Tactical Eyewear Protection Equipment

Assessment Report

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The cover photo and images included herein were provided by the National Urban Security Technology Laboratory, unless otherwise noted.

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 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, radiological, nuclear and explosive weapons detection; emergency response and recovery; and related equipment, instrumentation and technologies. In support of this tasking, NUSTL developed this report to provide emergency responders with information obtained from an operationally oriented assessment of tactical eyewear, which fall under AEL reference number 01ZA-03-EYEP, titled Protection, Eye.

For more information on NUSTL's SAVER Program or to view additional reports on tactical eyewear, visit www.dhs.gov/science-and-technology/SAVER.

U.S. Department of Homeland Security

SAVER

System Assessment and Validation for Emergency Responders

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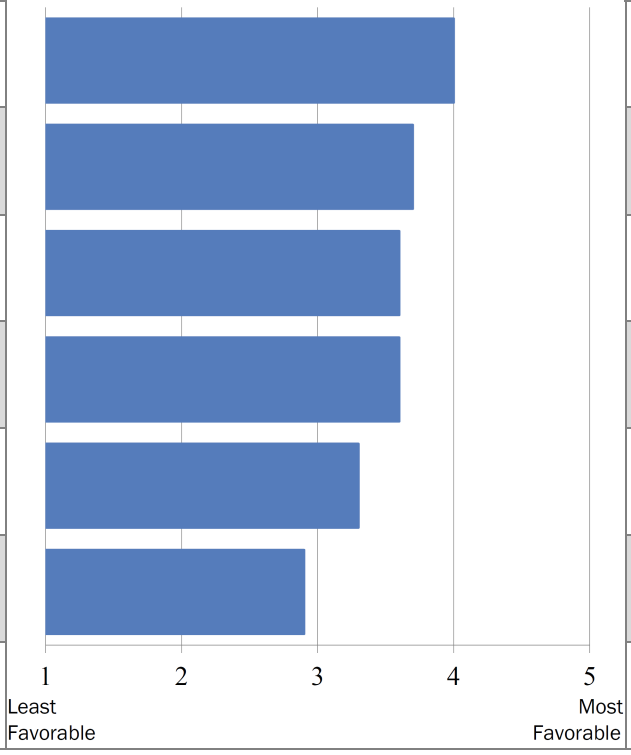
EXECUTIVE SUMMARY

In June 2019, the U.S. Department of Homeland Security's National Urban Security Technology Laboratory (NUSTL) conducted an operationally oriented assessment of tactical eyewear under its System Assessment and Validation for Emergency Responders (SAVER) Program.

Twelve products were assessed by emergency responders at the U.S. Army Combat Capabilities Development Command Soldier Center in Natick, Massachusetts. The eyewear products came from six different manufacturers—a pair of spectacles or glasses and a pair of goggles from each manufacturer was assessed during operational scenarios against a set of evaluation criteria. The evaluation criteria and operational scenarios used in this assessment were developed based on the input from a focus group of emergency responders with experience using tactical eyewear. The assessment addressed 22 evaluation criteria in four SAVER categories: capability, deployability, maintainability and usability.

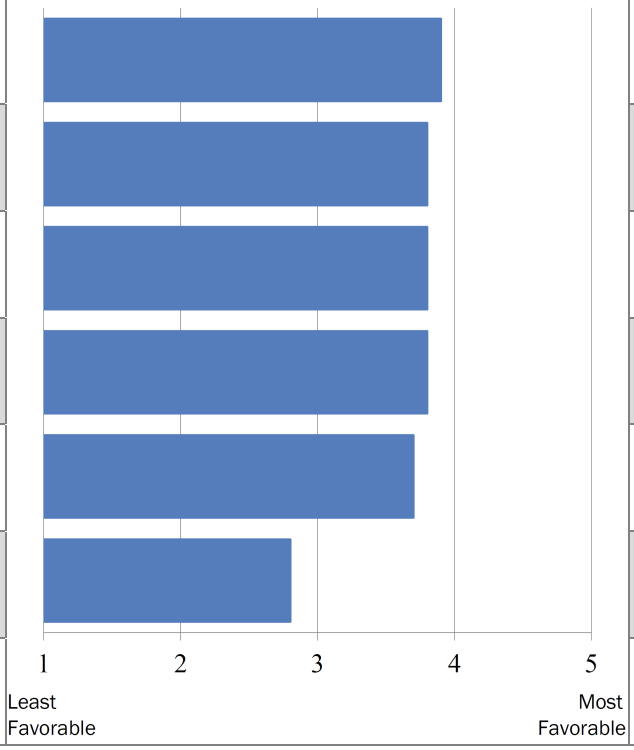
The results of the assessment of tactical spectacles are highlighted in the below table. Overall, the most favorable spectacles were the Wiley-X Vapors, which had the highest scores in the usability and maintainability categories. The Revision Stingerhawks did not score the highest in any of the four categories, but were rated second among spectacles. The Smith Optics Aegis and ESS Crossblade spectacles both scored 3.6 overall.

