

System Assessment and Validation for Emergency Responders (SAVER)

Handheld Thermal Imagers for Law Enforcement Assessment Report

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System Assessment and Validation for Emergency Responders

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FOREWORD

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions. Located within the Science and Technology Directorate (S&T) of DHS, the SAVER Program conducts objective assessments and validations on commercially available equipment and systems, and develops knowledge products that provide relevant equipment information to the emergency responder community. The SAVER Program mission includes:

- Conducting impartial, practitioner-relevant, operationally oriented assessments and validations of emergency response equipment.
- Providing information, in the form of knowledge products, that enables decision-makers and responders to better select, procure, use and maintain emergency response equipment.

SAVER Program 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?” These knowledge products are shared nationally with the responder community, providing a life-and cost-saving asset to DHS, as well as to Federal, state and local responders.

The SAVER Program is managed and executed by the National Urban Security Technology Laboratory (NUSTL). NUSTL is responsible for all SAVER activities, including selecting and prioritizing program topics, developing SAVER knowledge products, coordinating with other organizations and ensuring flexibility and responsiveness to first responder requirements.

NUSTL provides expertise and analysis on a wide range of key subject areas, including chemical, biological, radiological, nuclear and explosive weapons detection; emergency response and recovery; and related equipment, instrumentation and technologies. NUSTL developed this report to provide emergency responders with information obtained from an operationally oriented assessment of handheld thermal imagers, which fall under AEL reference number 03OE-02-TILA titled Optics, Thermal Imaging and/or Light Amplification.

Visit the SAVER website at www.dhs.gov/science-and-technology/SAVER for more information on the SAVER Program or to view additional reports on handheld thermal imagers and other technologies.

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EXECUTIVE SUMMARY

In November 2016, the System Assessment and Validation for Emergency Responders (SAVER) Program conducted an operationally oriented assessment of handheld¹ thermal imagers.

Six handheld thermal imagers were assessed by emergency responders at the Lawrence Livermore National Laboratory in Livermore, California. The criteria and scenarios used in this assessment were derived from the results of a focus group of emergency responders with experience using handheld thermal imagers. The assessment addressed 13 evaluation criteria in four SAVER categories: Usability, Deployability, Capability and Maintainability. The overall results of the assessment are highlighted in the below table.

Product	Overall Score	Overall	Usability	Deployability	Capability	Maintainability
L-3/Insight Technologies CRATOS Handheld (60Hz)		4.0	4.1	4.0	3.9	3.4
L-3/Insight Technologies MTM-PI (60Hz)		3.9	4.0	3.8	4.0	3.8
L-3/EOTech. Inc. X640 (30Hz)		3.6	3.7	4.1	2.5	3.8
FLIR Systems Inc. LS-XR (30Hz)		3.6	4.0	3.6	2.5	3.6
General Starlight Company Inc. (GSCI) TIM-14DXAA-17 (30Hz)		3.0	3.1	3.0	3.0	3.0
American Technologies Network (ATN) Corp. OTS-X-F630 1.5X (30Hz)		3.0	3.0	2.5	3.6	4.0
	0 1 2 3 4 5 Least Favorable Most Favorable					

¹ Capable of being operated with only one hand

1. INTRODUCTION

Handheld thermal imagers display an object's heat signature and residual heat signature. They are widely used by law enforcement personnel as an investigative tool during tactical or search and rescue operations. Handheld thermal imagers may be used to covertly identify suspicious activity, locate recently disturbed surfaces, skid marks or hidden items and to retrieve evidence.

In November 2016, the System Assessment and Validation for Emergency Responders (SAVER) Program conducted an operationally oriented assessment of handheld thermal imagers for law enforcement at the Lawrence Livermore National Laboratory in Livermore, California. The purpose of this assessment was to obtain information on handheld thermal imagers that may be useful in making operational and procurement decisions. The activities associated with this assessment were based on recommendations from a focus group of emergency responders with experience using handheld thermal imagers.

1.1 Evaluator Information

Five law enforcement officers from various jurisdictions and with at least 3 years of experience using handheld thermal imagers were selected to be evaluators for the assessment. Evaluator information is listed in Table 1-1. Prior to the assessment, evaluators signed a nondisclosure agreement, conflict of interest statement and photo release form.

Table 1-1. Evaluator Information

Evaluator	Years	State
Law Enforcement, Retired Detective	25 – 30	NV
Law Enforcement, Lieutenant	20 – 25	TX
Law Enforcement, Special Agent	20 – 25	VA
Law Enforcement, Sergeant	10 – 15	WA
Law Enforcement, Patrol Officer	1 – 5	WA

1.2 Assessment Products

Six products were selected and purchased for the assessment based on market research and the focus group's recommendations. Final selection was based on how well each product met the product selection criteria identified by the focus group and listed below.

