Enhanced Responder Personal Protective Equipment Transport Bags

Market Survey Report

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Science and Technology

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FOREWORD

The National Urban Security Technology Laboratory (NUSTL) is a federal laboratory within the U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T). Located in New York City, NUSTL is the only national laboratory focused exclusively on supporting the capabilities of federal, state, local, tribal, and territorial responders to address the homeland security mission. The laboratory assists responders with the use of technology to prevent, protect against, mitigate, respond to, and recover from homeland security threats and incidents. NUSTL provides expertise on a wide range of subject areas, including chemical, biological, radiological, nuclear, and explosive detection, personal protective equipment, and tools for emergency response and recovery.

NUSTL manages the System Assessment and Validation for Emergency Responders (SAVER®) program, which provides information on commercially available equipment to assist response organizations in equipment selection and procurement. SAVER knowledge products provide information on equipment that falls under the categories listed in the DHS Authorized Equipment List (AEL), focusing primarily on two main questions for the responder community: "What equipment is available?" and "How does it perform?" The SAVER program works with responders to conduct objective, practitioner-relevant, operationally-oriented assessments and validations of commercially available emergency response equipment. Having the right tools provides a safer work environment for responders and a safer community for those they serve.

NUSTL is responsible for all SAVER activities, including selecting and prioritizing program topics, developing SAVER knowledge products, and coordinating with other organizations to leverage appropriate subject matter expertise. In conjunction with CADMUS, NUSTL conducted a market survey of commercially available enhanced responder personal protective equipment transport bags. This equipment falls under the AEL reference number 19GN-00-BGPK titled "Bags/Packs." Additionally, AEL 01ZP-00-GBAG, "Bag/Box, Ensemble Gear Storage" may also be applicable.

SAVER reports are available at www.dhs.gov/science-and-technology/saver-documents-library.

Visit the NUSTL website at www.dhs.gov/science-and-technology/national-urban-security-technology-laboratory or contact the lab at NUSTL@hq.dhs.gov.

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SAVER

System Assessment and Validation for Emergency Responders ®

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EXECUTIVE SUMMARY

First responders are exposed to hazardous chemicals, toxins, and particles as part of their response operations, and those hazardous contaminants may collect on and be absorbed by their protective gear. First responders may not have a designated operation center or storage option for potentially contaminated gear. This often results in them leaving it in gear bags within vehicles. Currently, the gear bags many first responders use to store their personal protective equipment (PPE) are not designed to effectively provide containment of hazardous contaminants. Thus, these compounds could contaminate nearby materials or areas (e.g., sleeping or eating areas) as well as personal vehicles and private homes of responders.

Between February 2024 and May 2024, the System Assessment and Validation for Emergency Responders (SAVER) program conducted a market survey of commercially available transport bags for responder PPE intended to offer enhanced containment that is specifically designed to mitigate the risk for spread of fireground contamination. This market survey report is based on information gathered from manufacturer and vendor websites, internet research, industry publications, and a government-issued request for information (Notice 70RSAT24RFI000016) that was posted on the System of Award Management website. The survey identified three products ranging in price from $135 to $279.

The purpose of this market survey is to provide emergency responders with information that will guide emergency response agencies in making operational and procurement decisions. Emergency responder agencies should consider overall capabilities, technical specifications, and limitations of PPE transport bags in relation to their agency's operational needs when making equipment selections. Performance of these products and information included in this report has not been independently verified by the SAVER program.

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1.0 INTRODUCTION

First responders are exposed to hazardous chemicals, toxins, and particles as part of their response operations, and those hazardous compounds may collect on and be absorbed by their protective gear. Emergency responders use transport bags for the storage and movement of bunker gear and other personal protective equipment (PPE). Currently, the gear bags many first responders use to store their PPE are not designed to effectively contain and minimize spread of contaminants.