Tactical Spectacle Scoring

Spectacles Product	Overall Score	Overall	Usability	Capability	Maintainability	Deployability
Wiley-X Inc. Vapor		**4.0**	3.9	4.0	4.1	3.8
Revision Military Inc. Stingerhawk		**3.7**	3.7	3.8	3.8	3.6
Smith Optics Inc. Aegis		**3.6**	3.6	3.7	3.4	4.0
Eye Safety Systems (ESS) Inc. Crossblade		**3.6**	3.8	4.1	2.5	4.0
Oakley Inc. SI Ballistic M-Frame 2.0		**3.3**	3.4	3.9	2.0	3.8
Honeywell Safety Products SAS Uvex XMF		**2.9**	3.1	3.3	1.8	3.8

The results of the assessment of tactical goggles are highlighted in the below table. Overall, the most favorable goggles were the Smith Optics Outside the Wire, which had the highest maintainability score and tied for the highest scores in the capability and deployability categories. The Revision Bullet Ant, Wiley-X Spear and ESS Influx goggles were all given the same overall score, followed closely by the Oakley SI Ballistic Goggle 2.0.

Tactical Goggle Scoring

Goggles Product	Overall Score	Overall	Usability	Capability	Maintainability	Deployability
Smith Optics Inc. Outside the Wire		**3.9**	3.6	4.0	4.4	3.9
Revision Military Inc. Bullet Ant		**3.8**	4.0	4.0	3.8	2.9
Wiley-X Inc. Spear		**3.8**	3.7	3.9	4.3	3.0
Eye Safety Systems (ESS) Inc. Influx		**3.8**	3.9	4.1	3.4	3.9
Oakley Inc. SI Ballistic Goggle 2.0		**3.7**	3.9	3.9	3.3	3.7
Honeywell Safety Products SAS Uvex XMF		**2.8**	3.0	3.4	1.9	2.9

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1.0 INTRODUCTION

Tactical eyewear is used by police officers, firefighters, paramedics and other emergency responders to protect their eyes from hazards during field operations. Common hazards include bullet fragments, blunt objects, chemicals, blood and other biohazards. The scope of this project is focused on spectacles and goggles.

From June 4–6, 2019, the U.S. Department of Homeland Security (DHS), Science & Technology Directorate (S&T), National Urban Security Technology Laboratory's (NUSTL), System Assessment and Validation for Emergency Responders (SAVER) Program conducted an operationally oriented assessment of tactical eyewear at the U.S. Army Combat Capabilities Development Command (CCDC) Soldier Center in Natick, Massachusetts. The purpose of this assessment was to obtain information on tactical eyewear—both spectacles and goggles—that will be useful to first responder agencies making operational and procurement decisions. This assessment was planned based on input made by seven first responders experienced with tactical eyewear who participated in a SAVER focus group held at the CCDC Soldier Center.

1.1 Evaluator Information

Seven emergency responder evaluators from various jurisdictions and with at least 5 years of experience using tactical eyewear participated in the assessment. Evaluator information is listed in Table 1-1. Evaluators were selected by NUSTL and by the CCDC Soldier Center based on their respective responder discipline, geographic location and professional experience, as well as their operational experience using tactical eyewear. Evaluators were asked to sign an Informed Consent Form and Rules of Behavior (ROB) prior to the assessment, which was reviewed and approved by the DHS S&T Office of General Counsel and DHS S&T Privacy Office. The ROB included a Privacy Act notice regarding personally identifiable information and a photo/video release clause.

