



System Assessment and Validation for Emergency Responders (SAVER)

Hearing Protection with Integrated Radio Communications Assessment Report

November 2016



**Homeland
Security**

Science and Technology

U.S. Department of Homeland Security



System Assessment and Validation for Emergency Responders

Prepared by Oak Ridge National Laboratory

Approved for public release, distribution is unlimited.

The *Hearing Protection with Integrated Radio Communications* was funded under Interagency Agreement No. HSHQPM-15-X-00134 from the U.S. Department of Homeland Security, Science, and Technology Directorate.

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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 with 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 and
- Providing information in the form of knowledge products that enables decision makers and responders to better select, procure, use, and maintain emergency response equipment.

The 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 to provide a life- and cost-saving asset to DHS, as well as to federal, state, and local responders.

The SAVER Program is supported by a network of Technical Agents who perform assessment and validation activities. As a SAVER Program Technical Agent, the Oak Ridge National Laboratory (ORNL) has been tasked with providing expertise and analysis on key subject areas, including communications, sensors, security, weapon detection, and surveillance, among others. In support of this task, ORNL developed this report to provide emergency responders with information obtained from an operationally oriented assessment of hearing protection with integrated radio communications; these devices fall under AEL reference number 01ZA-04-HEAR, entitled “Protection, Hearing.”

For more information on the SAVER Program or to view additional reports on hearing protection with integrated radio communications or other technologies, visit <https://www.dhs.gov/science-and-technology/SAVER>.

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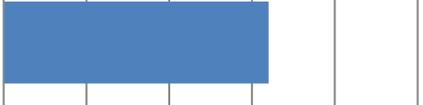
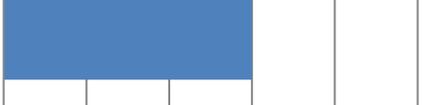
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EXECUTIVE SUMMARY

Tactical headsets are designed to fit under, or attach to, a ballistic helmet. They combine electronic hearing protection, radio communication, and the ability to maintain peripheral hearing in a tactical environment. In August 2016, the System Assessment and Validation for Emergency Responders (SAVER) Program conducted an operationally oriented assessment of hearing protection with integrated radio communications.

Six tactical headsets were assessed by emergency responders. The products chosen included models with ear cups, a combination of ear buds with three-fourths ear cups (or “horseshoe”-shaped housings), and bone conduction technology. Standard ear tips were ordered as applicable. The products chosen were based on criteria developed by a focus group of emergency responders with experience using hearing protection with integrated radio communications. The focus group meeting was followed up with market research.

The criteria and scenarios used in this assessment were derived from the results of that focus group meeting. The assessment addressed 12 evaluation criteria in four SAVER categories: Capability, Deployability, Usability, and Maintainability. The focus group briefly discussed Affordability but did not identify any evaluation criteria for that category. The overall results of the assessment are shown in the following table.

Product	Overall Score	Overall	Capability	Deployability	Usability	Maintainability
Tactical Command Industries – Liberator II™		3.6	3.8	3.3	3.4	3.1
Television Equipment Associates, Inc. – Invisio® X5		3.4	3.3	3.5	3.9	3.2
3M™ – Peltor™ COMTAC Advanced Communication Headset		3.3	3.1	3.5	3.2	3.2
Mine Safety Appliances – Supreme® Pro		3.2	3.3	3.2	3.3	2.7
Atlantic Signal – COMTAC Hybrid IV		3.0	3.0	3.0	3.1	3.4
Atlantic Signal – Enforcer		2.4	2.3	2.5	2.7	2.1
	0 1 2 3 4 5					
Key: 1 (least favorable) to 5 (most favorable)						

1. Introduction

Tactical headsets are designed to fit under, or attach to, a ballistic helmet. They combine electronic hearing protection, radio communication, and the ability to maintain peripheral hearing in a tactical environment. In August 2016, the System Assessment and Validation for Emergency Responders (SAVER) Program conducted an operationally oriented assessment of hearing protection with integrated radio communications. The purpose of this assessment was to obtain information on tactical headsets that will 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 hearing protection with integrated radio communications.

1.1 Evaluator Information

Six emergency responders from various jurisdictions, and with at least 5 years of experience using hearing protection with integrated radio communications, 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, a conflict of interest statement, a photo release form, and a consent form.