Between February 2024 and May 2024, the System Assessment and Validation for Emergency Responders (SAVER) program conducted a market survey of enhanced commercially available transport bags for responder PPE. This market survey report is based on information gathered from manufacturer and vendor websites, internet research, industry publications, and a government-issued a request for information (RFI) (Notice 70RSAT24RFI000016) that was posted on the System of Award Management website. The U.S. Department of Homeland Security (DHS) Science and Technology Directorate's (S&T's) Technology Scouting Group also contributed to the market research used in the development of this report.

The transport bags included in this report meet the following criteria:

- Made of material suitable to be decontaminated
- Easily portable by a single person
- Fit within the trunk of a vehicle
- Include a sealable mechanism

Due diligence was performed to develop a report that is representative of products in the marketplace.

2.0 OVERVIEW

2.1 Background

First responders from all public safety disciplines are exposed to hazardous chemicals, toxins, and particles as part of their regular response operations as well as responses to incidents that specifically involve chemical and biological hazards. These hazardous compounds can significantly impact first responders' immediate and long-term health. Responders' protective gear can also collect or absorb these contaminants, increasing the risk of the physical injury to or long-term adverse health effects for the wearers.

First responders may be left with minimal protection from contaminated PPE. When leaving their respective place of duty, they may not have an operation center or storage option designated for handling potentially contaminated gear; often the result is responders' leaving it in gear bags that they keep in their personal or duty vehicles. Currently, gear bags used by many first responders may not minimize the spread of contamination effectively nor provide containment of hazardous materials, which introduces the risk that hazardous contaminants could transfer to responders' work materials or duty station areas (e.g., sleeping or eating areas) as well as their personal vehicles and private homes.

Responders currently use large gear bags to transport their PPE to and from work when necessary. Similar in style to hockey equipment bags, they are generally made of nylon and have two handles as well as a larger shoulder strap as options for lifting and carrying. Gear bags often have multiple compartments to store different parts of a responder's PPE. The compartments of the gear bag are generally closed with standard zippers, which do not offer any type of seal or containment of carcinogens or toxins.

Figure 2-1 A member of the fire service carries a traditional gear bag.

2.2 Key Components: Seals, Closures, Materials

Currently, PPE transport bags for first responders are often soft-sided bags (e.g., duffel bags) with multiple compartments, zipper closures, and a shoulder strap. Many of these gear bags now have ventilation to help reduce mildew growth from storing wet gear inside the bag for extended periods of time. New studies have shown that protective gear worn by first responders can absorb not just water but fireground contaminants, putting firefighters at increased risk for developing long-term adverse health effects when these contaminants are later released from the gear.

Given these findings, this report explores PPE transport bags with enhanced features specifically designed to mitigate contamination risks. Many of the key components for enhanced mitigation are incorporated into the seals and closures of the bags, as well as the primary materials out of which they are constructed. Designs incorporate advanced materials to offer better containment of contaminants, such as compartments that can be sealed more effectively, materials that are chemical-resistant, and integrated features that help to neutralize or isolate harmful substances.

2.2.1 Seals

Some enhanced transport bags incorporate heat-welded seams in their construction. Heat-welded seams create strong, seamless barriers that prevent leaks and cross-contamination. They can offer chemical resistance, therefore preserving the bag's ability to contain hazardous compounds that may be contaminating transported gear and increase the health and safety of the user. Heat-welded seams also resist wear and tear, helping to ensure the integrity of the bag's containment capability and maintaining its effectiveness over time. Additionally, the smooth surfaces of heat-welded seams make bags easier to clean, allowing for thorough interior and exterior decontamination.

2.2.2 Closures

Closures such as water-resistant zippers can enhance the protective capability of a transport bag, reduce the risk of contamination, and extend the longevity of the equipment stored inside. These zippers prevent water and moisture from entering the containment area, keeping PPE dry. This can also contribute to a clean and hygienic environment inside the containment compartment of the bag, reducing the risk that the stored PPE items could become contaminated.

