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E/T LIGHT® IR

TEEX TESTED® for Commercial Building Clearing, Identifying Responders and Enhanced UAS Night Operation Orientation.

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In-Situ Evaluation of the Southwest Synergistic Solutions E/T (Emergency/Tactical) Light

Performed for the Texas A&M Engineering Extension Service (TEEX)
Product Development Center

By

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I. BACKGROUND

As part of the Defense to Response Technology Program (D2R), the Texas A&M Engineering Extension Service's (TEEX) Product Development Center identified several Department of Defense funded technologies capable of enhancing public safety and homeland security. D2R is the Domestic Preparedness Support Initiative's Technology Transition Program with the goal of transitioning relevant products to the response community. In support of this initiative, the Texas Center for Applied Technology (TCAT), an applied research and development center within the Texas A&M Engineering Experiment Station (TEES), assisted with formal test and evaluation of these products. This included observation and assessment of product operation and performance under realistic yet controlled conditions. Prior work performed by TCAT in third-party test and evaluation has included a number of efforts related to the operational testing of emergency responder equipment for the Department of Homeland Security, product test and evaluation for private industry, and analytic support for the U.S. Army's Operational Test Command at Ft. Hood, Texas.

The Southwest Synergistic Solutions E/T (Emergency/Tactical) Light combines four colors: red, yellow, green, blue or infrared red, green, blue into one lightweight, durable, illuminated marker that functions in austere environments. Developed originally for Joint Special Operations Command (JSOC) medics, the E/T Light is combat proven and offers an easy-to-use tool for marking and prioritizing locations using colored LEDs. The E/T Light is problem agnostic, can be used for both operations and training, and has many different potential applications, including, but not limited to:

- Night time/adverse condition triage tagging
- Team member marking
- Identification of friend or foe
- Trail marking
- Tactical combat casualty care
- Covert vehicle tracking
- Cleared room indicator

This report provides a third-party product evaluation of the Southwest Synergistic Solutions E/T (Emergency/Tactical) Light. This evaluation was performed in several stages. On May 10th, 2018 an operational test was performed at the Disaster City® complex (in College Station, Texas) and a ground-based visibility test was performed at a remote, rural site (in College Station, Texas). On June 11th, 2018 an air-based visibility test was performed at a remote, rural site (in Franklin, Texas). Test and evaluation of the product was performed under realistic conditions by experienced, subject-matter and technical experts. As no field test can include all possible applications and site scenarios that could be encountered, a representative set of conditions was selected and used to collect observations and subject-matter feedback. The sections that follow outline in more detail the location and methodology utilized during the onsite product evaluation, as well as the observations and recommendations/takeaways.

II. METHODOLOGY

Location

Evaluation of the Southwest Synergistic Solutions E/T Light was conducted in several stages at three separate locations. The first stage, Stage 1 – the operational evaluation, occurred in Building 137 (i.e., the Rescue Training Facility) located as part of Disaster City® at the Brayton Fire Training School in College Station, Texas. Disaster City® (shown in Figure 1) is part of the Texas A&M University System and is operated by and under the direct control and supervision of the Texas A&M Engineering Extension Service (TEEX), the training agency for the State of Texas and a component of the Texas A&M University System.

Figure 1: Brayton Fire Training School, College Station, Texas and the Rescue Training Facility at Disaster City® Used for the Stage 1 Product Evaluation

The second stage, Stage 2 – the ground-based visibility evaluation, occurred at night at a remote, rural site in College Station, Texas. This location, a construction site for a new roadway, was selected due its flat, straight-line visibility with minimal ambient light. Figure 2 shows a picture of the selected site during the daylight.

Figure 2: Rural Location Used for the Stage 2 Product Evaluation

The third stage, Stage 3 – the air-based visibility evaluation, occurred prior to civil twilight at a remote, rural site in Franklin, Texas. This location, an unoccupied pasture, was selected due its flat, straight-line visibility with minimal ambient light, and authorization for safe flight of an unmanned aerial system (UAS). Figure 3 shows a picture of the selected site during daylight.

Figure 3: Rural Location Used for the Stage 3 Product Evaluation

TEEX personnel were instrumental in all stages of the product evaluation process. From scenario design, to coordination and feedback elicitation, TEEX personnel provided support and oversight to help ensure safe and successful execution of the event. During Stage 1, a staging area was established clear of the area used for scenario execution and served as a neutral zone for participant training, coordination, and discussion. Within Building 137, a representative environment was constructed under realistic yet controlled conditions. A perimeter (i.e., a "hot zone") was established around the project area for safety purposes, and live munitions were prohibited within this area at all times. Figure 4 shows images from the product demonstration performed within the staging area and the product evaluation performed within Building 137. During Stage 3, the UAS was operated by two FAA certified pilots and all flights were performed within FAA regulations (i.e., including maintaining a flight ceiling of 400-foot above ground level (AGL), maintaining line-of-site of the UAS at all times, and flying only during civil twilight).