Table 1-1 Evaluator Information

Evaluator	Years of Experience	State
Fire Service, Firefighter/Paramedic	20+	MA
Fire Service, Firefighter	20+	VA
Law Enforcement, Special Weapons and Tactics (SWAT)	20+	WA
Law Enforcement, SWAT	15—20	MA
Law Enforcement, Bomb Squad	10—15	AZ
Fire Service, Firefighter/Paramedic	10—15	MA
Law Enforcement, SWAT	5—10	MA

1.2 Evaluator Equipment

Evaluators were asked to bring the following equipment that they might normally wear during an emergency response to the assessment:

- Personal protective equipment (PPE) such as gloves and helmets.
- Hearing protection devices that they normally wear for their jobs.
- Optical aids such as binoculars or night vision devices that they normally use for their jobs.
- Prior to the assessment, the evaluators' ophthalmologists provided their eyeglass prescriptions to the Naval Ophthalmic Support and Training Activity (NOSTRA) in Yorktown, Virginia, so that vision corrective lenses could be made in the universal prescription lens carrier (UPLC) format that is compatible with most tactical eyewear products. Six of the seven evaluators sent prescriptions that were filled. These evaluators wore the corrective lens inserts underneath their tactical eyewear during assessment activities. The other evaluator did not need vision correction.
- It should be noted that the UPLC lens inserts were made without anti-fog coating and that most evaluators had their inserts fog up during strenuous activities. The tactical eyewear products being assessed all had anti-fog coating and the scores and comments related to the anti-fog capability of the eyewear did not reflect the fogging of the prescription inserts.
- It should also be noted that the Oakley Inc. spectacles product did not come with a nosepiece that fit the UPLC inserts, so this product could not be tested with vision correction capability.

1.3 Assessment Products

Twelve tactical eyewear products from six vendors were selected for the assessment, including the six spectacles listed in Table 1-2 and the six goggles listed in Table 1-3. The products selected for assessment were identified through market research and selected according to product selection criteria identified by the focus group, including:

- Must meet ANSI Z87.1 standard for protection from impact, ionizing radiation and liquid splash hazards.
- Must have two or more lens types that are interchangeable and can be replaced.
- Must exceed the ANSI Z78.1 standard for ballistic rating.

In addition to meeting the product selection criteria, each product was on the Authorized Protective Eyewear List (APEL) of products tested and approved by the U.S. military.

Table 1-2 Spectacle Products Assessed

Vendor	Product	Product Image
Eye Safety Systems Inc.	Crossblade Spectacle	
Honeywell Safety Products SAS	Uvex XMF Tactical Eyewear	
Oakley Inc.	SI Ballistic M-Frame 2.0 Spectacle	
Revision Military Inc.	Stingerhawk Spectacle	
Smith Optics Inc.	Aegis Spectacle	
Wiley-X Inc.	Vapor Spectacle	

Note that all product images in Table 1-2 are courtesy of their respective vendors.

Table 1-3 Goggle Products Assessed

Vendor	Product	Product Image
Eye Safety Systems Inc.	Influx Goggle	
Honeywell Safety Products SAS	Uvex XMF Goggle	
Oakley Inc.	SI Ballistic Goggle 2.0	
Revision Military Inc.	Revision Bullet Ant Goggle	
Smith Optics Inc.	Outside the Wire Goggle	
Wiley-X Inc.	Spear Goggle	
Note that all product images in Table 1-3 are courtesy of their respective vendors.		

2.0 EVALUATION CRITERIA

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

- **Affordability** criteria relate 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** criteria relate to product features or functions needed to perform one or more responder relevant tasks.
- **Deployability** criteria relate to preparing to use the product, including transport, setup, training and operational/deployment restrictions.
- **Maintainability** criteria relate to the routine maintenance and minor repairs performed by responders, as well as included warranty terms, duration and coverage.
- **Usability** criteria relate to ergonomics and the relative ease of use when performing one or more responder relevant tasks.

The focus group of emergency responders identified 28 evaluation criteria within the five SAVER categories — see Table 2-1. 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. They also assigned a percentage to represent each category's importance relative to the other categories such that the percentage scale totaled to 100 percent. These weightings were factored into the calculation of numerical assessment scores using the formulas in Appendix A.

The products were assessed against 22 criteria because 6 criteria were specified by the focus group as "information only." Details for four information-only criteria were acquired from the vendor's website and product literature or through inquiries with vendor representatives. The other two information-only criteria were not able to be obtained during this assessment. Data related to Heat and Cold Resistance was not readily available from the vendors. Information on Compatibility with Body Cameras was not included because this capability was not applicable to any of the assessed products.

Table 2-1 lists the evaluation criteria identified by the focus group, the assessment categories they were assigned to and the weights assigned to the evaluation criteria and assessment categories. Evaluation criteria definitions can be found in Appendix A.

