Dry wipes	Sterile Vertex® TX3049	Texwipe	Polyester	9" × 9", 11" × 11", 12" × 12"	$300 per 500	No	Yes	Vertex® processing provides low levels of ions, NVRs (non-volatile residues), particles and fibers for use in critical cleaning applications and environments.	Designed for high sorption capacity
Dry wipes	Vertex® High Sorption TX49	Texwipe	Polyester	9" × 9", 12" × 12"	$558 per 1500	No	No	Vertex® processing provides low levels of ions, NVRs (non-volatile residues), particles and fibers for use in critical cleaning applications and environments.	Delicate surfaces or applications

Table A-14. Wipes Product Information (Continued)

Category	Product Name	Manufacturer	Material	Size	Cost	Individual Packaging	Sterilized Packaging	Features	Surface Type
Dry wipes	AlphaWipe® TX1031	Texwipe	Polyester	9" × 32", 12" × 12", 24" × 44"	$386 per 200	No	No	Ideal for mop cover	Abrasive
Dry wipes	Sterile AlphaSat® with AlphaSorb® HC TX3252	Texwipe	Polyester	12" × 12"	$413 per 125	No	Yes	Two-ply from continuous filament polyester	Not specified
Dry wipes	Sterile AlphaWipe® STX1004	Texwipe	Polyester	4" × 4", 9" × 9"	$644 per 2500	No	Yes	Not specified	Abrasive
Dry wipes	Sterile TexTra™ 10 TX3224	Texwipe	Polyester	9" × 9", 12" × 12"	$315 per 500	No	Yes	Sealed border or cut edge available	Not specified
Dry wipes	Sterile Vectra® Alpha® 10 TX3212	Texwipe	Polyester	12" × 12"	$540 per 500	No	Yes	Sealed border	Abrasive
Dry wipes	Sterile Vectra® AlphaSorb® 10 TX3215	Texwipe	Polyester	12" × 12"	$684 per 500	No	Yes	Sealed border with double layers	Abrasive
Dry wipes	TexTube® TX1070	Texwipe	Polyester	9" × 9"	$1,028 per 1,000	No	No	Two-ply tubular polyester wiper, pinsonic, sealed-border	Not specified
Dry wipes	ThermaSeal™ 60 TX2064	Texwipe	Polyester	4" × 4", 9" × 9"	$650 per 6,000	No	No	100% continuous-filament, double-knit polyester fabric; These wipers are laser cut (thermally sealed)	Not specified
Dry wipes	Vectra® Alpha 10 LT TX8659	Texwipe	Polyester	9" × 9"	$774 per 1,000	No	No	Balance of wiping efficiency, abrasion resistance and absorbency	Not specified
Dry wipes	Vectra® Honeycomb® 10 TX1060	Texwipe	Polyester	9" × 9"	$559 per 100	No	No	Honeycomb pockets, sealed border	Not specified
Dry wipes	BetaWipe™ TX2009	Texwipe	Polypropylene, cellulose	9" × 9"	$254 per 1,000	No	No	Designed for the removal of acids, etchants and chemical spills in controlled environments	Scratch-sensitive
Dry wipes	FoamWipe® TX704	Texwipe	Polyurethane	6" × 9" × 1/8"	$218 per 480	No	No	Open cell, 100 pore per inch, cut edge	Not specified
Dry wipes	Ghost Wipes	SKC	Polyvinyl alcohol	10" × 10"	$52 per 200	Yes	No	Meets all ASTM E1792, NIOSH 9102. Can be completely digested in hot water or acid solution	Surface metals
Dry wipes	Gauze Pad/Sponge	Curad	Rayon/polyester	2" × 3"	$6 per 6	Yes	Yes	Nonwoven material with absorbent cellulose layer	Not specified

Table A-14. Wipes Product Information (Continued)