- Marketed to law enforcement
- Monocular body style
- Minimum image resolution of 320x240 pixels
- Field of view between 15 and 30 degrees

The products selected for assessment met all product selection criteria.

Table 1-2 presents the products that were assessed.

Table 1-2. Assessed Products

Vendor	Product	Product Image
American Technologies Network (ATN) Corp.	OTS-X-F630 1.5X (30Hz)	
FLIR Systems Inc.	LS-XR (30Hz)	
General Starlight Company Inc. (GSCI)	TIM-14DXAA-17 (30Hz)	
L-3/EOTech Inc.	X640 (30Hz)	
L-3/Insight Technologies	CRATOS Handheld (60Hz)	
L-3/Insight Technologies	MTM-PI (60Hz)	

2. EVALUATION CRITERIA

The SAVER Program assesses products based on criteria in five established categories:

- **Affordability** groups criteria related to the total cost of ownership over the life of the product. This includes purchase price, training costs, warranty costs, recurring costs and maintenance costs.
- **Capability** groups criteria related to product features or functions needed to perform one or more responder relevant tasks.
- **Deployability** groups criteria related to preparing to use the product, including transport, setup, training and operational/deployment restrictions.
- **Maintainability** groups criteria related to the routine maintenance and minor repairs performed by responders, as well as included warranty terms, duration and coverage.
- **Usability** groups criteria related to ergonomics and the relative ease of use when performing one or more responder relevant tasks.

The focus group of emergency responders met in February 2015 and identified 13 evaluation criteria within four SAVER categories: Capability, Deployability, Maintainability, and Usability. They assigned a weight for each criterion's level of importance on a scale of 1 to 5, with 1 being somewhat important and 5 being of utmost importance. The SAVER categories were assigned a percentage to represent each category's importance relative to the other categories. The focus group discussed the Affordability category but determined that including cost in the evaluation would create an unwanted bias.

Products were assessed against 13 evaluation criteria. Table 2-1 presents the evaluation criteria and their associated weights as well as the percentages assigned to the SAVER categories. Refer to Appendix A for more thorough evaluation criteria definitions.

Table 2-1. Evaluation Criteria

SAVER CATEGORIES			
Usability	Deployability	Capability	Maintainability
Overall Weight 40%	Overall Weight 35%	Overall Weight 20%	Overall Weight 5%
Evaluation Criteria			
Image Quality Weight: 4	Power Weight: 4	Detection Weight: 4	Easy to Maintain Weight: 3
Ease of Use Weight: 4	Durability Weight: 4	Image Weight: 3	
Size and Weight Weight: 4	Startup Time Weight: 3	Video/Image Weight: 3	
Covertness Weight: 3	User Manual Weight: 2	Image Color Weight: 1	

3. ASSESSMENT METHODOLOGY

The six products were assessed over three days. On the first day of the assessment, subject matter experts (SMEs) and facilitators from Lawrence Livermore National Laboratory presented a safety briefing and an overview of the assessment process, procedures and schedule to the evaluators. Each product was then assessed in two phases: (1) specification assessment and (2) operational assessment.

3.1 Phase I – Specification Assessment

During the specification assessment, evaluators assessed each product based on vendor-provided information and specifications. Product information was confirmed by vendors prior to the assessment.

3.2 Phase II – Operational Assessment

During the operational assessment, evaluators assessed each product based on their hands-on experience using the product after becoming familiar with its proper use, capabilities and features. The SMEs and facilitators assisted the evaluators with product familiarization, and evaluators had access to reference materials, user manuals and specification sheets included with each product. The products were assessed in three scenarios: (1) setup, (2) outdoor (daytime/nighttime) and (3) outdoor daytime. Evaluators used the products one at a time and completed assessment worksheets for each product before assessing the next product.

3.2.1 Setup Scenario

During the setup scenario, evaluators reviewed the user manuals, installed the batteries and cleaned the lenses. Evaluators inspected the sturdiness of the controls and determined if the handheld thermal imagers featured covered ports and/or sealed battery compartments. Evaluators determined how long it took for an image to display when the devices were powered on as well as when the devices were started from standby mode. This scenario was designed to assess the following evaluation criteria: Deployability (User Manual, Durability and Startup Time) and Maintainability (Easy to Maintain).