Table 2-1 Evaluation Criteria

SAVER CATEGORIES				
Usability	**Capability**	**Maintainability**	**Deployability**	**Affordability**[i]
Overall Weight 35%	Overall Weight 30%	Overall Weight 25%	Overall Weight 10%	Overall Weight 0%
Evaluation Criteria				
Compatibility with Hearing Protection Weight: 5	**Fit** Weight: 5	**Durability** Weight: 4	**Ease of Changing Lenses** Weight: 3	**Cost** Information only
Compatibility with Masks/Respirators Weight: 5	**Visual Acuity** Weight: 5	**Scratch Resistance** Weight: 4	**Carrying Case Quality** Weight: 3	**Replacement Lens Cost** Information only
Compatibility with Headgear Weight: 5	**Adaptability (Multi-Use)** Weight: 4	**Ease of Cleaning and Disinfecting** Weight: 4	**Stowability on the Head** Weight: 2	
Accommodates Vision Correction Weight: 5	**Lens Type Options** Weight: 3	**Resistance to Chemicals** Weight: 2	**Availability in Different Sizes** Information only	
Comfort Weight: 4	**Heat and Cold Resistance** Information only	**Warranty** Information only	**Compatibility with Body Cameras** Information only	
Field of View Weight: 4	**Anti-fog** Weight: 3			
Use with Optical Aids Weight: 4	**Stylish** Weight: 2			
Retention System Weight: 2	**Frame Color** Weight: 1			

[i] Affordability was not given a weight based on the Tactical Eyewear Focus Group, where participants indicated that this information should not be scored but be provided as a part of the specifications during the assessment.

3.0 ASSESSMENT METHODOLOGY

The tactical eyewear assessment took place from June 4 to June 6, 2019, at the CCDC Soldier Center. The assessment began with a safety briefing, which was followed by an overview of NUSTL, the SAVER Program and the assessment plan. The seven evaluators were then paired into three teams: two teams of two people and one team of three people. Through a series of rotations, each team sequentially assessed 12 tactical eyewear products. Products were assessed in a three-part process consisting of a familiarization session, a hands-on operational assessment and an evaluator debrief session, as described below. All assessment activities took place under the guidance of NUSTL personnel.

3.1 Phase I – Familiarization Session

In this session, a representative from four of the manufacturers[ii] were present to provide the evaluators with an overview of the eyewear specifications and train them on how to change lenses. For the products whose manufacturers were not present, a subject matter expert (SME) from the CCDC Soldier Center provided the overview and training.

Figure 3-1 First Responders during the Familiarization Session

3.2 Phase II – Hands-On Operational Assessment

This phase of the assessment took place throughout the campus of the CCDC Soldier Center. During the hands-on 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 SME and manufacturers assisted the evaluators with product familiarization, and evaluators had access to the reference material included with each product. The products were assessed in four scenarios: (1) emergency medical response, (2) firearm usage[iii], (3) search and (4) physical training. Evaluators used the products one at a time and were guided through the rotations by a NUSTL staff member.

3.2.1 Emergency Medical Response

During this scenario, evaluators wore medical N95 masks, which cover the nose and mouth to protect the user from specific air-borne hazards, in-ear protection and the tactical eyewear products, with clear lenses being assessed. Evaluation criteria assessed during this scenario included compatibility with masks, compatibility with headgear and fit. Activities in this scenario included:

[ii] Vendor representatives from Eye Safety Systems Inc., Oakley Inc., Revision Military Inc. and Smith Optics Inc. were present and gave equipment familiarization sessions and were available to answer questions throughout the assessment. Honeywell Safety Products SAS and Wiley-X Inc. declined to send a representative.
[iii] Note that fire service focused evaluators did not participate in the firearm operational assessment as it did not align with their standard operational duties.

Part 1: Cardiopulmonary Resuscitation (CPR)–Evaluators found a CPR mannequin on the floor indoors and performed CPR on the mannequin for several minutes. While performing CPR, a NUSTL staff member used a plastic spray bottle, squeezing the trigger at least twice to spray water at the evaluator's tactical eyewear, to simulate a spurt of blood.

Part 2: Evacuation–Following the performance of CPR, the evaluators inspected their eyewear and cleared any water if it penetrated, then proceeded to lift the mannequin from the floor onto a gurney and transported the mannequin a short distance to a pre-identified evacuation area.

Part 3: Helicopter Draft–Near the evacuation area, a high-speed fan was turned on to blow around air and dust—simulating wind from a helicopter—allowing the evaluators to gauge fit and seal effectiveness to determine how effective the tactical eyewear is in protecting the eyes from wind-borne hazards.