Table 1-1. Evaluator Information

Evaluator	Experience (Years)	State
Training Facility – Tactical Instructor	20+	IL
Police Department – SWAT Team/Sniper	20+	PA
Sheriff’s Office – SWAT Team/Sniper	20+	SC
Police Department – SWAT Team	16–20	WI
Police Department – SWAT Team/Range Master	11–15	TN
Police Department – SWAT Team	6–10	AZ
Notes: SWAT: Special Weapons and Tactics AZ: Arizona; IL: Illinois; PA: Pennsylvania; SC: South Carolina; TN: Tennessee; WI: Wisconsin		

1.2 Assessment Products

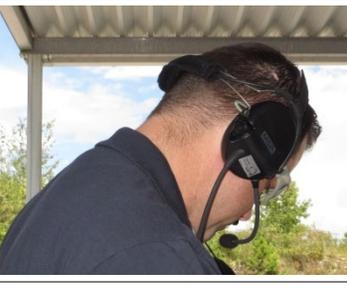
Six products were selected and purchased for the assessment based on market research and the focus group’s recommendations. Final selection was based on how well each product met the product selection criteria—identified by the focus group and listed below.

- Headset should not be integrated with a helmet.
- Inner-ear configurations must have electronic noise suppression.
- Batteries should be user-replaceable.

- If equipped with a behind-the-head (BTH) strap, product should also have an over-the-head (OTH) strap.

The products selected for assessment generally met the product selection criteria. Price was considered in the final selection process when there was a wide gap in manufacturer-suggested retail price, but all other factors were comparable. While the criteria required that the headset not be integrated with a helmet, the headset was required to fit under a ballistic helmet. Wireless applications were not acceptable as they pose a security risk during special weapons and tactics (SWAT) applications, so the push-to-talk (PTT) was required to be hard wired to the radio. Communication was required to be duplex. Table 1-2 shows the products that were assessed.

Table 1-2. Assessed Products

Vendor	Product	Product Image
Atlantic Signal	COMTAC Hybrid IV	
Atlantic Signal	Enforcer	
Mine Safety Appliances (MSA)	Supreme [®] Pro	
Tactical Command Industries (TCI [™])	Liberator II [™]	

Vendor	Product	Product Image
Television Equipment Associates, Inc. (TEA)	Invisio® X5	
3M™	Peltor™ COMTAC Advanced Communication Headset (ACH)	

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 total cost 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 preparation to use the product, including transport, setup, training, and operational/deployment restrictions.
- **Usability** groups criteria related to ergonomics and the relative ease of use when performing one or more responder-relevant tasks.
- **Maintainability** groups criteria related to the routine maintenance and minor repairs performed by responders, as well as included warranty terms, duration, and coverage.

The focus group of emergency responders met in December 2015 and identified 12 evaluation criteria within four SAVER categories: Capability, Deployability, Usability, and Maintainability. The focus group 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.

Products were assessed against all 12 evaluation criteria. Table 2-1 presents the evaluation criteria, their associated weights, and the percentages assigned to the SAVER categories. Refer to Appendix A for evaluation criteria definitions.

Table 2-1. Evaluation Criteria

SAVER Categories			
Capability Overall Weight 45%	Deployability Overall Weight 35%	Usability Overall Weight 15%	Maintainability Overall Weight 5%
Evaluation Criteria			
Radio Communications Clarity Weight: 5	Durability Weight: 4	Comfort Weight: 4	Product Support Weight: 4
Decibel Reduction Weight: 3	Accessories Weight: 3	Controls Weight: 3	Battery Accessibility Weight: 2
Ambient Noise Amplification Weight: 3	Size Weight: 3		
Power Weight: 3	Color Options Weight: 1		

3. Assessment Methodology

The six selected tactical headsets were assessed over 4 days. Each product was assessed in two phases: (1) specification assessment and (2) operational assessment. On the first day of the assessment, the facilitator presented an overview of the assessment process, procedures, and schedule to the evaluators. The evaluators were then given an opportunity to become familiar with the proper use, capabilities, and features of the products, and were assisted by the subject matter expert (SME) and facilitator during this familiarization process. Each day began with a safety briefing conducted by staff trained in the safety protocol of that facility. The fifth day was a closeout and included a debriefing and final rating of the products.

To assist with the assessment for each of the two phases, evaluators used a workbook that detailed the procedures, affiliated criteria, and evaluation considerations. Some criteria were

rated multiple times throughout the assessment, requiring an overall rating. Each evaluator met regularly with their respective scribe to transcribe comments and develop ratings based on the evaluation considerations listed with the procedures. Because each evaluator was assigned a number, the collected data was not directly associated with the evaluator, and thus the survey followed human research study protocol.