3.2.2 Outdoor (Daytime/Nighttime) Scenario

The outdoor scenario was conducted in an open field adjacent to a wooded area at night, between the hours of 6:30 p.m. and 9:30 p.m., and again during the day, between the hours of 9:00 a.m. and 5:00 p.m. While adjusting the zoom function of the handheld thermal imagers, evaluators scanned a parking lot and attempted to identify skid marks on the pavement as well as a car that was recently operated. Next, evaluators attempted to detect footprints leading away from the car towards the field and then searched for a person partially concealed in the first row of trees at the edge of the wooded area. During the search for this person, evaluators also conducted an article search for evidence thrown away by the person (an inoperable handgun was used) and checked for recently disturbed/turned soil. After finding the article of evidence and the recently disturbed/turned soil, the evaluators continued to search for the person. Once the person was detected, evaluators approached the individual until that person was identified. When applicable, evaluators captured and reviewed a still image and a video to assess the quality of the still image

and/or video. Throughout this scenario, the evaluators adjusted the controls and used the devices with one hand and then the other. Once all handheld thermal imagers were assessed by all evaluators, evaluators inspected them to determine if any damage occurred during the assessment. This scenario was designed to assess the following evaluation criteria: Usability (Image Quality, Ease of Use and Covertness) and Capability (Image Magnification, Detection, Video/Image Capture and Image Color).

3.2.3 Indoor Scenario

During the indoor scenario, evaluators attempted to locate a person hiding in dark areas, one area was a series of dark hallways in which all elements of light or reflective surfaces were taped off, and a second was a single dark room in which all lights were turned off, including those in surrounding hallways. When applicable, evaluators captured and reviewed still images and video to assess the quality of the still images and/or video. Next, the lights in the building were turned on and evaluators attempted to detect articles hidden in a manufactured wall with a hiding space patched in the wall. Finally, evaluators attempted to detect articles with thermal signatures through fog created by a fog machine at different distances in the dark room and along the dark hallway. Throughout this scenario, the evaluators adjusted the controls and used the devices with one hand and then the other. At the end of this scenario, evaluators assessed the size and weight of the handheld thermal imagers. This scenario was designed to assess the following evaluation criteria: Capability (Video/Image Capture and Detection) and Usability (Image Quality, Ease of Use, and Size and Weight).

3.3 Data Gathering and Analysis

Each evaluator was issued an assessment workbook that contained vendor-provided information and specifications, assessment procedures and worksheets for recording criteria ratings and comments. Evaluators used the following 1 to 5 scale:

1. The product *meets none* of my expectations for this criterion
2. The product *meets some* of my expectations for this criterion
3. The product *meets most* of my expectations for this criterion
4. The product *meets all* of my expectations for this criterion
5. The product *exceeds* my expectations for this criterion.

Criteria that were rated multiple times throughout the assessment were assigned final overall ratings by the evaluators. Facilitators captured advantages and disadvantages for the assessed products as well as general comments on the handheld thermal imager assessment and the assessment process. Once assessment activities were completed, evaluators had an opportunity to review their criteria ratings and comments for all products and make adjustments as necessary.

At the conclusion of assessment activities, an overall assessment score, as well as category scores and criteria scores, were calculated for each product using the formulas referenced in Appendix B. In addition, evaluator comments for each product were reviewed and summarized for this assessment report.

4. ASSESSMENT RESULTS

Overall scores for the assessed products ranged from 3.0 to 4.0. Table 4-1 presents the overall assessment score and category scores for each product. Products are listed in order from highest to lowest overall assessment score throughout this section. Calculation of the overall score uses the raw scores for each category, prior to rounding; products with the same rounded overall score are in order based on the raw data.

Table 4-1. Assessment Results

Product	Overall Score	Overall	Usability	Deployability	Capability	Maintainability
L-3/Insight Technologies CRATOS Handheld (60Hz)		4.0	4.1	4.0	3.9	3.4
L-3/Insight Technologies MTM-PI (60Hz)		3.9	4.0	3.8	4.0	3.8
L-3/EOTech, Inc. X640 (30Hz)		3.6	3.7	4.1	2.5	3.8
FLIR Systems Inc. LS-XR (30Hz)		3.6	4.0	3.6	2.5	3.6
General Starlight Company Inc. (GSCI) TIM-14DXAA-17 (30Hz)		3.0	3.1	3.0	3.0	3.0
American Technologies Network (ATN) Corp. OTS-X-F630 1.5X (30Hz)		3.0	3.0	2.5	3.6	4.0
	0 1 2 3 4 5 Least Favorable Most Favorable					

Table 4-2 presents the criteria ratings for each product. The ratings are graphically represented by colored and shaded circles. A green, fully shaded circle represents the highest rating. Refer to Appendix A for evaluation criteria definitions.