Heat-welded thermoplastic polyurethane (TPU) gas-tight zippers provide waterproofing and airtight sealing. The heat-welding process fuses the TPU material and the material around the zipper, creating a seamless, impenetrable barrier against water, moisture, and gases. TPU is highly durable, resistant to abrasion, and stays flexible across various temperatures (is -40°C to 125°C), ensuring the zipper performs reliably in extreme cold and heat. The chemical resistance of TPU adds another layer of protection, safeguarding the transport bag's contents from exposure to harmful substances. The smooth surface of the TPU zipper makes it easy to clean and disinfect, maintaining high hygiene standards for compartments designed to store PPE and other gear.

2.2.3 Materials

The marketplace also offers some advances in the primary materials used to construct transport bags. C-reinforced polyvinyl chloride (PVC) materials, such as tarpaulin, are durable and chemical resistant. The polyester reinforcement enhances the PVC's strength, making it resistant to tearing, punctures, and abrasions, allowing bags made of this material to withstand harsh conditions during handling and storage. PVC's waterproof and weatherproof properties, especially when reinforced with polyester, allow for outdoor storage, protecting PPE from moisture, ultraviolet (UV) radiation, and temperature fluctuations. Meanwhile, PVC's inherent chemical resistance ensures that bags made of this material can safely contain hazardous contamination without the risk of leaks or degradation of the material.

Similarly, fabrics that are laminated, or coated, with TPU are durable, and –critical for containing hazardous material – chemical resistant. The material's flexibility and elasticity allow it to conform to different gear shapes for a secure fit. Its lightweight nature and minimal maintenance make it practical for portable and reusable containment solutions. TPU-treated fabrics' durability and resistance to abrasions, tears, and UV radiation ensure that the containment structures of such bags remain intact even in challenging environments. TPU's chemical resistance is beneficial for off-gassing as it can help contain and reduce the release of volatile organic compounds (VOCs) that may have absorbed onto the gear. Additionally, fabrics laminated or coated with TPU can be heat-welded to create strong, seamless seams that ensure leak-proof containment.

2.3 Applications

First responders, specifically the fire service and others who encounter potentially hazardous compounds during emergency response, use gear bags for the storage and transport of their post-incident PPE. Particular use cases are expanded upon below.

2.3.1 On-site Deployment and Storage

Following response operations, responders on-site may use PPE transport bags (in lieu of plastic disposable bags) to store and contain contaminated gear, such as jackets, pants, hoods, helmets, gloves, masks, and boots. This immediate containment reduces further spread of hazardous substances within the response area and reduces the risk of exposure for responders and other personnel present. In larger-scale incidents or disasters, temporary holding areas may be set up to manage gear from multiple responders. PPE transport bags can facilitate organized storage in such areas by ensuring that each responder's gear remains separate and identifiable (e.g., via color coding or labels), which, reduces the risk of mix-ups or cross-contamination between different teams or agencies.

2.3.2 Transportation and Storage in Personal Vehicles

Many first responders stow PPE transport bags in their personal vehicles while commuting from one work location to the next. While the primary purposes of these bags are transporting and storing gear, bags made with enhanced fabrics, closures, and seams can increase a responder's protection from hazardous chemicals and toxins on contaminated gear. Enhanced transport bags can reduce, or even prevent leakage or spillage of the contaminants during transit, thus limiting the risks they pose to responders, transport personnel, the public, and the environment.

2.4 Additional Considerations

Many first responders are responsible for transporting their gear between response operations. A PPE transport bag should be able to fit within the trunk of a command or personal vehicle and must be single-person portable (e.g., be outfitted with handles or wheels). Bags made of materials and closures such as those described above (2.2.2 and 2.2.3) can help limit contaminants from leaving the PPE transport bag. The bags' material should also withstand cleaning agents to allow for effective cleaning and decontamination.

As a best practice for safety and health, one should be sure to keep their face away from the opening when unzipping bags with contaminated gear and/or wear respiratory protection, as PPE may off-gas while contained.