3.1 Phase I: Specification Assessment

During the specification assessment, evaluators assessed each product based on vendor-provided information and specifications. Product information was provided by vendors prior to the assessment in the form of operation manuals, specification sheets, and/or quick-start guides and was available throughout the assessment. Specification criteria generally related to the product selection criteria developed by the focus group. Table 3-1 identifies the criteria assessed during this phase.

Table 3-1. Specification Criteria

Criterion	Definition
Power	Type of battery and runtime
Accessories	Ability to order alternate boom microphone and/or mounting options
Color	Ability to order in different colors
Comfort	Weight, availability of padding on headpiece and ear cups, and availability of OTH, BTH, or both straps
Controls	Ability to order right- or left-handed headset controls
Product Support	Terms of the warranty and availability of technical support

3.2 Phase II: Operational Assessment

The operational assessment included three scenarios: (1) setup scenario, (2) indoor scenario, and (3) range scenario. The venues for each scenario were chosen based on the requirements of the criteria. All attempts were made to simulate the actual ambient noise the evaluators would experience when actively using the hearing protection with integrated radio communications.

Evaluators assessed the products one at a time and completed the assessment of a criterion for one product before assessing that same criterion for the next product.

3.2.1 Setup Scenario

At the beginning of the setup scenario, evaluators inspected the entire headset system¹ for any manufacturer defects. Evaluators also inspected the overall ruggedness of the products—including the durability/sturdiness of the boom microphones and buttons/controls—and determined if the headsets featured covered ports (Durability). The



Figure 3-1. Evaluator Donning Headset with APR Mask

¹ The system included the PTT which was ordered specific to the radios used during the assessment.

systems were inspected again at the end of the assessment. They also assessed the ease of battery changes (by removing and reinstalling the batteries to ascertain if any special tools were required), noted the location of the battery compartment(s), and noted if the battery compartment(s) featured seals (Battery Accessibility and Durability). Evaluators then donned the headsets and adjusted them for fit (Comfort). Evaluators also assessed Comfort while wearing the headsets with safety glasses and their ballistic service helmets, and then again while wearing only an air-purifying respirator (APR) mask (Figure 3-1) to evaluate the addition of personal protective equipment (PPE).

3.2.2 Indoor Scenario

Evaluators assessed Ambient Noise Amplification by donning the headsets and listening as different levels of sound were introduced, to include replication of a person whispering (30 dB at 6 feet) and normal communication at an increasing volume from 65 dB to 85 dB at 4 feet from the sound source. Next, a siren with a 121-dB noise level was activated. A calibrated, sound-level meter was used to demarcate areas in 5-dB increments from the noise source. Groups of two to three evaluators walked slowly towards the sound source, (Figure 3-2), beginning at the 100-dB level. As they approached the 121-dB noise source, evaluators were able to determine at what distance/level the sound level was reduced to a level that was acceptable, or if each headset's noise-suppression function would completely eliminate/cancel the loud ambient noise (Decibel Reduction).



Figure 3-2. Evaluators Walking Towards the Siren while Assessing the Decibel Reduction

Evaluators then worked as a group during a second activation of the siren at the same decibel level to reevaluate Decibel Reduction during radio communication. In this procedure, the evaluators were stationary and within 3 feet of the 121-dB sound source. The SME was equipped with a handheld radio, while each of the six evaluators donned a headset and radio. Individually, the evaluators identified their headset and then recited a portion of the alphabet. All radios were tuned into the same channel so evaluators could listen to the individual transmissions. Next, all six of the evaluators listened as the SME, who was standing in the room at a distance of 60 feet from the sound source, recited a portion of the alphabet through the handheld radio. Once each evaluator verbally communicated through his respective headset and also listened to a communication, they completed an assessment of Radio Communications Clarity to rate and comment on the clarity of the headset's microphone (transmission to the handheld radio) and speaker (listening through headset).

The evaluators were permitted to adjust the controls on the headsets as necessary throughout the indoor scenario. Each procedure was repeated until each evaluator assessed every product. In order to prevent exposures to noise above Occupational Exposure levels, those not wearing a

headset during any of the simulations of ambient noise above 85 dB were required to wear double hearing protection (foam ear plugs and ear muffs).

3.2.3 Range Scenario

The range scenario was conducted at a nearby training facility that offered access to an outdoor range and a shoot house. Evaluators wore soft body armor and safety glasses throughout this scenario. Double hearing protection was worn by those not wearing a headset when there was live fire or the use of a distraction device (i.e., flashbang).