What Table 4-2. Criteria Ratings

KEY									
Least Favorable		Most Favorable							
									
Category	Evaluation Criteria	CRATOS Handheld (60Hz)	MTM-PI (60Hz)	X640 (30Hz)	LS-XR (30Hz)	TIM-14DXAA-17 (30Hz)	OTS-X-F630 1.5X (30Hz)		
Usability	Image Quality								
	Ease of Use								
	Size and Weight								
	Coverttness								
Deployability	Power								
	Durability								
	Start-up Time								
	User Manual								
Capability	Detection								
	Image Magnification								
	Video/Image Capture								
	Image Color								
Maintainability	Easy to Maintain								

Table 4-3. Key Specifications

Key Specification	CRATOS Handheld (60Hz)	MTM-PI (60Hz)	X640 (30Hz)	LS-XR (30Hz)	TIM-14DXAA-17 (30Hz)	OTS-X-F630 1.5X (30Hz)
MSRP	\$13,860	\$15,329	\$5,499	\$5,999	NP	\$5,695
Warranty Duration	1 year for defects in materials and workmanship	1 year for defects in materials and workmanship	3 years	2 years parts and labor; 10 years detector	7 years	3 years
Image Resolution (pixels)	640 x 480	640 x 480	640 x 480	640 x 512	800 x 600	800 x 600
Field of View	21° horizontal	37.5° diagonal 30° horizontal 22.5° vertical	24° x 18°	18° x 14° NTSC	23° x 17°	22°
Refresh Rate ²	60 Hz	60 Hz	30 Hz	< 9Hz NTSC or 30Hz	30 Hz	30 Hz
Dimensions (Length x Width x Height)	4.5 x 2.9 x 2.6 in	5.2 x 2.8 x 2.2 in	5.5 x 4.5 x 2.0 in	6.70 x 2.31 x 2.44 in	135 x 50 x 45 mm	5.75 x 2.4 x 3.3 in
Weight	< 21 ounces	≤ 13.7 ounces	13 ounces	12 ounces	360 grams (without batteries)	1.1 pounds
Operating Temperature Range	-26°F to 126°F	-29°F to 122°F	-4°F to 140°F	-4°F to 122°F (Laser: 4°F to 122°F)	-25°C to 65°C	NP
Storage Temperature Range	-40°F to 165°F	-40°F to 160°F	-4°F to 176°F	-40°F to 40°F	NP	NP
Impact Resistant	NP	NP	Shock resistant military standard 810G, Method 516.6	1 Meter Drop Test	NP	NP
Ingress Protection (IP) Rating	IP68, Immersion to 20 meters for 2 hours	IP68, Immersion to 20 meters for 2 hours	IP67, submersible up to 1 meter	IP67, submersible up to 1 meter	NP	Waterproof
Battery Type	1.5v Lithium AA	CR123	AA Lithium	Internal Li-Ion Cell	AA Lithium	CR123A
Battery Runtime	≥ 4 hours	4 hours	5 hours	5 hours	7 hours	2 hours
Notes:	Hz – hertz F – Fahrenheit	in – inches C – Celsius	NP – information not provided	mm – millimeters NTSC – National Television System Committee		

² the frequency at which the image on a monitor is renewed

4.1 L-3/Insight Technologies CRATOS Handheld (60Hz)

The CRATOS Handheld received an overall assessment score of 4.0 and has a manufacturer's suggested retail price (MSRP) of \$13,860.

The following sections, broken out by SAVER category, summarize the assessment results.



Figure 4-1. CRATOS Handheld

Image courtesy of L-3 Communications Corporation

4.1.1 Usability

The CRATOS Handheld received a Usability score of 4.1. The following information is based on evaluator comments:

- Image clarity was excellent, at all zoom levels. Provided many useful viewing options.
- The device was ergonomically well-designed and it was operated well in either hand.
- The eyepiece fit comfortably against the eye and prevented light from escaping, which aided in covertness.
- Some evaluators found the menu-button combination easy to use, while others found it somewhat cumbersome.
- The light colored device exterior might make it easier for an adversary to see while in use.

4.1.2 Deployability

The CRATOS Handheld received a Deployability score of 4.0. The following information is based on evaluator comments:

- The device was well-built and very rugged and the controls seemed very durable.
- The unit came with water resistant, removable covers for all ports.
- The use of readily available batteries was a good feature.
- The run-time was sufficient and the device did not have an automatic shut-off.
- Startup time was approximately 4 seconds.
- The user manual was comprehensive, but some evaluators found it difficult to locate some specific information. However, the quick-start guide was very useful.

4.1.3 Capability

The CRATOS Handheld received a Capability score of 3.9. The following information is based on evaluator comments:

- The evaluators found this unit to have the best detection capability, with high clarity and fine details.
- The color image features were especially useful for discerning subtle thermal differences.

- This device performed very well on the longer-distance detections.
- The zoom feature only had two discrete settings, and required manual focusing when switching between the settings.
- The evaluators remarked that an auto-focus feature would have enhanced device use.
- This device did not have image or video capturing capabilities.