Figure 4: Product Demonstration and Product Evaluation

Evaluation Process

In order to evaluate the Southwest Synergistic Solutions E/T Light, observation of product performance under realistic settings and conditions occurred, along with collection of end-user feedback and comparison of performance with other commonly used products on the market. Subject-matter experts with technical and operational experience in the state-of-practice methodologies, needs/requirements, and commonly encountered challenges participated in the event. The product evaluation took place in several stages and documentation of the evaluation specifics and observations was performed. This process allowed for test and evaluation of product functionality and collection of firsthand feedback and performance results. It also allowed determination of whether product performance was acceptable for responder use to include ease of use, effectiveness, and potential operational impacts. A description of each to the evaluation stages is provided in the following sections.

Stage 1 – Operational Evaluation

The goal of the Stage 1 evaluation was to assess product use and performance within an operational setting. In order to guide this test and evaluation, TEEX/TEES evaluators developed a representative scenario designed to test the capabilities of the product under realistic conditions. The product was put in the hands of subject-matter experts and used in both training and simulated operational settings. These subject-matter experts consisted of six law enforcement personnel from three different organizations (i.e., two different municipalities and one sheriff's office). Participants were not aware of the scenario specifics prior to the evaluation event. The test and evaluation process consisted of two phases. During the first phase, a representative from the product vendor provided a short (i.e., approximately 15 minutes) demonstration of the product. Participants were then encouraged to try the product themselves and ask questions to help clarify its use and benefit. During the second phase, the participants then used the product as part of a realistic operational scenario.

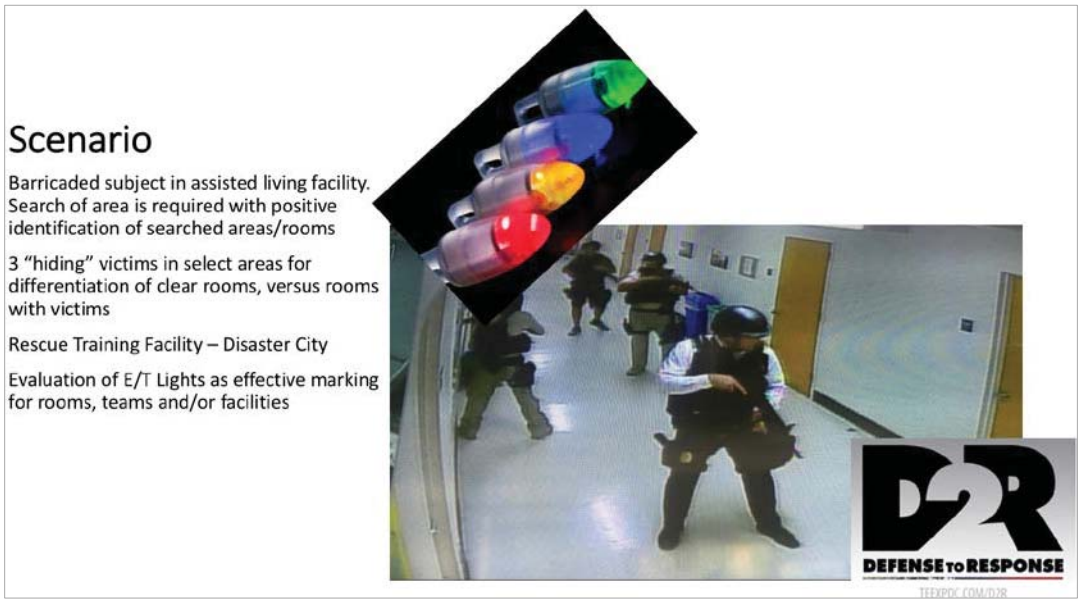

Figure 5: Scenario Overview

The scenario centered around use of the lights for marking of cleared rooms in a facility with a subject barricaded inside. A summary of the scenario context is provided in Figure 5. Three trials were performed, allowing participants multiple opportunities for working with the product. During each trial, product use was varied to allow performance testing under different conditions. Participants immersed themselves as if the scenario was a real-world event (shown in Figure 6). This included tactical movements for control and protection, clearing and securing each room in the building, and communicating and coordinating with one another until completion of the mission. Evaluators and videographers were allowed inside the building for documentation purposes but did not interfere with the participant activities. Table 1 provides a summary of the personnel, organizations, and respective roles within the product evaluation.

Figure 6: Participant Immersion into the Event

Upon completion of each trial, a hot wash was conducted. Each hot wash was led by TEEX personnel and served to elicit feedback from the participants. Focus areas included first impressions of the product, input on the operational performance of the product, comparison of the product to others on the market, and feedback on potential product improvements.