On the outdoor range, evaluators worked as a group during the firing of a 9-mm pistol (Figure 3-3). Ten rounds were shot at a cadence of approximately one shot-per-second. The SME was equipped with a handheld radio while each of the six evaluators donned a headset and a radio. Evaluators stood on either side within 1 to 6 feet from the shooter. Individually, the

evaluators identified their headset and then recited a portion of the alphabet. All radios were tuned to the same channel so evaluators could listen to the individual transmissions. Next, all six of the evaluators listened as the SME, who was positioned near the firing line, recited a portion of the alphabet. Once each evaluator conducted a communication on his respective headset and also listened to a communication, the evaluator assessed Radio Communications Clarity to rate and comment on the clarity of the headset's microphone (transmission to the handheld radio) and speaker (listening through headset). Controls on the headsets could be adjusted as necessary throughout this procedure. This procedure was repeated until all evaluators assessed all products.

In the shoot house (Figure 3-4) evaluators assessed Decibel Reduction while firing shots with and without radio communication. As on the outdoor range, the evaluators worked as a group during the firing of a 9-mm pistol. Ten rounds were shot at a cadence of approximately one shot-per-second. Because the loud ambient noise was measured at 127 dB, the SME was required to stand outside the shoot house with a handheld radio. Each of the six evaluators donned a headset and a radio. All radios were tuned to the same channel. Individually, the evaluators identified their headset and then recited a portion of the alphabet. Next, all six of the evaluators listened as the SME recited a portion of the alphabet. Once each evaluator conducted a communication on his respective headset and also listened to a communication, the



Figure 3-3. Evaluators Assessing Clarity on Open Range during Firing of Pistol



Figure 3-4. Evaluator Assessing Decibel Reduction inside Shoot House

evaluator assessed the Decibel Reduction to ascertain whether the headset adjusted for the decibel level of the loud ambient noise without cutting out radio communication on both the sending and receiving end. Controls on the headsets could be adjusted as necessary throughout this procedure. This procedure was repeated until all evaluators assessed all products.

While conducting radio communications, a flashbang was also activated inside the shoot house. During this activity, the SME was positioned in a trailer 300 feet from the shoot house. Because the training facility protocol required double hearing protection with headsets during the activation of flashbang in an enclosed area, those headsets that relied on ear buds or bone conduction could not be tested with the flashbang inside the shoot house. Those headsets—the Atlantic Signal Enforcer, the Atlantic Signal COMTAC Hybrid IV, and the TEA Invisio® X5—were tested just outside the shoot house door and therefore could not be fully tested to the prescribed criteria for Decibel Reduction with a flashbang.

Back on the open shooting range, each evaluator donned a headset, a ballistic service helmet, soft body armor, knee and elbow pads, and safety glasses. Evaluators fired three to five rounds from a 5.56-mm, AR-15 style rifle in standing, kneeling, and prone positions (Figure 3-5) to assess Decibel Reduction and Size. Controls were not adjusted during this procedure. For Size, evaluators assessed the headset interference when wearing a helmet and firing a weapon. This procedure was repeated until all evaluators assessed all products.



Figure 3-5. Evaluator Assessing Decibel Reduction and Size during Prone Firing Position

3.3 Data Gathering and Analysis

Each evaluator was issued an assessment workbook that contained 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. The scribes captured advantages and disadvantages for the assessed products as well as general comments on the hearing protection with integrated radio communications assessment. Once assessment activities were completed, evaluators had an opportunity to review their criteria ratings and comments for all products and make adjustments as necessary. The facilitator also captured comments on the assessment process.

At the conclusion of the assessment activities, category scores, criteria scores, and an overall assessment score 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 2.4 to 3.6, with those in the median being very close in overall rating. 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 used the raw scores for each category, prior to rounding. While some products scored higher in Deployability and Usability, the TCI™ Liberator II™ ranked the highest when the overall score was calculated using the criteria weights.

Table 4-1. Assessment Results

Product	Overall Score	Overall	Capability	Deployability	Usability	Maintainability
Tactical Command Industries – Liberator II™		3.6	3.8	3.3	3.4	3.1
Television Equipment Associates, Inc. – Invisio® X5		3.4	3.3	3.5	3.9	3.2
3M™ – Peltor™ COMTAC Advanced Communication Headset		3.3	3.1	3.5	3.2	3.2
Mine Safety Appliances – Supreme® Pro		3.2	3.3	3.2	3.3	2.7
Atlantic Signal – COMTAC Hybrid IV		3.0	3.0	3.0	3.1	3.4
Atlantic Signal – Enforcer		2.4	2.3	2.5	2.7	2.1
	0 1 2 3 4 5					
	Key: 1 (least favorable) to 5 (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.