4.1.4 Maintainability

The CRATOS Handheld received a Maintainability score of 3.4. The following information is based on evaluator comments:

- The evaluators found this device to have desirable maintenance features, including:
 - Ease of battery replacement
 - Ease of cleaning
 - Good design for the clips used to access compartments and ports.

4.2 L-3/Insight Technologies MTM-PI (60Hz)

The MTM-PI received an overall assessment score of 3.9 and has an MSRP of \$15,329.

The following sections, broken out by SAVER category, summarize the assessment results.



Figure 4-2. MTM-PI

Image courtesy of L-3 Communications Corporation

4.2.1 Usability

The MTM-PI received a Usability score of 4.0. The following information is based on evaluator comments:

- The evaluators were complimentary about the image quality of this device, although one evaluator conveyed that he had trouble focusing the unit and experienced excessive “white noise.”
- The ergonomic design of this device was well-received, many commented on the ease of control, light weight and comfort of this unit.
- The evaluators felt that this device was very covert and quiet, although they questioned the need for an external laser-on indicator light that made the device more readily detectable.
- Most of the evaluators believed that the control buttons were easy to reach and ergonomic.

4.2.2 Deployability

The MTM-PI received a Deployability score of 3.8. The following information is based on evaluator comments:

- This unit featured a sturdy design that could be used in most outdoor weather conditions.

- This device had a slightly shorter startup time than other units tested.
- The user manual was somewhat difficult to read due to the small font size.
- The quick start guide was positively received as it was deemed easy to read, very detailed and touted features that would be useful in the field, including being waterproof.
- The evaluators questioned the choice of batteries for this unit, citing the expense of battery replacement and the relatively short battery life.

4.2.3 Capability

The MTM-PI received a Capability score of 4.0. The following information is based on evaluator comments:

- The evaluators seemed happy with the sensitivity of this device, but felt limited by the lack of color capabilities when viewing the image.
- The image outline feature was quite useful. Several evaluators commented on the ease with which this device could detect objects.
- When moving between different discrete image magnifications, the evaluators felt that image quality was somewhat degraded.
- This device performed well in image and video capture, but only had enough internal memory to capture 15 seconds of video footage.

4.2.4 Maintainability

The MTM-PI received a Maintainability score of 3.8. The following information is based on evaluator comments:

- The evaluators liked the ease of battery replacement, the battery compartment was easy to access and no tools were required for opening the compartment.
- The evaluators were pleased with the easy care requirements for lens and case cleaning and working conditions for the device.

4.3 L-3/EOTech Inc. X640 (30Hz)

The X640 received an overall assessment score of 3.6 and has an MSRP of \$5,499.

The following sections, broken out by SAVER category, summarize the assessment results.

4.3.1 Usability

The X640 received a Usability score of 3.7. The following information is based on evaluator comments:

- Image clarity for this unit was subpar relative to other units tested.



Figure 4-3. X640

Image courtesy of L-3 EOTech Inc.

- The evaluators found this unit easy to use, but some did not like the eye cup design, feeling that it was too stiff and did not mold easily to the eye.
- The evaluators liked the size and weight, and how well the device fit in their hands.
- The device had inferior covertness, as the design allowed light to escape around the edge of the eye cup.

4.3.2 Deployability

The X640 received a Deployability score of 4.1. The following information is based on evaluator comments:

- The evaluators indicated that the manual was in depth and organized but some found that it was more complicated than the device itself.
- The startup time for this device was comparable to the other imagers evaluated.
- This unit did not rate as highly with the evaluators on durability, based on the feel of the device (did not feel as sturdy as others).
- The evaluators believed that the device casing would not be as durable as other devices evaluated.

4.3.3 Capability

The X640 received a Capability score of 2.5. The following information is based on evaluator comments:

- This device worked best at close range and the performance was not as good when viewing objects at longer distances.
- The zoom features of this device were not impressive.
- Evaluators reported “image washout” under some conditions (warm surroundings made it difficult to discern targets).
- Some evaluators reported that images became blurry at higher magnifications.
- The evaluators were complimentary of the wide variety of color options for this device that allowed for customization of the detection capabilities relative to the use conditions.

4.3.4 Maintainability

The X640 received a Maintainability score of 3.8. The following information is based on evaluator comments:

- The evaluators indicated that it would be easy to clean the device and liked that it came with a cleaning cloth.
- The evaluators noted that battery change-out could be improved by clearly marking the battery compartments. The evaluators believed that changing batteries with compromised dexterity (i.e., while donning gloves) would be difficult.