Figure 3-2 Assessing Tactical Eyewear During the Emergency Medical Response Scenario
First Responders Administering CPR while Wearing Spectacles and an N95 Mask (Left); Transporting a Mannequin while Wearing Spectacles and an N95 Mask (Center); and Testing Spectacles in Front of a High Speed Fan (Right)

3.2.2 Firearm Usage

During this scenario, evaluators wore a combination of the evaluator's tactical helmets; hearing protection and the tactical eyewear being assessed with both clear and either dark or colored (e.g., yellow) lenses. Evaluation criteria being assessed during this scenario included compatibility with hearing protection, compatibility with headgear, use with optical aids, fit and visual acuity. Activities in this scenario included:

Part 1: Rifle (without Helmet)–Evaluators used a Laser Shot Airsoft rifle with scope to aim and shoot at a target mounted at an approximate distance of 100 meters. The rifle had the approximate recoil of an actual firearm but did not fire any projectiles. Evaluators used both the clear and dark or colored lenses of the spectacles and goggles with in-ear and over-the-ear hearing protection. The focus of this scenario was to assess the eyewear's compatibility with hearing protection and a rifle scope.

Part 2: Rifle (with Helmet)–Evaluators used an Airsoft rifle with scope to aim at a target mounted at an approximate distance of 100 meters. They used both the clear and dark or colored lenses of the spectacles and goggles with in-ear and over-the-ear hearing protection in combination with a tactical ballistic helmet. The focus of this scenario was to assess the eyewear's compatibility with headgear, hearing protection and a rifle scope.

Note that the assessment plan called for the use of a mock handgun as well, but this did not occur during the scenario activities as the mock rifle provided the evaluators with enough insight to assess the eyewear's compatibility with firearm usage.

Figure 3-3 First Responders Wearing Goggles with a Helmet at the Firearm Usage Scenario

3.2.3 SEARCH

During this scenario, evaluators wore the tactical eyewear being assessed with both clear and dark lenses. In some scenarios, additional equipment (i.e., binoculars and a night vision monocle) was used. Evaluation criteria being assessed during this scenario included field of view, use with optical aids, visual acuity, adaptability (multi-use) and ease of changing lenses. Activities in this scenario included:

Part 1: Binocular Search–Evaluators used binoculars while wearing tactical eyewear in an outdoor setting to find and read building and street signs at a distance.

Part 2: Outdoor Search–Evaluators transitioned their tactical eyewear lenses to a dark shade (i.e., grey, smoke) and conducted an outdoor search in both direct sunlight and a covered entry way. During the outdoor search they tried to identify three objects: a mock radio, a mock knife and mock handguns.

Part 3: Indoor Search–During the indoor search, evaluators searched rooms with lights on and with sunlight through windows and low-light conditions with lights off and window blinds closed, while wearing both clear and dark lenses. Items to be identified in the search included mock handguns and mock grenades.

Part 4: Dark Search–Evaluators searched a dark room for objects, with both clear and dark lenses in their tactical eyewear. Additionally, they used a night vision monocle to assist in identifying dark objects in the dark room, including a mock handgun and mock grenade.

Figure 3-4 Assessing Tactical Eyewear During the Search Scenario
First Responder Wearing Spectacles during the Binocular Search (Left); First Responder Wearing a Clear Lens in Goggles with Night Vision during the Indoor Search (Center) and While Wearing a Dark Lens in Goggles during the Indoor Search (Right)

3.2.4 Physical Training

During a portion of this scenario, evaluators wore half-faced air-purifying respirator (APR) masks, helmets and the tactical eyewear being assessed with clear lenses. During some rotations, additional protective equipment was worn, including knee pads and elbow pads. Evaluation criteria being assessed during this scenario included compatibility with masks, field of view, retention system, anti-fog, carrying case quality and stowability on the head. Activities in this scenario included:

Part 1: Obstacle Course–Evaluators went through a training obstacle course known as the Load Effects Assessment Program (LEAP) in which they crawled through a tunnel, climbed stairs, climbed a ladder, walked a balance beam and jumped over a wall. Note that following the first rotation, the test director determined that since the obstacle course scenario and hazardous material drill scenario included the same activities, moving forward in the assessment, only the hazardous material drill scenario would be conducted.

Part 2: Hazardous Material Drill–During this scenario, evaluators donned a half-faced APR mask and repeated the LEAP. No hazardous materials were present.