Table 4-2. Criteria Ratings

Key							
Category	Evaluation Criteria	Liberator II™	Invisio® X5	Peltor™ COMTAC ACH	Supreme® Pro	COMTAC Hybrid IV	Enforcer
Capability	Radio Communications Clarity						
	Decibel Reduction						
	Ambient Noise Amplification						
	Power						
Deployability	Durability						
	Accessories						
	Size						
	Color Options						
Usability	Comfort						
	Controls						
Maintainability	Product Support						
	Battery Accessibility						

Table 4-3 presents specifications found in the vendor-provided information for each assessed product. Although not always clearly stated in the provided information, all the vendors deliver a 1-year warranty for damages resulting during normal wear and tear.

Table 4-3. Key Specifications

Key Specification	Liberator II™	Invisio® X5	Peltor™ COMTAC ACH	Supreme® Pro	COMTAC Hybrid IV	Enforcer
Battery Type	AAA	AA	AAA	AAA	AAA	N/A ¹
Battery Runtime	600 hours	100 hours	500 hours	600 hours	250 hours	N/A ¹
Boom Microphone Configurable for Right or Left Hand	Y	N/A ²	Y	N	Y	Y
Alternate Helmet Mounting Options	N	N	Y ³	N	N ⁴	N
Color Options	Black Green	Black	Black Brown Green Camo	Black Brown	Green Coyote	Black
Weight w/PTT	20.55 oz.	15.35 oz.	23.00 oz.	21.10 oz.	17.85 oz.	12.40 oz.
Padding on Ear Cup	Y	N/A ⁵	Y	Y	Y	Y
OTH and/or BTH Strap	Both	N/A ⁶	Both	Both	Both	Both ⁷
Controls Optional for Right or Left Hand	N	N	N	N	Y	Y ⁷
Product Support	Phone or e-mail	Phone or e-mail	Phone or e-mail	Phone or e-mail	Phone or e-mail	Phone or e-mail

Notes:
 N/A: not applicable
 Y: yes
 N: no
¹ Runs on radio
² Bone conduction; no microphone
³ Proprietary mount for military use available
⁴ Arc rail mount on III model
⁵ No ear cups
⁶ No straps
⁷ Reconfigure from front to back

4.1 TCI™ Liberator II™

The TCI™ Liberator II™ (Figure 4-1) received an overall assessment score of 3.6 and costs \$641 as assessed. The PTT, batteries, a carrying bag, and a quick-start guide are included in the purchase.

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



Figure 4-1. TCI™ Liberator II™

Image courtesy of Safariland LLC

4.1.1 Capability

The Liberator II™ received a Capability score of 3.8. The following information is based on evaluator comments:

- As the decibel level increases, the headset adjusts for the decibel level of the sound.
- Communications, both incoming and outgoing, are clear and audible with no distortion; however, the boom microphone does not have 360° functionality.
- The power supply has a 4-hour shutoff battery-saving mode with warning tone when the battery level is low.

4.1.2 Deployability

The Liberator II™ received a Deployability score of 3.3. The following information is based on evaluator comments:

- The product is well constructed with robust cabling, but the boom microphone is loose at the headset connection.
- The boom microphone can be ordered in a right- or left-handed configuration.
- The headset fits under most ballistic helmets and remains in place when firing a weapon in standing, kneeling, and prone positions.

4.1.3 Usability

The Liberator II™ received a Usability score of 3.4. The following information is based on evaluator comments:

- Both the BTH and OTH straps provide good support, although the BTH is not adjustable and can cause the ear cups to put pressure on the ears.
- The fit is comfortable with most PPE; a gas mask must be worn over the headset, rather than under it.
- The controls are easy to access.

4.1.4 Maintainability

The Liberator II™ received a Maintainability score of 3.1. The following information is based on evaluator comments:

- The battery-replacement procedure is difficult; the direction of the battery replacement is not easily discernable, and a tool is sometimes needed to align the first battery.

4.2 TEA Invisio® X5

The TEA Invisio® X5 (Figure 4-2) received an overall assessment score of 3.4 and costs \$2,120 as assessed. The control module, adaptor cable for the radio, batteries, a user manual (hard copy and CD), a carrying bag, and a canal-tip kit are included in the purchase.