Category	Product Name	Manufacturer	Material	Size	Cost	Individual Packaging	Sterilized Packaging	Features	Surface Type
Pre-wetted wipes	Sterile Pre-Wet Vertex® High Sorption TX3044P	Texwipe	Polyester; 70% Denatured Ethanol	12" × 12"	$170 per 125	No	Yes	Vertex® processing provides low levels of ions, NVRs (non-volatile residues), particles and fibers for use in critical cleaning applications and environments.	Not specified
Pre-wetted wipes	TechniSat® TX1048	Texwipe	45% Polyester/ 55% Cellulose; 6% IPA	8" × 5", 9" × 11"	$300 per 2,520	No	No	Nonwoven with cut edge	Not specified
Pre-wetted wipes	Sterile TechniSat® TX3214	Texwipe	45% Polyester/ 55% Cellulose; 70% IPA	9" × 11", 8" × 5.5"	$391 per 1,000	No	Yes	Nonwoven with cut edge	Not specified
Pre-wetted wipes	Sterile TechniSat® STX1068	Texwipe	45% Polyester /55% Cellulose; 70% ethanol	7" × 11"	$429 per 1,000	No	Yes	Nonwoven with cut edge	Not specified
Pre-wetted wipes	Alcohol Swabs, Alcohol prep pads	QuickSilver Analytics, drugs.com, VWR, CleanTex, Curad, Many others	70% to 90% IPA	1.5” × 1"	$6 per 20	Yes	Yes	Two-ply nonwoven sponge pad	Not specified
Pre-wetted wipes	AlphaSat® with Vectra® AlphaSorb® 10 TX1057	Texwipe	Polyester with 10% IPA or 100% IPA	9" × 9"	$730 per 480	No	No	Sealed border with double layers	Abrasive
Pre-wetted wipes	AlphaSat® (with AlphaWipe®) TX7031	Texwipe	Polyester; 6% IPA	9" × 32"	$714 per 100	No	No	Designed for mop cover	Abrasive
Pre-wetted wipes	AlphaSat® with Vectra® Alpha® 10 TX8415	Texwipe	Polyester; 6% IPA	9" × 9"	$673 per 600	No	No	Sealed border	Abrasive
Pre-wetted wipes	Vectra® QuanSat® LT TX8691	Texwipe	Polyester; 6% IPA	9" × 9"	$456 per 600	No	No	No Titanium Dioxide (TiO2) added; balance of wiping efficiency, abrasion resistance and absorbency	Not specified

Table A-14. Wipes Product Information (Continued)

Category	Product Name	Manufacturer	Material	Size	Cost	Individual Packaging	Sterilized Packaging	Features	Surface Type
Pre-wetted wipes	Sterile AlphaSat® (with AlphaWipe®) STX1034	Texwipe	Polyester; 70% IPA	4" × 4"	$233 per 400	No	Yes	Not specified	Abrasive
Pre-wetted wipes	Sterile AlphaSat® with Vectra® Alpha® 10 TX3280	Texwipe	Polyester; 70% IPA	9" × 9", 12" × 12"	$500 per 250	No	Yes	Sealed border	Abrasive
Pre-wetted wipes	Sterile Pre-Wet Vertex® High Sorption TX3049P	Texwipe	Polyester; 70% IPA	9" × 9", 12" × 12"	$160 per 125	No	Yes	Vertex® processing provides low levels of ions, NVRs (non-volatile residues), particles and fibers for use in critical cleaning applications and environments.	Not specified
Pre-wetted wipes	Sterile PolySat® TX3213	Texwipe	Polypropylene ; 70% IPA	9" × 11"	$355 per 1,000	No	Yes	100% melt-blown polypropylene with a cut edge	Not specified
Tabs	Smear Tabs	SKC	Low-ash, acid-hardened Paper	Unknown	$48 per 100	No	No	Paper tab	Not specified