Table 1: Stage 1 Product Evaluation Personnel Listing

Stage 1 D2R Event Attendees		
Participants	**Organization**	**Role**
4 Unnamed Participants	College Station Police Dept.	Subject-Matter Experts
1 Unnamed Participant	Bryan Police Dept.	Subject-Matter Experts
1 Unnamed Participant	Sheriff's Office	Subject-Matter Experts
Clint and Joe	TEEX ESTI	Safety Officers
Caleb, Paul, Ryan	TEEX PDC	Event Coordinators
Shelby, Gerry, Dione, Allison	TEEX PDC	Videography and Event Support
John	TEEX	Observer
Jim, Keith, Christopher, Joshua, Matthew	TEES TCAT	Evaluators
John	DetectaChem	Vendor/Product Manager
1 Unnamed Virtual Participant	ARA	Vendor/Product Manager
Juan	ET Light	Vendor/Product Manager

Stage 2 – Ground-based Visibility Evaluation

The goal of the Stage 2 evaluation was to assess visibility of the light on the ground at different distances to compare product performance with other commonly used products on the market. This evaluation included both "fresh" products (i.e., both LED and chemical lights that were newly turned on/activated) as well as "expiring" products (i.e., both LED and chemical lights that had been turned on/activated for different durations of time), and the evaluation included several different colors. To accomplish this, attendees relocated to the previously discussed Stage 2 evaluation site. This location was selected due to its remote, rural location and straight-line visibility with minimal ambient light. The evaluation occurred late at night (i.e., beginning at 10:40 PM and ending at 12:50 AM) to avoid outside interference. There was no moon and the sky was cloudless that night.

Attendees were divided into two groups, with one group serving as observers that remained at a fixed location to assess light visibility while a second group served as range staff in staging and activating the lights at incremental, measured distances from the fixed observers. Using a measuring wheel, light tests were conducted at four distances from the observers: 300 feet, 900 feet, 1,320 feet, and 2,640 feet. The two groups communicated with one another and coordinated each step of the evaluation process using portable radios. The light observers varied in age, gender, and corrective vision (i.e., glasses, contacts, and no corrective vision) to allow diversity in the measurements obtained. Three main areas were assessed, including:

- ***Is the light visible*** – blind test of brand new lights (i.e., including both LED and chemical lights in several different colors) at specified distances
- ***Which light is brighter*** – blind test of lights at varying durations of use (i.e., including both LED and chemical lights in several different colors) at specified distances
- ***Is the light visible*** – IR visibility of the E/T Light at specified distances

During the evaluation, different products and different colors were assessed. This allowed comparison of performance under different conditions. Table 2 provides a summary of the personnel, organizations, and respective roles within the product evaluation.

Table 2: Stage 2 Product Evaluation Personnel Listing

Stage 2 D2R Event Attendees		
Participants	**Organization**	**Role**
Caleb, Paul, Ryan	TEEX PDC	Event Coordinators
Shelby, Gerry, Dione, Allison	TEEX PDC	Videography and Event Support
Jim, Keith	TEES TCAT	Evaluators

Stage 3 – Air-based Visibility Evaluation

The goal of the Stage 3 evaluation was to assess visibility of the E/T Light from the air at different distances. This evaluation utilized only E/T Lights that had not been used previously and the evaluation included

several different colors and modes. To accomplish this, a UAS was flown at the previously discussed Stage 3 evaluation site and video captured and reviewed for visibility purposes. This UAS, a DJI Inspire 2 with a Zenmuse X5 camera, allowed capture of 4K video. Figure 7 shows the UAS used during preliminary preparations for the evaluation. The evaluation occurred during civil twilight to allow adequate darkness while adhering to FAA Part 107 flight regulations.

Figure 7: UAS Used for Stage 3 Evaluation

Attendees were divided into two groups, with one group operating the UAS to maintain a fixed location and 400-foot elevation while a second group served as range staff in staging and activating the lights at incremental, measured distances from the fixed observers. With only adjusting the UAS camera settings to ensure adequate exposure, light tests were conducted at four distances: 300 feet, 900 feet, 1,320 feet, and 2,640 feet. Figure 8 shows the mounted E/T Light and its visibility from the UAS 2,640 feet away and at an elevation of 400 feet AGL. The two groups communicated with one another and coordinated each step of the evaluation process using portable radios. The E/T Light was cycled through the various modes at each specified distance, leaving each mode enabled for 5 – 10 seconds. The modes tested were: red, red flashing, yellow, yellow flashing, green, green flashing, blue, blue flashing, red and green colors combined, slow strobe, medium strobe, and fast strobe.