Figure 4-2. TEA Invisio® X5

Image courtesy of TEA

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

4.2.1 Capability

The Invisio® X5 received a Capability score of 3.3. The following information is based on evaluator comments:

- As the decibel level increases, the headset adjusts for the decibel level of the sound.
- Hearing protection is good, but there is a high-pitched buzz when firing a weapon.
- In addition to batteries, the headset also uses power from the communications device.
- The bone conduction configuration requires precise insertion of the ear tips into the ear canal; thus, there can be a sharp learning curve in the use of this technology.

4.2.2 Deployability

The Invisio® X5 received a Deployability score of 3.5. The following information is based on evaluator comments:

- The wires routinely get tangled.
- The lack of a boom microphone was a distinct advantage.
- The fit under a ballistic helmet is comfortable and does not interfere with the firing of a weapon in standing, kneeling, and prone positions.

4.2.3 Usability

The Invisio® X5 received a Usability score of 3.9. The following information is based on evaluator comments:

- Due to the configuration, donning PPE is a quick process. This product fits comfortably under a gas mask.
- The canal-tip kit contains three different sizes and lengths of ear buds (six choices).
- The control knobs are large for easy adjustment.

4.2.4 Maintainability

The Invisio® X5 received a Maintainability score of 3.2. The following information is based on evaluator comments:

- Batteries are easy to install, and the battery compartment is clearly labeled.

4.3 3M™ Peltor™ COMTAC ACH

The 3M™ Peltor™ COMTAC ACH (Figure 4-3) received an overall assessment score of 3.3 and costs \$1,831 as assessed. The PTT, batteries, a quick-start guide, a carrying bag, and helmet cushions are included in the purchase.

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



Figure 4-3. 3M™ Peltor™ COMTAC ACH

Image courtesy of Scientific Sales Inc.

4.3.1 Capability

The Peltor COMTAC ACH received a Capability score of 3.1. The following information is based on evaluator comments:

- Communications are clear, but adjustment to controls is required for receiving communications at all decibel levels. When set at full volume, the sound is too loud.
- The power supply has a 4-hour shutoff battery-saving mode with warning tone when the battery level is low.

4.3.2 Deployability

The Peltor COMTAC ACH received a Deployability score of 3.5. The following information is based on evaluator comments:

- The foam windscreens are flimsy and can easily fall out.
- The headset fits under most ballistic helmets except those with low-cut ears.
- Numerous color options are available including a camouflage version.

4.3.3 Usability

The Peltor COMTAC ACH received a Usability score of 3.2. The following information is based on evaluator comments:

- Both OTH and BTH straps are available, but the unpadded OTH is uncomfortable after a long period of time.
- The headset has to be worn over the gas mask, making it unbalanced and wobbly.
- The padded ear cup is quite comfortable.
- The microphone can be easily reconfigured in the field and rotated out of the way.

4.3.4 Maintainability

The Peltor COMTAC ACH received a Maintainability score of 3.2. The following information is based on evaluator comments:

- The two-compartment battery configuration requires extra time for battery changes.

4.4 MSA Supreme® Pro

The MSA Supreme® Pro (Figure 4-4) received an overall assessment score of 3.2 and costs \$1,650 as assessed. The PTT, batteries, a manual, and a kit with additional gel caps are included in the purchase.

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

4.4.1 Capability

The Supreme® Pro received a Capability score of 3.3. The following information is based on evaluator comments:

- All decibel levels are audible and clear except when firing a weapon; communication from the headset cut off.
- Adjustments to changes in decibel level were immediate; receiving of communications required no adjustments.
- The power supply has a 4-hour shutoff battery-saving mode with warning tone when the battery level is low.

4.4.2 Deployability

The Supreme® Pro received a Deployability score of 3.2. The following information is based on evaluator comments:

- Overall, the headset is quite rugged.
- The boom microphone is not reconfigurable.
- The headset fits under most ballistic helmets with little adjustment.

4.4.3 Usability

The Supreme® Pro received a Usability score of 3.3. The following information is based on evaluator comments:

- Both the OTH and BTH straps provide good support, but the OTH strap padding is not adequate.
- The headset fits well with all PPE, but a gas mask must be worn over the headset.
- The ear cups are well padded.



Figure 4-4. MSA Supreme® Pro

Image courtesy of MSA

4.4.4 Maintainability

The Supreme[®] Pro received a Maintainability score of 2.7. The following information is based on evaluator comments:

- Battery installation is difficult, sometimes requiring a tool for initial installation, and the correct battery orientation is unclear.