Table A-15. Collection Kit Product Information

Kit Name	Manufacturer	Solid, Liquid, Aerosol	Contents	Summary
Carpet Sampling Cassette Kit	SKC	Aerosol	Carpet Cassette with disposable template, Luer adapter, zip bag, and label.	Sample carpet or air for indoor contaminants. The kit uses the filter assembly from SKC along with tubing and supplies to convert the collectors into a carpet vacuum/aerosol sampler. Kit does not include sampling pump.
Micro Spoon and Spatula Weighing Set	Bel-Art Products	Solid, Liquid	Six different, small size, double-ended tools (6” long) and a pair of tweezers (5.7” long)	Each double-ended tool has two different end shapes providing 12 tools; stainless steel; carrying case
Sample Kit	Sampling Systems	Solid	Sterile Scoop (30 mL) and a sterile LDPE Sample Bag (900 mL). Bags contain a metal closure and are water and powder tight.	Designed for sampling powders, the kit comprises of 10 sets. Each set is individually bagged and contains one sterile Scoop (30ml) and one sterile Sample Bag (900ml). Everything in the kit is sterilized by gamma irradiation.
Dipper Sampling Kit	New Star Environmental	Liquid	1.5' handle, 3' handle, 6' handle, 250mL dipping beaker, 500mL dipping beaker, & 1000 mL dipping beaker	Using the various beaker and handle sizes, this kit can be used a variety of different sampling situations.
Wipe Sample Test Kit	SKC	Solid, Liquid	Paper and glass fiber filters, sterile sample bags, latex gloves, cotton swabs, pH paper, cover slips, 25 Ghost Wipes, 72 micro slides, 20 sample containers, 3 dropper bottles, 25 paper templates, and 1 each: marking pen, masking tape, clear tape, stainless steel forceps, and carry case	This kit can be used to follow OSHA wipe sample methods (solvents not included) for collecting potentially toxic materials from a surface.
Nutrimenta Kit	Thomas Scientific	Solid, liquid	Ice probe cylindrical probe; Ellipso spoon sampler; Surgel cylindrical sampler; Cebu conical sampler; Pic probe sampler; Dip dipper sampler; Mipaw sampler; Multipro sampler; Probe cylinder; Radic spatula; Zanzibar portable thermometer; Sampling data recording sheet and sampling check list	This kit is housed in a hard-shell container with a handle for transport of the kit. Included is a variety of tools for sample collection and preservation. Tools included are all food-safe
HotZone Sample Collection Kit; Liquid module	Hotzone Solutions Group	Liquid	Tygon tubing, Luer-lock tubing adapter, blunt fill needle, plastic syringes 10 mL and 60 mL, Pasteur pipettes, glass-bonded silica filter/sink	Liquid samples can be collected from surface puddles, surface waters, waste and bulk collectors, or from inside of containers and indentations. Low volume samples can be collected using disposable PE pipettes or syringes fitted with stainless steel fill needle. Larger volume syringes and tubing serve for extraction of the samples. The chemical resistant tubing is securely fitted to the syringe via Luer type fitting. The tubing can be lowered to depths of up to 5 (five) meters. Glass-bonded silica weight attached to the tubing for this purpose serves also to filter of any solid material that could plug the system.

Table A-15. Collection Kit Product Information (Continued)

Kit Name	Manufacturer	Solid, Liquid, Aerosol	Contents	Summary
HotZone Sample Collection Kit; Solid Scoop module	Hotzone Solutions Group	Solid	Spatulas, scoops, scoop/spatulas, balance spoons	Solid scoop module is intended for collection of soil, bulk solids or powders. Stainless steel scoop, spatula and trulla can be used for surface scrapping, shallow digging and collection of soil samples and other bulk material. Solid powders stored in plastic or paper bags can be conveniently sampled using the stainless-steel balance spoon.
HotZone Sample Collection Kit; Aerosol module	Hotzone Solutions Group	Aerosol	Air sampler, BIOSdefender model 510 M, Filter cassette, filters, filter cassette holder with collar clip, luer adapter, tygon tubing, air sampling tubes, impinger, HZS air/vapor sample collection storage system	Air/vapor/aerosol module uses a pump for active sampling at both, low and high flow ends. Solid aerosols/particles potentially containing chemical, biological or radiological threats are collected using cassettes with membrane filters. A range of membranes of different pore sizes are available. A vacuum-style cassette design provides also direct collection of the solid particles and pathogens from solid surfaces, such is carpet.
CBRN/TIM Sampling Equipment with Easy to Carry Backpack	SAAB	Solid, liquid, aerosol	Plastic bags, ties and tensioner, pens, labels, sealing tape, extra caps, Parafilm, extra absorbent bags, gloves, transport tubes for plastic / glass test tubes packed in Teflon bottles, manual air sampler, rapid tests (test paper/strips), claw, rain cover, sample forms, instruction manual, sampling templates, spatulas, syringes, cannulas, PTFE tubing, Pasteur pipettes, scalpels, tweezers, spoons, sterile swabs, sterile gauze cloth, sodium chloride solution.	This kit is designed for first responders, military and other operational personnel that take samples of chemical, biological and radiological agents or materials, including toxins and other toxic industrial materials. The kit is housed in a backpack.
CBRN/TIM Sampling Kit	SAAB	Solid, Liquid	Documentation binder (sealing tape, sample forms, instruction manual), Clipboard/sample evidence board, C-protective plastic, 250mL glass bottle, 2x 100mL glass bottles, 1000mL glass bottle, Gloves, Pens, 40mL vials, gas impermeable plastic bags, cable ties, tie tensioner, scissors, spatulas, tweezers, spoons, scalpels, Pasteur pipettes, wipes,	Designed for first responders (emergency responders), military or other operational personnel to take samples of chemical, biological and radiological agents, including toxins and other toxic industrial materials. The kit is housed in a pelican case.
Advanced CBRN Sampling Kit	SAAB	Solid, liquid, aerosol	It contains more than 300 different articles for forensic sampling of CBRN agents from air, water, liquids, soil, powder, objects and vegetation and includes 11 different sampling kits, one record kit, one accessory kit, three mission boxes and a cooling box for samples.	Comprehensive sampling kit for use in various situations. Contains 12 modules that allow for sampling of solids, liquids, vapors, and aerosols. This kit contains more than 300 items and is designed for CBRN sample collection and transportation. All equipment follows NATO Standard AEP 10 and AEP 49. The kit is customizable.