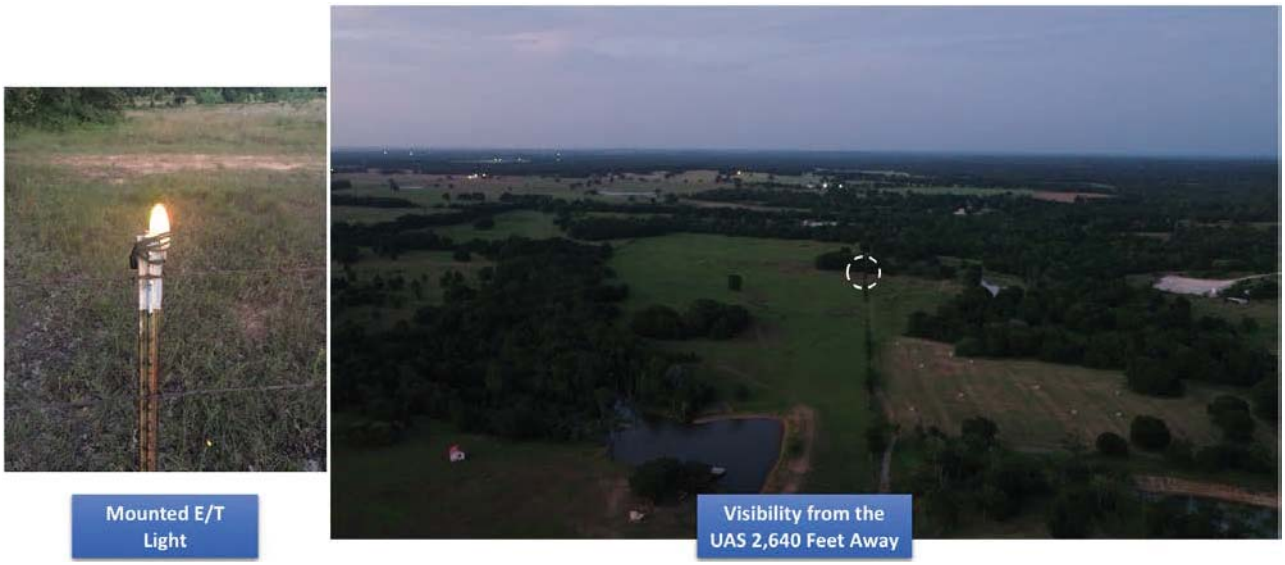

Figure 8: Mounted E/T Light and Visibility from the Air

Following the flight, the collected video was downloaded and a group of four participants assessed the visibility of the lights. The participants varied in age, gender, and corrective vision (i.e., glasses, contacts, and no corrective vision) to allow diversity in the measurements obtained. Each of the videos were then replayed on a 27-inch Thunderbolt display with resolution of 2560 x 1440 pixels and 16.7 million colors while participants independently viewed and documented whether or not the various light colors and modes were identifiable. The results were then aggregated and feedback obtained. Table 3 provides a summary of the personnel, organizations, and respective roles within the Stage 3 product evaluation data collection effort.

Table 3: Stage 3 Product Evaluation Personnel Listing

Stage 3 D2R Event Attendees		
Participants	**Organization**	**Role**
Keith	TEES TCAT	Event Coordinator and Evaluator
Matthew	TEES TCAT	UAS Pilot
Joshua	TEES TCAT	Event Support

III. Observations

Product Overview

The Southwest Synergistic Solutions E/T Light is a combat proven, lightweight, durable, illuminated marker that functions in all austere environments. It offers an easy-to-use tool for marking and prioritizing locations using colored LEDs and combines four colors: red, yellow, green, blue or infrared red, green, blue into one light. The E/T Light is problem agnostic, can be used for both operations and training, and

has many different potential applications. Figure 9 provides a photo of the E/T Light as well as various accessories that store multiple lights within a handy pouch, focus the light beam, and enable various configurations for mounting or hanging the light. The E/T Light is both small and lightweight for easy carry. It supports multiple configurations for diverse applications, including a magnetic base, lanyard, wristband, and various clips such as an 'S' shaped carabiner. As a result, it can be activated and attached to metal structures, hung from objects using the lanyard or clips, or simply dropped onto the ground.

The E/T Light is notched on one end for easy touch identification of the activation button, even in total darkness or when wearing gloves. The light is actuated by pressing the activation button. Each press of the button cycles through a different display mode. The default modes are red, red flashing, yellow, yellow flashing, green, green flashing, blue, and blue flashing followed by dual-color modes with solid, strobe, and various timed and time delayed flashing patterns. After 3 seconds, by default, the device locks into the selected mode and cannot easily be changed without powering the device off. This locking feature prevents inadvertent selection changes as well as deactivation of the device when dropped or thrown. The device has multiple operating modes, both with and without the locking feature, and can be reprogrammed in the field. The last mode selected is always retained and will resume the last set state if power is lost and then restored. Power is provided by a consumer-grade CR2 lithium battery, with each battery enabling 4 ½ to 9 ½ days of utilization based upon the selected color mode since each mode has a differing power consumption rate. The E/T light maintains constant luminosity throughout the battery life cycle and alerts the user when the battery is close to its end of life with a red flashing light with increasing flashing frequency. The battery can be easily and inexpensively replaced. Finally, the silicone housing ensures the device is fully waterproof and certified for use 200 feet under water and up to 66 pounds of pressure. Figure 10 provides a diagram of the various device features.