4.5 Atlantic Signal COMTAC Hybrid IV

The Atlantic Signal COMTAC Hybrid IV (Figure 4-5) received an overall assessment score of 3.0 and costs \$930 as assessed. The PTT, radio connection cable, ear tips, batteries, a carrying bag, and a manual are included in the purchase.



Figure 4-5. Atlantic Signal COMTAC Hybrid IV

Image courtesy of Atlantic Signal

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

4.5.1 Capability

The COMTAC Hybrid IV received a Capability score of 3.0. The following information is based on evaluator comments:

- Low-decibel communication is amplified and received without adjustment to controls, and there is excellent suppression of higher-decibel levels. However, if the ear tip is inserted too far into the ear canal, the amplification capability is decreased.
- There is a volume-boost mode that enables a high-volume setting, adding to the clarity.
- Transmission when firing a weapon is clear and audible with no interference.

4.5.2 Deployability

The COMTAC Hybrid IV received a Deployability score of 3.0. The following information is based on evaluator comments:

- The PTT operated well, but is easily broken at the connection tip.
- The fit is tight with both low-cut and high-cut ballistic helmets.
- There is no fit interference when firing a weapon in standing, kneeling, and prone positions.

4.5.3 Usability

The COMTAC Hybrid IV received a Usability score of 3.1. The following information is based on evaluator comments:

- The fit is very comfortable overall, but the ear-cup padding needs to be thicker.
- The inner-ear configuration slows down the donning of PPE.
- The boom microphone can be ordered for right- or left-handed use.

4.5.4 Maintainability

The COMTAC Hybrid IV received a Maintainability score of 3.4. The following information is based on evaluator comments:

- The two-compartment battery configuration requires extra time for battery changes.

4.6 Atlantic Signal Enforcer

The Atlantic Signal Enforcer (Figure 4-6) received an overall assessment score of 2.4 and costs \$965 as assessed. The PTT, radio-connection cable, ear tips, and a carrying bag are included in the purchase.

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



Figure 4-6. Atlantic Signal Enforcer

Image courtesy of Atlantic Signal

4.6.1 Capability

The Enforcer received a Capability score of 2.3. The following information is based on evaluator comments:

- Lower-decibel communication is not amplified, and there are no adjustment controls.
- Communication from the headset is cut off every time a weapon is fired.
- The product is powered solely from the radio.

4.6.2 Deployability

The Enforcer received a Deployability score of 2.5. The following information is based on evaluator comments:

- The ear buds can fall off easily, which negates the hearing protection, and the gel padding around the jawbone peels off easily.
- The cables are a heavy gauge, and the PTT clamp provides a secure grip.
- The boom microphone can be ordered for either right- or left-handed configuration.
- The product fits well under most ballistic helmets.

4.6.3 Usability

The Enforcer received a Usability score of 2.7. The following information is based on evaluator comments:

- The product is very lightweight.
- The BTH strap is adjustable, but the OTH strap is not.
- The configuration results in difficulty in donning safety glasses.
- Padding is very minimal.

4.6.4 Maintainability

The Enforcer received a Maintainability score of 2.1. The following information is based on evaluator comments:

- No batteries are required.

5. Summary

The evaluators found the assessed headsets to have a common battery type, where batteries were used. While none of the headsets were integrated with a helmet, the commercially available headsets do not provide for alternate mounting options. Padding is available on all ear cup models as are both OTH and BTH straps. For those headsets that incorporate ear buds, different sizes of ear tips are available to meet individual fit, as this can affect comfort. For this assessment, standard ear tips were ordered. Warranty expression is generally 1 year and based on normal use, and product support is available both by phone and e-mail for all headsets. None of the headsets failed to function at any time during the assessment. As displayed in Table 4-2, all of the headsets met some expectation for Clarity and Decibel Reduction. Except for the Enforcer, expectations were met for Amplification.

Emergency responder agencies that consider purchasing hearing protection with integrated radio communications should carefully consider each product’s overall capabilities and limitations in relation to their agency’s operational needs. The advantages and disadvantages for the assessed hearing protection with integrated radio communications are highlighted in Table 5-1.