Table A-15. Collection Kit Product Information (Continued)

Kit Name	Manufacturer	Solid, Liquid, Aerosol	Contents	Summary
Complete Biological Module	QuickSilver Analytics	Solid	1- Bio Green Module Pouch, 9- Bio Vial Assemblies with sterile water, 6- 2mL transfer pipettes, 6- Large spatulas, 6- Sterile gauze pads, 5- Dacron Swabs, 5- Macro foam swabs, 5- Micro foam swabs, 6- Micro spatulas, 12- Sani-Cloth germicidal wipes, 5- All in one swabs, 1- 6' roll of parafilm	Sampling Kit mostly comprised of swabs, wipes and spatulas
Mini Push Pack, Bio	QuickSilver Analytics	Solid	Bio Vial Assembly, 2 mL disposable pipette, Ceber Wipe, Macrofoam swab, Dacron swab, microfoam swab, Gauze pad, Large spatula, Micro spatula, Sterile Scalpel, Sample collection bag, Piece of parafilm, 2 part Chain-of Custody form, Mylar pouch.	Single-use version of the CBRE Sampling Kit bio module
Residue and Powder Sampling Area Kit	QuickSilver Analytics	Solid	6" Ruler; Pen, Markers; Camera, Wipes, Spatulas, Swabs, Biological Sampling Kits, Small Area Sampling Kits, Sample Vial Assemblies, Chain-of-Custody Forms	The kit is capable of obtaining up to 9 samples of varying size. Kits are also individually serial numbered for reach back.
Evidence Collection ID and Sealing Kit	Sirchie	Solid, Liquid	Rechargeable Vacuum, Longwave UV Source, Magnifier; Flashlight, Scissors, Evidence Collection Lifters with Backers, Polystyrene Vials, Pipettes, Spatulas, Retractable Lifter Knife with Blade, Stainless Combination Blade, Tweezers; Evidence collection items (markers, labels, tape, etc.) Black, Molded Copolymer carrying Case, Textured with Handle and Molded Inserts.	A general purpose, professional crime scene investigation kit complete with vacuum sampler and thoroughly outfitted with collection supplies.
SEARCH 3-Drawer/Storage Evidence Collection Kit	Sirchie	Solid, Liquid	Jars, Cans, Bags, Scalpel, Zip-Top Bags, Scissors, Tweezers, Gloves, Syringes, Collection Tube; LED Penlight, Carbon; High-Impact, Copolymer Carrying Case with Handle	This kit features a 3-drawer organizer with a top compartment opening as well. The drawers are further organized into compartment with clear lids so the items can be seen without opening.
Evidence Collection and Identification Kit	Sirchie	Solid, Liquid	Ultraviolet Light, Evidence Collection Lifters, Tweezers; Scissors, Carbide Tip Scriber, Evidence Knife, Sampling Pipettes, Magnifying Glass, Probe with Paint Chip Cutter, Collection Tubes with EDTA, Disposable Syringes, Jars, Gloves, Spatulas, Scalpels, Measuring Tape, Evidence collection labels, tags, bags, and markers, Molded Polypropylene case, Attach-Type, Molded Polypropylene Carrying Case with Metal Frame and Machined Component Pad.	This kit is housed in a hard-shell container with a handle for transport of the kit. Included is a variety of tools for sample collection and preservation. Instructions and procedures booklet included.