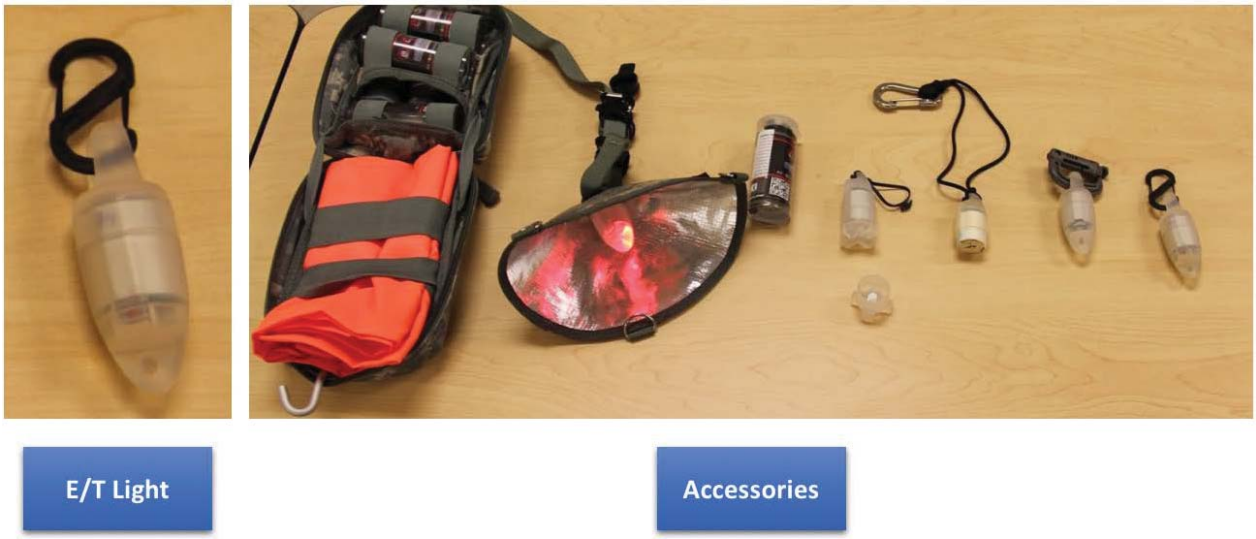

Figure 9: Product Overview

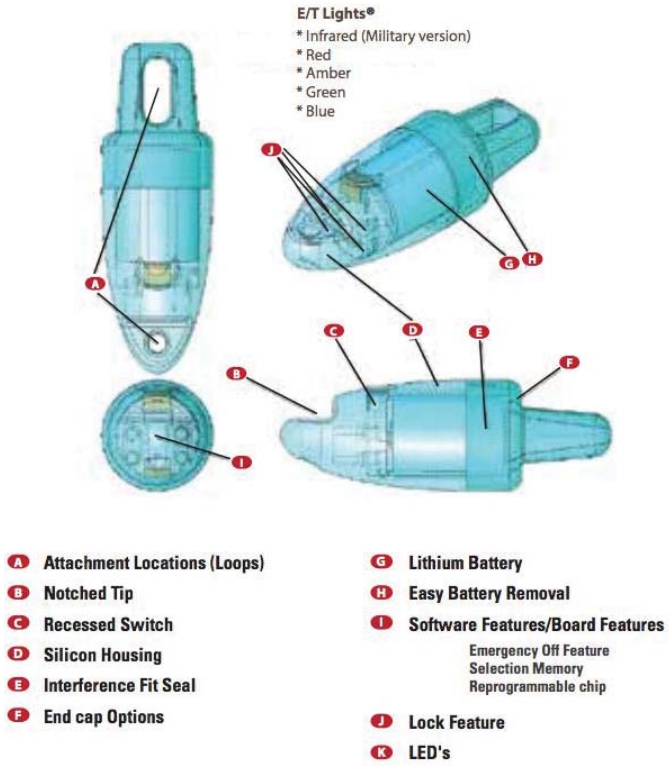

Figure 10: Product Diagram

Stage 1 – End-User Training

The Stage 1 evaluation began with a short product demonstration. A representative from the product vendor provided participants with a short, six-minute overview of the product. This included the components of the product and its utilization and reconfiguration. Participants were then encouraged to try the product themselves and ask questions to help clarify its use and benefit. This lasted roughly nine minutes and allowed each participant to work with the product and ask questions to clarify their understanding of its usage. As part of this process, a discussion on operational tactics/protocols also occurred. Figure 11 shows images from the product overview and end-user trials.

Figure 11: Product Demonstration

Stage 1 – Operational Evaluation

During Stage 1, participants used the product as part of a realistic operational scenario. As previously discussed, the scenario centered around use of the lights for marking cleared rooms in a facility with a subject barricaded inside. Prior to starting, TEEX personnel provided an overview of the scenario along with their goal. This description was as follows:

> *A subject has barricaded themselves within an assisted living facility. The building has not yet been cleared and there are known victims and a potential suspect hiding inside. The goal of the scenario is to clear the building using the E/T Lights to mark the status of each room. Please treat the operation in realistic fashion for evaluation purposes.*

A walkthrough of the building by participants and planning/preparation and discussion of procedures occurred, including tactical organization and the use of personal protective equipment (PPE). Three trials were performed, allowing participants multiple opportunities for working with the product. During each trial, multiple tests were performed and product use was varied to allow performance testing under different conditions. Participants immersed themselves as if the scenario was a real-world event. This included tactical movements for control and protection, clearing and securing each room in the building, and communicating and coordinating with one another until completion of the mission. Evaluators and videographers were allowed inside the building for documentation purposes but did not interfere with the participant activities. The following subsections provide a summary of the actions performed within each trial.