2.5 Emerging Technologies

Recent developments in chemical-resistant materials, such as semi-crystalline polymers, may reduce responders' exposure to chemicals and other contaminants if incorporated into PPE transport bags. Emerging technologies in nanomaterials could also lead to creating PPE transport bags with higher chemical resistance to bases, solvents, and acids than are currently available. Additionally, emerging polymerization processes are attempting to create a new material, known as a "two-dimensional polymer," which would be stronger than steel and as light as plastic.[1]

Another emerging solution for mitigating contamination risks to responders are vehicle cabinets with filtering or venting systems. These storage solutions can be standalone or built into the rear of vehicles. Some cabinets can be customized to vehicle size while other prefabricated options are based on the makes and models of frequently used command vehicles. With this type of product, response agencies can select the number of compartments they desire and purchase them with or without ventilation systems. A separate publication on these solutions will be available on the SAVER website.

2.6 Standards/Certification Programs

There are no specific performance standards for responder PPE transportation or storage bags; however, some standards for storage bags used to transport turnout gear that is covered in fireground contaminants are relevant.

2.6.1 NFPA 1851: Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting

This standard describes how firefighting protective gear should be maintained to reduce health and safety risks specifically associated with improper maintenance, contamination, or damage. Chapter 9 specifically focuses on storage of ensembles.[2]

[1] New lightweight material is stronger than steel, MIT News, Massachusetts Institute of Technology, Anne Trafton, February 2, 2022, https://news.mit.edu/2022/polymer-lightweight-material-2d-0202

[2] NFPA 1851 Standard on Selection, Care and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting, National Fire Protection Association, 2020 Edition.

2.6.2 NFPA 1585: Standard for Exposure and Contamination Control

This standard addresses minimum requirements for limiting emergency responders' exposure to fireground contaminants and for controlling those contaminants in the emergency responder's workplace. Chapter 8 specifically focuses on personal protective clothing and ensembles[3].

2.6.3 International Electrotechnical Commission (IEC) 60529, Degrees of protection provided by enclosures (IP Code)

This standard provides a means of rating the resistance of device enclosures to the ingress of dust and liquids, known as the "IP Code" (IP stands for "ingress protection"). A product's rating according to the IP Code is listed as "IP" followed by two digits; the first numeral indicates resistance to solid foreign objects, and the second numeral indicates resistance to water. As the numerical value increases the protection level increases. As an example, IP-63 means dust-tight and protected against spraying water. See Appendix A, which provides information on the levels of ingress protection as specified by the 2-digit designations. In instances where an "X" is present, there is no data available to specify a protection rating with regard to one of the criteria.

This standard may be relevant in terms of ensuring that contaminants are kept within the storage bag, and no liquids can enter. Such a sealed bag is only recommended for transport, not long-term storage because trapped moisture can lead to mildew and mold growth.

[3] NFPA 1585: Standard for Exposure and Contamination Control, National Fire Protection Association, 2025 Edition.

3.0 PRODUCT INFORMATION

This section provides information on three enhanced transportation bags. All products include either welded seams or zippers and each is available in only one color. None are available via the General Services Administration schedule.

Table 3-1 provides general characteristics and specifications of the bags, which are listed alphabetically by manufacturer. The information in Section 3.0 has not been independently verified by the SAVER program. Below are definitions of the product information in table 3-1, in column order.

Exterior Dimensions refers to the outer measurement (length, width, and height) of a fully expanded transport bag, given in inches.

Weight refers to the weight of a transport bag, given in pounds.

Compartments refers to the number of separate spaces inside the transport bag.

Closure Mechanism refers to the way the storage bag can be securely sealed.

IP Rating refers to the ingress protection (IP) rating of the transport bag.

MSRP refers to the manufacturer's suggested retail price in U.S. dollars, rounded to the nearest dollar, and includes whatever comes standard with the transport bag.