Appendix B.
Introduction Accessory Product Information

Table B-1. Instrument Accessory Probes

Product Name	Manufacturer	Associated PBA Instrument	Solid, Liquid, Aerosol	Material	Probe Length (m)	Cost	Summary
Fiber Reflectance Probes	B&W Tek	B&W Tek iRaman Series	Solid, Liquid	Widow: Silica Shaft: Stainless Steel	1.5 m	Unknown	The FRP fiber reflectance probe combines optical fibers at one end for sample measurement and is bundle bifurcated into two channels at the other end for connection to a light source and spectrometer. A fiber optic reflectance probe can measure either diffuse or specular reflectance from surfaces.
Fiber Dip Probe	B&W Tek	B&W Tek iRaman Series	Liquid	Widow: Silica Shaft: Stainless Steel Seal: Epoxy	1.5 m	Unknown	The FDP (fiber dip probe) is used for measuring the transmittance and absorbance of liquid solutions. The FDP can be inserted into a beaker or any liquid container.
BAC201 Fiber-Optic Raman Needle Probe	B&W Tek	B&W Tek iRaman Series	Solid, Liquid	Needle Tube: Stainless Steel Window: Silica	1.5 m	$10,000	The BAC201 is a fiber optic Raman probe designed to analyze samples at hard-to-reach places, such as inside small cavities, tissues, and miniature reactors. The probe tip is sealed with a fused silica ball lens, which allows for high throughput and easy cleaning. The optical elements inside the needle are permanently fixed in alignment, with no possibility of movement due to impact or vibrations.
BAC102 Raman Trigger Probe	B&W Tek	B&W Tek iRaman Series	Solid, Liquid	Shaft: Stainless Steel Window: quartz	1.5 m	$5,000	The BAC102 Raman Trigger Probe offers a trigger function. The probe can be brought directly to the sample and make contact with either the sample or the packaging of the sample via a detachable distance regulator that ensures proper focusing while minimizing contamination to the lens material.
BAC101 Industrial-Grade Raman Probe	B&W Tek	B&W Tek iRaman Series	Solid, Liquid	Shaft: Stainless Steel or Hastelloy C-276 Window: Sapphire or silica Seal: epoxy	1.5 m	$8,000	The BAC101 industrial-grade probe is available with shafts of 316SS or Hastelloy C-276 for use with the 532 and 785nm excitation portable Raman instruments, and high-throughput (HT) versions are available. Due to the extremely short working distance of the probe shaft, highly reproducible results are achieved working with the probe tip immersed in liquids, slurries, powders, or in direct contact with solids.
NanoRam® Immersion Probe	B&W Tek	B&W Tek NanoRam	Solid, Liquid	Stainless Steel	0.305 m	Unknown	Allows for in situ measurements of liquids and powders, and measurements of larger containers only accessible from the top.
Dip Probes	Bay Spec	Bay Spec SuperGamut™ Series & NirSpector	Liquid	Stainless Steel probe.	1.5 m	Unknown	As an attachment, the Dip Probe cable connects to a removable tip and probe. Options include 200 to 600 um fiber and 1 to 20 mm pathlength. The probe cable is polyurethane furcation tubing with PVC monocoil

Table B-1. Instrument Accessory Probes (Continued)