Trial #1

Table 4: Stage 1 – Trial #1 Results

Time / Activity	Actions
8:13 PM / Started Trial #1	▪ Entered the building ▪ Lights were off throughout the building
	▪ Cleared each room ▪ Marked cleared rooms using E/T lights in flashing mode and colored green/red based on room status ▪ Dropped E/T Lights on the floor outside each cleared room prior to proceeding to the next room
8:17 PM / Ended Trial #1	▪ Exited the building

Trial #2

Table 5: Stage 1 – Trial #2 Results

Time / Activity	Actions
8:25 PM / Started Trial #2	▪ Entered the building ▪ Lights were off throughout the building
	▪ Cleared each room ▪ Marked cleared rooms using E/T lights in solid mode and colored green/red based on room status ▪ Mounted E/T Lights magnetically on the door frame of each cleared room prior to proceeding to the next room
8:29 PM / Ended Trial #2	▪ Exited the building

Trial #3

Table 6: Stage 1 – Trial #3 Results

Time / Activity	Actions
8:35 PM / Started Trial #3	▪ Entered the building ▪ Lights were on throughout the building
	▪ Cleared each room ▪ Marked cleared rooms using E/T lights in solid mode and colored green/red based on room status ▪ Dropped E/T Light on the floor outside each cleared room prior to proceeding to the next room
8:38 PM / Ended Trial #3	▪ Exited the building

Stage 2 – Ground-based Visibility Evaluation

During Stage 2, an assessment of product visibility at different distances and a comparison of product performance to other commonly used products on the market occurred. This evaluation included both "fresh" products (i.e., both LED and chemical lights that were newly turned on/activated) as well as "expired" products (i.e., both LED and chemical lights that had been turned on/activated for different durations of time), and the evaluation included several different colors (i.e., depending on the available/supported colors for each product). Attendees were divided into two groups, with one group serving as observers that remained at a fixed location to assess light visibility while a second group served as range staff in staging and activating the lights at incremental, measured distances from the fixed observers. Three main areas were assessed, including:

- ***Is the light visible*** – blind test of brand new lights (i.e., including both LED and chemical lights in several different colors) at specified distances (*Trial #1*)
- ***Which light is brighter*** – blind test of lights at varying durations of use (i.e., including both LED and chemical lights in several different colors) at specified distances (*Trial #2*)
- ***Is the light visible*** – IR visibility of the E/T Light at specified distances (*Trial #3*)

During the evaluation, different products and different colors, at different distances, were assessed. This allowed comparison of performance under different conditions. The following subsections provide a summary of the results obtained during each of the three trials.

Trial #1

Table 7: Stage 2 – Trial #1 Product Overview

Product	Type	Available/Supported Colors
Product A	Chemical Light	Green
Product B	Chemical Light	Green
Product C	E/T Light	Red, Blue, Green, Yellow
Product D	Chemical Light	Red, Blue, Green, Yellow
Product E	LED Light	Mixed Flash
Product F	LED Light	Yellow

Table 8: Stage 2 – Trial #1 Results

Product and Color	300 Feet*	900 Feet*	1,320 Feet*	2,640 Feet*
Product A, Color Green	6/6	6/6	6/6	6/6
Product B, Color Green	6/6	6/6	6/6	4/6
Product C, Color Red	6/6	6/6	6/6	6/6
Product C, Color Blue	6/6	6/6	6/6	4/6
Product C, Color Green	6/6	6/6	6/6	6/6
Product C, Color Yellow	6/6	6/6	6/6	6/6
Product D, Color Red	6/6	6/6	4/6	2/6
Product D, Color Blue	6/6	6/6	2/6	0/6
Product D, Color Green	6/6	6/6	6/6	4/6
Product D, Color Yellow	6/6	6/6	6/6	4/6
Product E, Color Mixed	6/6	6/6	6/6	6/6
Product F, Color Yellow	6/6	6/6	6/6	6/6

** Measured as the number of positive observations (the numerator) over the total observations (the denominator).*

Trial #2

Table 9: Stage 2 – Trial #2 Results

Product and Color	1,320 Feet		
	E/T Light is Brighter*	Other Light is Brighter*	They are the Same*
Lights just turned on, Color Red	6/6	0/6	0/6
Lights just turned on, Color Blue	6/6	0/6	0/6
Lights just turned on, Color Green	0/6	0/6	6/6
Lights just turned on, Color Yellow	6/6	0/6	0/6
Lights just turned on, Color Green	0/6	0/6	6/6
Lights just turned on, Color Green	0/6	1/6	5/6
Lights that have been on for 6 hours, Color Red	6/6	0/6	0/6
Lights that have been on for 6 hours, Color Blue	6/6	0/6	0/6
Lights that have been on for 6 hours, Color Green	6/6	0/6	0/6
Lights that have been on for 6 hours, Color Yellow	6/6	0/6	0/6
Lights that have been on for 6 hours, Color Green	6/6	0/6	0/6
Lights that have been on for 6 hours, Color Green	6/6	0/6	0/6

Lights that have been on for 9 hours, Color Red	6/6	0/6	0/6
Lights that have been on for 9 hours, Color Blue	6/6	0/6	0/6
Lights that have been on for 9 hours, Color Green	6/6	0/6	0/6
Lights that have been on for 9 hours, Color Yellow	6/6	0/6	0/6

** Measured as the number of positive observations (the numerator) over the total observations (the denominator).*

Please note that Trial #2 did not test the 2,640-foot distance due to the visibility difficulties encountered during Trial #1 (i.e., it was difficult to identify the light without moving or pointing the cone of the light at observers) and the 300 and 900-foot distances were not tested due to the clear advantage of visibility of the E/T Light at 1,320 feet.