Table 3-1 Product Comparison Matrix

Manufacturer (Distributor)	Product	Exterior Dimensions (LxWxH) in inches	Weight (in pounds)	Compartments	Closure Mechanism	IP Rating	MSRP
Thin Red Line (MP Consulting)	DOT System, Sealed Bag (4-2)	36 x 16 x 16	1	1	Welded TPU, gas-tight zipper	--	$279
Lightning X	Carcinogen Resistant Containment Turnout Bag (LXFB99)	30 x 14 x 15	6	4	Water resistant zippers, welded seams	--	$150
SGT Fire Bags	Delta Bravo Turnout Gear Bag	25 x 40 x 18	6	2	Clips, zippers, welded seams	IP X6	$135
-- indicates no data is available							

3.1 Thin Red Line, DOT System Sealed Bag

Figure 3-1 DOT System Sealed Bag

Image Credit: Thin Red Line Decon

MSRP	$279
Material	Polyester reinforced polyvinyl chloride
Exterior Dimensions (LxWxH)	36” x 16” x 16”
Weight (pounds)	1
Compartments	1
Locking Mechanism	Welded TPU, gas-tight zipper
Storage Temperature Range (°F)	-31 to 284 degrees
IP Rating	No data available
Color Available	Yellow

- The Thin Red Line Decon, DOT System Sealed Bag can be cleaned or decontaminated by an extractor or washing machine and hung to dry.
- Maintenance to be performed by the user includes applying silicone gel, which is included with purchase, to the zipper every three to four months to keep it lubricated.
- The DOT System Sealed Bag has a three-year warranty.
- Customer service is available Monday–Saturday, 8:00 am–5:00 pm Central via phone.
- The MSRP includes the bag and silicone gel. No accessories are available for purchase.

3.2 Lightning X, Laminated Carcinogen-Resistant Containment Turnout Bag LXFB99

Figure 3-2 Laminated Carcinogen-Resistant Containment Turnout Bag

Image Credit: Lightning X

MSRP	$150
Material	Thermoplastic polyurethane fabric
Exterior Dimensions (LxWxH)	30” x 14” x 15”
Weight (pounds)	6
Compartments	4
Locking Mechanism	Water resistant zippers, welded seams
Storage Temperature Range (°F)	No data available
IP Rating	No data available
Color Available	Heather gray

- The Lightning X Laminated Carcinogen-Resistant Containment Turnout Bag can be cleaned and washed out with a hose to remove any remaining contaminants.
- This bag has one large primary compartment, and three smaller side compartments.
- The straps, handle, and shoulder carry strap feature reflective tape for visibility.
- The Lightning X Laminated Carcinogen-Resistant Turnout Bag has a manufacturer’s limited lifetime warranty.
- Customer service is available Monday–Friday, via phone or email.
- The MSRP includes the bag only. Accessories, such as straps, zipper pulls, and glove clips are available for purchase separately.

3.3 SGT Fire Bags, Delta Bravo Turnout Gear Bag

Figure 3-3 Delta Bravo Turnout Gear Bag

Image Credit: SGT Fire Bags

MSRP	$135
Material	Tarpaulin
Exterior Dimensions (LxWxH)	25” x 40” x 18”
Weight (pounds)	6 lbs, 10 ounces
Compartments	2
Locking Mechanism	Clips, zippers, welded seams
Storage Temperature Range (°F)	N/A
IP Rating	IP X6
Color Available	Black

- The SGT Fire Bags Delta Bravo Turnout Gear Bag can be cleaned with decontamination-specific cleaning solutions and water. The bag should be left in a well-ventilated area to air dry.
- This bag includes one large primary compartment and a water-resistant side pocket. The side pocket includes a removable pouch.
- A reversible black/red hook and loop handle can indicate clean or contaminated gear.
- The Delta Bravo Turnout Gear Bag has hard poly side handles to ease overhead lifting and reflective tape for increased visibility.
- Tarpaulin, the material used for the bag, is chemical, oil, UV, and abrasion resistant.
- Information on warranties was not available.
- Customer service is available via phone or email.
- The MSRP includes the bag only. No accessories are available for purchase.

4.0 MANUFACTURER AND DISTRIBUTOR CONTACT INFORMATION

Additional information on the products included in this market survey report can be obtained from the manufacturers or distributors listed in table 4-1.