4.4 FLIR Systems Inc. LS-XR (30Hz)

The LS-XR received an overall assessment score of 3.6 and has an MSRP of \$5,999.

The following sections, broken out by SAVER category, summarize the assessment results.



Figure 4-4. LS-XR

Image courtesy of FLIR Systems Inc.

4.4.1 Usability

The LS-XR received a Usability score of 4.0. The following information is based on evaluator comments:

- The evaluators reported that the image quality of this device was inferior to the other devices tested. The images were “snowy” and the image details were not crisp.
- This device received favorable ratings for ease of use.
- The evaluators liked the ergonomic qualities of the device, and felt that the simplicity of operation was very beneficial for most applications.
- The small size and weight of this unit was a plus.
- This device rated high for covertness.

4.4.2 Deployability

The LS-XR received a Deployability score of 3.6. The following information is based on evaluator comments:

- This device uses a rechargeable internal battery with an approximately 4-hour operational life. This can be a drawback in that batteries are not field replaceable.
- The evaluators believed that the unit was durable.
- The user manual was not in depth, it was more like a quick start guide.

4.4.3 Capability

The LS-XR received a Capability score of 2.5. The following information is based on evaluator comments:

- Some evaluators reported inferior sensitivity in most applications and lesser performance when viewing objects at a distance.
- Image clarity was not as good as that of the other devices evaluated.
- The evaluators reported some dissatisfaction with the zoom function, stating that image quality was diminished when zooming in.
- The image color capabilities were basic, but sufficient.
- This device received average ratings for object detection.

4.4.4 Maintainability

The LS-XR received a Maintainability score of 3.6. The following information is based on evaluator comments:

- The evaluators felt that adequate maintenance instructions were not available.
- In terms of maintenance, the evaluators indicated that rechargeable batteries may reduce flexibility in the field.

4.5 General Starlight Company Inc. (GSCI) TIM-14DXAA-17 (30Hz)

The TIM-14DXAA-17 received an overall assessment score of 3.0. The MSRP was not provided by the manufacturer.

The following sections, broken out by SAVER category, summarize the assessment results.



Figure 4-5. TIM-14DXAA-17

Image courtesy of General Starlight Company Inc.

4.5.1 Usability

The TIM-14DXAA-17 received a Usability score of 3.1. The following information is based on evaluator comments:

- Image quality for this unit was reported as average compared to other units evaluated.
- The images displayed some graininess with some zoom levels.
- The evaluators felt that this unit was the most difficult to use with one hand.
- This unit had more button controls than the other imagers evaluated, and in combination with difficult-to-use menu displays, made operating this unit unsatisfactory.
- The evaluators were satisfied with the covertness of this device.

4.5.2 Deployability

The TIM-14DXAA-17 received a Deployability score of 3.0. The following information is based on evaluator comments:

- The evaluators liked the use of standard AA batteries and the battery life.
- This device did not seem as durable as others that were evaluated. Some features (lens cap, buttons) seemed more vulnerable to breakage.
- The evaluators reported that the user manual was fairly basic, but was well illustrated and easy to follow.
- The manual did not specify cleaning instructions.
- The lens caps seemed fragile; evaluators believed it could be easily broken.

4.5.3 Capability

The TIM-14DXAA-17 received a Capability score of 3.0. The following information is based on evaluator comments:

- This unit received average ratings for detection.
- The evaluators reported good detection of larger objects at closer distances, but performance was not as good (lack of crispness, inferior sensitivity) for smaller objects or at longer distances.
- This device provided superior zoom capabilities relative to the other devices evaluated.
- This device has multiple color display options, rated as average by the evaluators.

4.5.4 Maintainability

The TIM-14DXAA-17 received a Maintainability score of 3.0. The following information is based on evaluator comments:

- The evaluators felt that battery change out was prone to error (i.e., compartment not well-marked, low-light change out more difficult, compartment cover could be cross-threaded when closing).
- The evaluators indicated that there were no directions or accessories provide for cleaning.

4.6 American Technologies Network (ATN) Corp. OTS-X-F630 1.5X (30Hz)

The OTS-X-F630 1.5X received an overall assessment score of 3.0 and has an MSRP of \$5,695.

The following sections, broken out by SAVER category, summarize the assessment results.



Figure 4-6. OTS-X-F630 1.5X

Image courtesy of American Technologies Network Corp.

4.6.1 Usability

The OTS-X-F630 1.5X received a Usability score of 3.0. The following information is based on evaluator comments:

- The evaluators reported reasonable image clarity, but indicated that to achieve that clarity, continual refocusing was needed using two hands.
- One evaluator described a “burn-in” type effect that required covering the lens to reset.
- Responses related to ease of use were mixed.
- Some evaluators found the device to be heavy, bulky and hard to use with one hand.
- Some evaluators reported that the menu was cumbersome; others reported no similar issues.
- Covertness was rated as adequate.