Trial #3

Table 10: Stage 2 – Trial #3 Results

Product and Color	Visibility
E/T Light IR Visibility at 300 feet	Visible
E/T Light IR Visibility at 900 feet	Not Visible
E/T Light IR Visibility at 1,320 feet	*Not Tested*
E/T Light IR Visibility at 2,640 feet	*Not Tested*

Please note that Trial #3 required a specialized IR viewer and only a single, first generation commercial quality device was available for evaluation use. Thus, only a single measurement was taken at each of the two distances evaluated and image quality was not as good as that with military-grade devices. The 1,320-foot and 2,640-foot distances were not tested due to lack of visibility at 900 feet.

Stage 3 – Air-based Visibility Evaluation

During Stage 3, an assessment of product visibility from the air at different distances was performed. This evaluation included only "fresh" E/T Lights (i.e., LED lights that were newly turned on/activated) and the evaluation included several different colors and modes. Attendees were divided into two groups, with one group operating the UAS to maintain a fixed location and 400-foot elevation while a second group served as range staff in staging and activating the lights at incremental, measured distances from the fixed

observers. With only adjusting the UAS camera settings to ensure adequate exposure, light tests were conducted at four distances: 300 feet, 900 feet, 1,320 feet, and 2,640 feet.

Following the flight, the collected video was downloaded and a group of four participants assessed the visibility of the lights. These participants varied in age, gender, and corrective vision (i.e., glasses, contacts, and no corrective vision) to allow diversity in the measurements obtained. Each of the videos were then replayed and participants independently viewed and documented whether or not the different light colors and modes were identifiable. The results were then aggregated and feedback obtained. During this evaluation, visibility of each of the colors and modes was assessed. This allowed comparison of performance under different conditions. The following table provides a summary of the results obtained.

Table 11: Stage 3 Results

Color and Mode	300 Feet*	900 Feet*	1,320 Feet*	2,640 Feet*
Red	*4/4*	*4/4*	*4/4*	*3/4*
Red Flash	*4/4*	*4/4*	*4/4*	*3/4*
Yellow	*4/4*	*4/4*	*4/4*	*3/4*
Yellow Flash	*4/4*	*4/4*	*4/4*	*4/4*
Green	*4/4*	*4/4*	*1/4*	*4/4*
Green Flash	*4/4*	*4/4*	*1/4*	*4/4*
Blue	*4/4*	*4/4*	*4/4*	*4/4*
Blue Flash	*4/4*	*4/4*	*4/4*	*4/4*
Red and Green	*4/4*	*4/4*	*4/4*	*4/4*
Strobe Slow	*4/4*	*4/4*	*4/4*	*4/4*
Strobe Medium	*4/4*	*4/4*	*4/4*	*4/4*
Strobe Fast	*4/4*	*4/4*	*4/4*	*4/4*

** Measured as the number of positive observations (the numerator) over the total observations (the denominator).*

IV. Evaluation Feedback and Final Assessment

Upon completion of the Stage 1 product demonstration and each of the trials, a hot wash occurred where participants, all of whom are local subject-matter experts, were allowed to provide feedback on the product. Feedback was collected on product performance, ease of use, effectiveness, and potential operational impacts. The following subsections provide a summary of the feedback captured during each

of these sessions. Comments provided back to the participants by the product vendor are captured in italicized brackets.

Post Product Demonstration Feedback

General Comments

- The lanyards might get tangled up if you are carrying multiple at a time. *[The devices can be easily reconfigured and the mounting hardware carried separately.]*
- The magnetic base is very nice.
- If multiple agencies converge on a scene, the different colors may not mean anything to the late arrivers.
- It could be used to draw attention to a dumped gun, the location of victims, or for marking a safe/cleared route.

Trial #1 Hot Wash Feedback

Trial #1 was treated as a rehearsal and a hot wash did not occur. Thus, no feedback was collected.

Trial #2 Hot Wash Feedback

First Impressions

- It is a very effective tool, they liked it and the fact that it is reusable.
- One user stated that he would like to carry all mounting options with him, that way he could mount/hang the device however needed.
- The meaning of the colors is situation dependent.
- They felt that the multiple flashing lights down the hallway was distracting, especially in a closed area. They felt in a wider open area that the flashing lights would be ok.
- The lights were very easy to activate and get to the color they wanted.
- The lights would work well with an entry team, allowing them to follow the lights and work up to red rooms.
- A rescue team could easily identify which rooms had victims and proceed straight to these.
- They want to see how the light would perform in brighter lights/sunlight (i.e., especially visibility of the lights).

Comparison to Other Products on the Market

- They liked this product over standard chemical lights, especially the constant lighting it provides over long periods of time.

Trial #3 Hot Wash Feedback

General Comments

- When thrown down, the light bounced hard making it difficult to control placement in the hallway. The magnet allowed more control; most buildings have steel door frames which serve as easy mounting locations.