Table 4-1 Manufacturer and Distributor Contact Information

Manufacturer/ Distributor	Website	Address	Phone Number	Email Address/ Web Form
Lightning X	gearbags.com	2365 Tipton Drive Charlotte, NC 28206	1-704-295-0299	info@gearbags.com
MP Consulting	--	122 E Main Street #295 Lakeland, FL 33801	1-863-427-5339	--
SGT Fire Bags	www.sgtfirebags.com	5620 SW 4th Court Plantation, FL 33317	1-954-715-1748	www.sgtfirebags.com/contact
Thin Red Line Decon	thinredlinedecon.com	970 Sunshine Lane Units J/K Altamonte Springs, FL 32714	1-877-947-3633	info@thinredlinedecon.com

5.0 CONCLUSIONS

First responders may not have a designated operation center or storage option for potentially contaminated gear. This often results in them leaving it in gear bags within vehicles. Currently, the gear bags many first responders use to store their PPE may not be made of materials or construction that effectively provides containment of hazardous compounds and minimizes the spread of contamination. This market survey report focuses on enhanced commercially available transport bags for responder PPE that offer structural elements to mitigate those risks.

This market survey report provides information on three products that range in price from $135-$279. The three enhanced PPE transport bags include either welded seams and/or zippers. Welded seams introduce durable barriers that prevent leaks and cross-contamination, while resisting wear and tear to maintain their effectiveness over time. Structural elements such as welded zippers, provide durable gas-tight, waterproof, and airtight seals on enhanced gear bags.

Emergency responder agencies should carefully research the overall capabilities and limitations of these products in relation to their agency's operational needs when making equipment selections.

Appendix A. INGRESS PROTECTION LEVELS (IP CODE)

This section provides information on the levels of ingress protection as specified by the 2-digit designations in the IEC 60529 standard[4]. Table A-1 provides levels of solid ingress protection (first digit). Table A-2 provides levels of liquid ingress protection (second digit). Note in instances where an "X" is present there is no data available to specify a protection rating with regard to one of the criteria.

Appendix Table A-1 Levels of Solid Ingress Protection per First Digit of IP Code

Digit	Object Size Effective Against	General Description
0	No Protection	No protection against contact and ingress of solids
1	> 50 mm	Large surfaces, e.g., back of hand, but no protection against deliberate contact with body part
2	> 12.5 mm	Prevents entry of fingers and similarly sized objects
3	> 2.5 mm	Prevents entry of tools, thick wires, etc.
4	> 1 mm	Prevents entry of most wires, screws, large ants, etc.
5	Dust Protected	Dust ingress not entirely prevented but does not enter in sufficient quantity to interfere with satisfactory operation of equipment
6	Dust Tight	No ingress of dust

Appendix Table A-2 Levels of Liquid Ingress Protection per Second Digit of IP Code

Digit	Water Exposure Protection	General Description
0	No Protection	No protection
1	Vertically dripping water	Vertically dripping water has no harmful effects
2	Dripping water, enclosure tilted up to 15 degrees	Vertically dripping water has no harmful effects when enclosure is tilted at an angle up to 15 degrees of normal vertical position
3	Spraying water	Water sprayed at angles up to 60 degrees from the vertical position has no harmful effects

[4] "IP Ratings," International Electrotechnical Commission, 2021. [Online]. Available: www.iec.ch/ip-ratings.

Digit	Water Exposure Protection	General Description
4	Splashing water	Water splashed against the enclosure from any direction has no harmful effect
5	Water jets	Water projected by a nozzle (6.3 mm) against enclosure from any direction has no harmful effects
6	Powerful water jets	Water projected in powerful jets against the enclosure from any direction has no harmful effects
7	Temporary immersion in water	Ingress of water in harmful quantity is not possible when the enclosure is temporarily immersed in water under standard conditions or pressure and time
8	Continuous immersion in water	The equipment is suitable for continuous immersion in water under conditions more severe than for numeral 7