Product Name	Manufacturer	Associated PBA Instrument	Solid, Liquid, Aerosol	Material	Probe Length (m)	Cost	Summary
RamanProbe™	InPhotonics	InPhotonics InPhocelle and InPhotote	Solid	Shaft: Stainless Steel	5 m cable, 0.08 m probe	$4,950	The RamanProbe is available for select excitation wavelengths in the visible and near-IR. The patented design filters Rayleigh scattering with an attenuation of 10E8. The probe also eliminates background signals arising in the fiber optic cables for optimum data quality even over 500 feet of fiber.
RamanProbe™ II	InPhotonics	InPhotonics InPhocelle and InPhotote	Solid, Liquid	Shaft: Stainless Steel Window: sapphire	5 m cable, 0.23 m probe	$6,745	The RamanProbe II is a fiber optic probe for immersion analysis. The 8" long body and removable sleeve enable the probe to be immersed directly in solutions for true in situ analysis up to 200C.
Reaction RamanProbe™	InPhotonics	InPhotonics InPhocelle and InPhotote	Solid, Liquid	Shaft: Stainless Steel or Hastelloy C-276 Window: Sapphire	5 m cable, 0.33 m probe	$8,200-9,200	The stainless steel probe has a removable immersion sleeve made of either 316 stainless-steel or Hastelloy C-276. The probe has an adjustable working distance, to enable focusing on particles through solution media as well as measurement of dissolved species. Because the optical filters at located at the end of the probe, the Reaction RamanProbe is also available in longer lengths upon request.
RPB Fiber Optic Raman Probe	InPhotonics	InPhotonics InPhocelle and InPhotote	Solid	Shaft: aluminum, stainless steel	1.5 m cable, 0.147 m probe	$2,750	The RPB is available for three excitation wavelengths: 785, 633, and 532 nm and can be directly coupled to a most spectrograph designs. The probe is lightweight and compact, and has a manual safety shutter to shield the user from laser light.
Contact Ball Probe Attachment	Metrohm	Metrohm Mira DS	Solid, Liquid	316L Stainless steel	0.152 m	$12,390	Identify substances by contacting the liquid or powder with the probe. The short focal length of the spherical optics allows for direct contact analysis.
Telescopic Sampling Wand extension	Bruker	Bruker De-Tector Flex	Solid, Liquid	Unknown	Unknown	Unknown	Extends the sampling wand
Sampling Probe	Horiba	Horiba Macro Ram	Solid, Liquid	Unknown	Unknown	Unknown	Each MacroRAM is equipped with the capability to connect an external probe for remote sample measurements

Table B-2. Standoff Attachments

Product Name	Manufacturer	Associated PBA Instrument	Solid, Liquid, Aerosol	Cost	Summary
Stand-off Attachment	Metrohm	Mira DS	Solid, Liquid	$7,363	The stand-off attachment to the Metrohm Mira DS allows for analysis from a distance of 0.25 to 1.5 meters.
SuperHead	Horiba	Macro Ram	Solid, Liquid	Multiple Varieties Available	The SuperHead is a high efficiency remote Raman probe which enables in situ non-invasive chemical analysis to be undertaken. The SuperHead can perform measurements in a non-contact/non-invasive mode or in an immersion mode, using specific accessories.

Table B-3. Instrument Collection Accessories

Product Name	Manufacturer	Associated PBA Instrument	Solid, Liquid, Aerosol	Cost	Summary
ClearSampler Starter Kit	Smiths Detection	HazMatID Elite, potentially other FTIR systems	Solid, Liquid	$40 for handle; $48 per 6 discs	The collection discs collect samples for FTIR analysis, from clothing, porous surfaces, and dried/caked-on residuals from containers or bags, even oils suspended in aqueous solutions. The single use discs retain the sample material for further analysis or evidentiary needs. These discs could potentially be used on other IR instruments.
H-stick	ThermoFisher	ThermoFisher Gemini	Liquid	Unknown	SERS capability in a test stick that reduces fluorescence in the sample.
SERS Attachments	Metrohm	Mira DS	Solid, Liquid	Unknown	The SERS attachment to the Metrohm Mira DS allows for analysis of SERS substrate papers. The SERS paper substrates are sold separately.
Acu-Swab-R	Acumen	ThermoFisher Defender RMX	Solid, Liquid	Swabs $25, Sidecar $75	Acu-Swab-R is a swab held in a vial for swabbing small amounts of materials and analysis by Raman. The vial holds the swab in the correct placement, as does the sidecar for analysis by the Defender RMX.
Solid Phase Micro Extraction (SPME) Fibers	Sigma Aldrich	FLIR Griffin G510	Liquid	$450	Fibers collect sample target in aqueous matrixes. A myriad of fiber coatings dependent upon application.
PSI-Probe	FLIR	FLIR Griffin G510	Solid	$10,043	The heated probe allows analysis of trace solid sampling introduction.
Twister	Gerstel	Griffin G510	Solid, Liquid, Aerosol	$620-742	Used in aqueous, vapor and solid samples. The PDMS coated Twister is stirred in the sample for several minutes. Analytes of interest been exposed to the PDMS phase and are extracted. The Griffin G510 PSI-probe can analyze the Twister.
Solid Liquid Adapter (SLA)	Smiths Detection	Smiths Detection JCAD	Solid, Liquid	Unknown	The SLA retrofits onto the existing JCAD system, expanding its detection and identification capabilities to include explosives, non-traditional agents, and narcotics. It consists of a probe with swab consumable, which heats and vaporizes encountered substances.