- It is a good product, they (i.e., the participants) just need to learn how best to use them operationally.
- One individual suggested putting on the "S" carabiner clip to help with bounce when thrown down as the magnetic base did not seem to help. One light accidently bounced back into the room.
- They saw plenty of uses for the lights and felt they worked well in lit environments.
- They reaffirmed that the solid color is the way to go in an enclosed environment (e.g., the building hallways).
- At the team level, the device worked well. However, in an active shooter situation, the multiple colors may not be good and might be confusing. For example, if units roll up later, they may be unclear on the color scheme being used.
- One user said they accidently set the color wrong, but that it was very easy to reset and fix.
- A rescue task force could go straight to the red lights, and once each was dealt with, they could be turned to green to alert other units.

How to Make it Better

- When thrown on the floor, need a way to keep the light from rolling away or being kicked.

Product Assessment

Overall, the product performed very well and participants saw significant value in it. Assessment of specific aspects of the product are as follows:

- *Training:*
  - **Ease of Use:** It is quick and easy for the participants to understand and use. In only minutes, the six participants were fully competent in operational use of the product.
- *Performance:*
  - **Objective Results:** It is a very effective tool that can easily be used to mark key locations of interest.
  - **Visibility:** It is visible and easily distinguishable even from a significant distance away, from both the ground and the air, and especially at night. The flashing and strobe modes enhance the ability of a viewer to quickly and easily detect/identify a light.
  - **Quick and Adjustable:** It is quickly and easily activated and adjusted to the mode needed. Even if a mistake is made, the user can quickly reset the device and set it to the desired state.
  - **Advanced Modes:** The product supports advance modes and custom reprogramming if desired. This allows customization of the product operation to best meet the operational needs of the user and environment.
  - **Long-lasting:** Once activated, it is long-lasting and can operate for many days providing constant lighting throughout that duration.
  - **Indoor/Outdoor Suitability:** It worked fully in varying lighting conditions to include both dark and heavily lit environments. It can be configured to address location and operation-specific needs (e.g., color and flashing/non-flashing), and is waterproof with the ability to be submerged in water yet still function.

- **PPE Capable:** There were no issues using the product with PPE. Even when wearing gloves, users were able to easily activate and adjust settings of the device as needed.
- **Control:** When mounting magnetically or hanging the device, there were no issues. However, when dropping the device on the floor, there was some bounce and control issues making it difficult to control placement. A means of keeping the light from rolling off or being kicked would be beneficial.

- *Packaging:*
  - **Easy to Carry:** It is very easy to carry and the participants saw value in that. They were able to carry several lights at a time by simply clipping them to the straps on their uniforms.
  - **Reconfigurability:** It is easily reconfigured for different applications. From controlling how it is mounted, to the color and mode of the display, the device could be adjusted to meet the operational needs of the user and environment.
- *Applications:*
  - **Generalized Applications:** The are many different applications for this tool. From drawing attention to a dumped gun, to marking the location of victims or a safe/cleared route, the device provides a generalized tool.
  - **Multi-Modes:** It supports multiple color and display modes that can be set and adjusted/reprogrammed as needed. This is both a benefit and a detriment to device. It allows for great flexibility with regards to notification protocols but also could lead to confusion/uncertainty as colors may be situation dependent (i.e., an individual must be familiar with the protocol being used). Establishing common protocols/standards is a necessity for use in distributed, team-based environments.
  - **Reusability:** It is reusable and can be used for numerous operations before a battery replacement is required.

V. Conclusions

This report documents the test and evaluation of the Southwest Synergistic Solutions E/T Light. This evaluation placed the product in realistic field conditions and tested the overall system operation using a practical and realistic scenario. Subject-matter experts with operational experience in the state-of-practice methodologies, needs/requirements, and commonly encountered challenges participated in the event. TEEX/TEES personnel provided operational and technical subject-matter oversight throughout the event, assisting with execution and documentation of the product evaluation methodology and results. This evaluation occurred in several stages on May 10th, 2018 in College Station, Texas and on June 11th, 2018 in Franklin, Texas.

TEEX/TEES evaluators developed a representative scenario designed to test the capabilities of the product under realistic conditions. The product was put in the hands of subject-matter experts and used in both training and simulated operational settings. This process allowed for test and evaluation of product functionally and collection of firsthand feedback from subject-matter experts. It also allowed

determination of whether product performance was acceptable for responder use to include ease of use, effectiveness, and potential operational impacts. TEEX/TEES then captured the feedback and results.

The product performed very well and participants saw significant value in it. The product provided an easy tool for marking locations that functions well in both lighted and unlighted environments. The reconfigurability of modes and mounting allows great flexibility and there are many potential uses for the device. *Overall, the participants felt this product would provide significant value and would improve their operational performance.*

Finally, it should be noted that the findings and observations presented in this report are subject to the constraints afforded this evaluation based on participants, evaluation location, scenario development, and time allotted to this field test. Every effort was made to translate actual situations encountered by participants into a realistic situation for the purpose of this product evaluation. It should also be noted that even the most well-planned system and best trained operations personnel cannot account for every possible real-world situation encountered and therefore an evaluation of this type cannot capture every possible aspect.

“Southwest Synergistic Solutions, LLC’s E/T Light has been TEEX TESTED for Commercial Buidling Cleraing, Identifying Responders and Enhanced UAS Night Operation Orientation. This testing does not constitute an endorsement by TEEX.”

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