Table 5-1. Product Advantages and Disadvantages

Vendor	Product	Advantages	Disadvantages
 <p>Cost: \$641</p>	<p>TCI Liberator II™</p> <p>Overall Score: 3.6</p>	<ul style="list-style-type: none"> • Long runtime • Battery compartment sealed and tethered • Waterproof battery compartment • Available in black or green • Controls easy to find and manipulate 	<ul style="list-style-type: none"> • Fixed boom microphone • Depending on cut of ballistic helmet, cheek weld can be difficult • Heavier weight
 <p>Cost: \$2,120</p>	<p>TEA Invisio® X5</p> <p>Overall Score: 3.4</p>	<ul style="list-style-type: none"> • Battery compartment sealed and tethered • Waterproof battery compartment • Low weight • Allows a good cheek weld 	<ul style="list-style-type: none"> • Short runtime • 10-second delay upon powering up • Heavy PTT

Vendor	Product	Advantages	Disadvantages
 <p>Cost: \$1,831</p>	<p>3M™ Peltor™ COMTAC ACH</p> <p>Overall Score: 3.3</p>	<ul style="list-style-type: none"> • Long runtime • Battery compartment sealed • Boom microphone can be moved right to left • Available in black, brown, green, or camouflage • Overall configuration allows for easy cheek weld 	<ul style="list-style-type: none"> • Battery compartment not tethered • Heavier weight • Controls available for left side only
 <p>Cost: \$1,650</p>	<p>MSA Supreme® Pro</p> <p>Overall Score: 3.2</p>	<ul style="list-style-type: none"> • Long runtime • Battery compartment sealed • Waterproof battery compartment • Available in black or brown • Controls easy to find and manipulate 	<ul style="list-style-type: none"> • Battery compartment not tethered • Fixed boom microphone • Difficult to get cheek weld
 <p>Cost: \$930</p>	<p>Atlantic Signal COMTAC Hybrid IV</p> <p>Overall Score: 3.0</p>	<ul style="list-style-type: none"> • Battery compartment sealed • Ear buds tethered • Available in green or coyote • Fully adjustable 	<ul style="list-style-type: none"> • Short runtime • Battery compartment not tethered • Heavier weight • Little uncomfortable obtaining good cheek weld
 <p>Cost: \$965</p>	<p>Atlantic Signal Enforcer</p> <p>Overall Score: 2.4</p>	<ul style="list-style-type: none"> • No battery • Multiple PTT options • Light weight • Easy access controls 	<ul style="list-style-type: none"> • Fragile inner-ear wires • Poor fit with most helmets • Only one color option

Appendix A. Evaluation Criteria Definitions

The focus group identified 12 evaluation criteria, which are defined as follows.

Capability

Radio Communications Clarity refers to the clarity of radio transmission and reception.

Decibel Reduction refers to the device being able to safely reduce hazardous ambient sounds while simultaneously providing the user with continuous situational awareness. Decibel Reduction also includes whether the product is able to lower ambient sounds (e.g., gunshot) to a safe level or if it cuts out all sound completely when high decibel levels are present. Focus group participants noted the decibel level should not be too low as to cut out conversations during operation (e.g., a nearby siren).

Ambient Noise Amplification refers to how well the device is able to amplify ambient noise to increase clarity.

Power refers to the battery runtime and battery type(s) used by the product (e.g., rechargeable or single use, commercially available or proprietary).

Deployability

Durability refers to the overall ruggedness of the device, including the durability/sturdiness of the boom microphone and buttons/controls. Durability also takes into account features like covered ports and/or seals on the battery compartment.

Accessories refers to the option to purchase different rail mounts and the availability of right- or left-handed boom microphones and/or controls.

Size refers to the overall size of the headset. Focus group participants noted the size of the headset should not interfere with safety glasses, helmets, or firing a weapon.

Color Options refers to the available color options for the headset.

Usability

Comfort refers to the overall fit and comfort of the headset. Factors that may affect comfort include design (e.g., adjustability, style and type of earpiece, over-the-head or behind-the-head strap, padding on the headpiece) and weight. Focus group participants noted that headsets can become uncomfortable after extended periods of use and safety glasses, gas masks, and helmets may affect comfort.

Controls refers to the location of the controls and how easily they can be manipulated. Controls also includes the location of the microphone and whether the microphone is configurable for left- or right-handed use.

Maintainability

Product Support refers to the duration and terms of the warranty, as well as the availability and contact methods for technical support.

Battery Accessibility refers to the ease of replacing the batteries, including whether or not tools are required to access the battery compartment.

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

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

Category Score Example¹

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

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

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

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

¹Examples are for illustration purposes only. Formulas will vary depending on the number of criteria and categories assessed and the criteria and category weights.