4.6.2 Deployability

The OTS-X-F630 1.5X received a Deployability score of 2.5. The following information is based on evaluator comments:

- Evaluators did not like the relatively short run-time for this device, which was approximately 2 hours.
- In general, the evaluators felt that the heavy design (prone to dropping), the non-captive lens cap, and the use of plastic exterior parts made this unit seem less durable.
- The user manual seemed outdated and was more complex to navigate than others that were evaluated.

4.6.3 Capability

The OTS-X-F630 1.5X received a Capability score of 3.6. The following information is based on evaluator comments:

- Evaluators generally reported good detection capabilities, but some had problems with image wash-out and limited distance range.
- Focusing problems made using the zooming features somewhat difficult.
- The evaluators liked the still-image capturing capability.
- The evaluators liked the available image color options, but some reported that traversing the image color menus was not easy.

4.6.4 Maintainability

The OTS-X-F630 1.5X received a maintainability score of 4.0. The following information is based on evaluator comments:

- The evaluators felt that the maintenance requirements for this device were about average for the devices evaluated.
- There were no tools required to change the batteries, which was ideal.




5. SUMMARY




Handheld thermal imagers display an object’s heat signature and residual heat signature thereby making handheld thermal imagers a valuable investigative tool for law enforcement and emergency responders.

The advantages and disadvantages, as identified by the evaluators, for the assessed products are highlighted in Table 5-1.

Emergency responder agencies that consider purchasing handheld thermal imagers should carefully research each product’s overall capabilities and limitations in relation to their agency’s operational needs.

Table 5-1. Product Advantages and Disadvantages

Vendor/Product		Advantages	Disadvantages
 <p>MSRP: \$13,860</p>	<p>L-3/Insight Technologies CRATOS Handheld (60Hz)</p> <p>Overall Score: 4.0</p>	<ul style="list-style-type: none"> • Superior image clarity • Best detection capability • Useful image color options • Rugged, ergonomic design • Comfortable to use • Eyepiece design prevents light from escaping • Water-resistant • Uses readily available batteries • Seems easy to maintain 	<ul style="list-style-type: none"> • Lighter colored exterior reduces covertness • No image capture or video capabilities
 <p>MSRP: \$15,329</p>	<p>L-3/Insight Technologies MTM-PI (60Hz)</p> <p>Overall Score: 3.9</p>	<ul style="list-style-type: none"> • Generally good image quality • Very capable detection • Useful image outline feature • Easy to control and handle • Able to capture images and video • Seems easy to maintain • No tools required for battery change 	<ul style="list-style-type: none"> • Some images displayed “white noise” • “Laser-on” indicator light reduces covertness • Lack of image color capabilities • Uses batteries that are less common, may be difficult to replace while in the field • Limited video storage capacity (15 seconds)
 <p>MSRP: \$5,499</p>	<p>L-3/EOTech Inc. X640 (30Hz)</p> <p>Overall Score: 3.6</p>	<ul style="list-style-type: none"> • Subpar image quality (image wash-out) • Very useful image color options • Ergonomic design • Uses readily available batteries 	<ul style="list-style-type: none"> • Inferior eye cup design, which reduced covertness • Reduced performance at longer ranges • Did not seem as durable • Less capable zoom features • Cumbersome battery change

Vendor/Product		Advantages	Disadvantages
 <p>MSRP: \$5,999</p>	<p>FLIR Systems Inc. LS-XR (30Hz)</p> <p>Overall Score: 3.6</p>	<ul style="list-style-type: none"> • Good ergonomic design • Simple to operate • Useful color image capabilities • Durable design • High rating for covertness 	<ul style="list-style-type: none"> • Image quality less than other devices (snowy, less crisp) • Inferior sensitivity • Reduced performance at longer distances • Rechargeable batteries reduced field flexibility
 <p>MSRP: NP</p>	<p>General Starlight Company Inc. (GSCI) TIM-14DXAA-17 (30Hz)</p> <p>Overall Score: 3.0</p>	<ul style="list-style-type: none"> • Average image quality • Average detection capabilities • Superior zoom capabilities • Good image color options • Good covertness due to lack of shiny surfaces 	<ul style="list-style-type: none"> • Some graininess with zoom • Difficult to use with one hand • Difficult button/menu navigation • Durability concerns • No instructions for cleaning
 <p>MSRP: \$5,695</p>	<p>American Technologies Network (ATN) Corp. OTS-X-F630 1.5X (30Hz)</p> <p>Overall Score: 3.0</p>	<ul style="list-style-type: none"> • Average image quality • Good detection capabilities • Strong image color options • Still image capture capability 	<ul style="list-style-type: none"> • Required two-handed operation for most tasks • Bulky, less durable • Relatively short run-time • Required repeated focusing • Difficult menu navigation • Poor user manual

APPENDIX A. EVALUATION CRITERIA DEFINITIONS

The focus group identified 13 criteria, which they defined as follows.

USABILITY

Image Quality refers to the clarity of the image permitting the user to distinguish detailed features on targets/objects of interest, without magnification. Image Quality is affected by the frame rate/refresh rate, image resolution and adjustable brightness.

Ease of Use refers to how easily the device can be held, carried (i.e., usable lanyard, hand strap or attachment point) and used (i.e., easily and quickly placed up to the eye with minimal adjustments). Ease of Use also includes the ease of powering the device on and off, as well as adjusting the focus and eye relief, with and without gloves. The focus group noted the controls should be easily accessible, the device should be able to be powered on/off ambidextrously with one hand and the eyepiece should fit comfortably with and without glasses.

Size and Weight refers to the overall size and weight of the thermal imager.

Covertiness refers to factors that contribute to being able to use the device without being detected (i.e., the device should operate quietly and restrict light from escaping around the eyepiece).

DEPLOYABILITY

Power refers to the battery runtime, battery charge time, power options (e.g., AC and DC power options) and battery type(s) (e.g., rechargeable or single use, commercially available or proprietary) used by the thermal imager. Power also includes the thermal imager being able to accept alternate battery options (i.e., replace a proprietary battery with a commercially available battery).

Durability refers to the overall ruggedness of the device, including the sturdiness of its buttons/controls and if it features covered ports and/or a sealed battery compartment. Durability also includes the device's water resistance (i.e., Ingress Protection [IP] rating) and shock resistance.

Startup Time refers to the amount of time required for an image to appear once the device is powered on as well as the amount of time required for an image to appear once the device is started up from standby mode, if applicable.

User Manual refers to the user manual and/or quick-start guide being comprehensive and having instructions and diagrams that are easy to understand.

CAPABILITY

Detection refers to the sensitivity and range of the thermal imager. Sensitivity refers to how easily subtle thermal differences (e.g., skid marks, footprints) can be seen. Range refers to the range of detection, recognition and identification of targets/objects of interest. Focus group participants noted the image color may help with detection.

Image Magnification refers to the device featuring fixed or user-adjustable magnification, and if user-adjustable, whether the device has a digital or optical zoom. Focus group participants noted magnification may affect image quality and the detection range of the device.

Video/Image Capture refers to the ability of the device to capture and store video and/or still images to removable media or internal storage. Video/Image Capture also refers to the quality of the captured video and still images (i.e., does the captured video/still images look like what you meant to capture?).

Image Color refers to the color of the image produced by the device (e.g., color, black-hot, white-hot) as well as if the image color is user-selectable.

MAINTAINABILITY

Easy to Maintain refers to the ease of cleaning the lens and replacing the batteries.

APPENDIX B. ASSESSMENT SCORING FORMULAS

The overall score for each product was calculated using the product’s averaged criterion ratings and category scores. An average rating for each criterion was calculated by summing the evaluators' ratings and dividing the sum by the number of responses. Category scores for each product were calculated by multiplying the average criterion rating by the weight assigned to the criterion by the focus group, resulting in a weighted criterion score. The sum of the weighted criterion scores was then divided by the sum of the weights for each criterion in the category as seen in the formula and example below.

Category Score Formula

$$\frac{\sum(\text{Average Criterion Rating} \times \text{Criterion Weight})}{\sum(\text{Criterion Weights})} = \frac{\text{Category Score}}{\text{Score}}$$

Category Score Example³

$$\frac{(4.3 \times 4) + (5 \times 4) + (4 \times 3) + (4.5 \times 3) + (4.5 \times 3)}{4 + 4 + 3 + 3 + 3} = 4.5$$

To determine the overall assessment score for each product, each category score was multiplied by the percentage assigned to the category by the focus group. The resulting weighted category scores were summed to determine an overall assessment score as seen in the formula and example below.

Overall Score Formula

$$\sum(\text{Category Score} \times \text{Category Percentage}) = \frac{\text{Overall Assessment Score}}{\text{Score}}$$

Overall Score Example¹

<u>Capability</u>	<u>Usability</u>	<u>Affordability</u>	<u>Maintainability</u>	<u>Deployability</u>	
(4.0 × 33%)	+ (4.2 × 27%)	+ (4.2 × 20%)	+ (3.8 × 10%)	+ (4.5 × 10%)	= 4.1

³Examples are for illustration purposes only. Formulas will vary depending on the number of criteria and categories assessed and the criteria and category weights.