Figure 3-5 First Responders Completing the LEAP during the Physical Training Scenario

3.3 Destructive Testing

After all rotations of the operational assessment were completed, evaluators engaged in destructive testing to aid in scoring the following criteria: resistance to chemicals, scratch resistance and durability.

Note: the destructive testing that took place during the assessment was not conducted to manufacturers specifications and in some instances was designed to exceed normal wear and tear. This testing was driven by the desire of the users to test the equipment to failure. While scoring this category, evaluators took into account their usage of the equipment and the overall wear-and-tear and points of failure of the product over the two days of testing.

3.3.1 Scratch Resistance

On the final day of the assessment, the tactical eyewear lenses were tested with three different abrasive products to determine their scratch resistance. They were first rubbed with rough paper towels, followed by a commercially available plastic dish scouring pad and finally with a commercially available stainless-steel scouring pad. At the end of this activity, scratched lenses were discarded, and new lenses were inserted for the resistance to chemicals testing.

Figure 3-6 Assessing Scratch Resistance
First Responder Attempting to Scratch Lenses (Left); Spectacles Following Scratch Resistant Testing (Right)

3.3.2 Resistance to Chemicals

On the afternoon of the second day of the assessment, following the completion of all the hands-on operational activities, three substances were applied to the lenses of the eyewear products and allowed to sit overnight. Commercially available sunscreen with a sun protection factor of 30 was applied to the exterior half of the left lens of each product. Commercially available insect repellent with seven percent N, N-Diethyl-meta-toluamide (DEET) was applied to the outer half of the right lens of each product. Finally, rubbing alcohol was applied to the interior half of each lens. All three chemicals were applied on the inside and outside of the lenses. The next morning, the evaluators cleaned and examined the lenses to see if any of the substances damaged or impacted the lenses in any way.

Figure 3-7 Assessing Resistance to Chemicals
Goggle Lens with Chemicals Applied (Left);
Spectacle Lens with Chemicals Applied (Right)

3.3.3 Durability

Each tactical eyewear product was put through several destructive tests for durability. First, they were folded inwardly so that the two lenses touched each other and were then straightened out. Then they were dropped from six feet onto a tile floor. After this, they were banged roughly against a hard table for approximately 30 seconds. Following the durability testing, the evaluators inspected each product.

Figure 3-8 Assessing Durability
Spectacles After Being Folded Inward (Left);
First Responders Conducting Durability Testing on Goggles (Right)

3.4 Data Gathering and Analysis

Each evaluator was given vendor-provided product information and specifications and a copy of the 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* my expectations for this criterion
5) The product *exceeds* my expectations for this criterion.

Criteria that were rated multiple times throughout the assessment activities were assigned overall ratings by the individual evaluators. Facilitators captured advantages and disadvantages for the assessed products as well as general comments on the tactical eyewear 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 adjust as necessary.

At the conclusion of the 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.

4.0 ASSESSMENT RESULTS

Two types of tactical eyewear products—spectacles and goggles—were assessed. The results for spectacles are presented in Section 4.1 and the results for goggles are presented in Section 4.2.

4.1 SPECTACLES RESULTS

Overall scores for the assessed spectacles products ranged from 4.0 to 2.9. 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 for Spectacles

Spectacles Product	Overall Score	Overall	Usability	Capability	Maintainability	Deployability
Wiley-X Inc. Vapor Spectacle		**4.0**	3.9	4.0	4.1	3.8
Revision Military Inc. Stingerhawk Spectacle		**3.7**	3.7	3.8	3.8	3.6
Smith Optics Inc. Aegis Spectacle		**3.6**	3.6	3.7	3.4	4.0
Eye Safety Systems Inc. Crossblade Spectacle		**3.6**	3.8	4.1	2.5	4.0
Oakley Inc. SI Ballistic M-Frame 2.0 Spectacle		**3.3**	3.4	3.9	2.0	3.8
Honeywell Safety Products SAS Uvex XMF Spectacle		**2.9**	3.1	3.3	1.8	3.8
	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. N/A appears for the Oakley (SI Ballistic M-Frame) spectacles vision correction accommodation because the prescription inserts were not compatible with the universal prescription lens carrier. N/A also appears for the Oakley's resistance to chemicals because the spectacles that were treated with chemicals could not be found the next day.

Table 4-2 Product Criteria Ratings

Lowest Rating → Highest Rating 		Product Name					
Category	**Evaluation Criteria**	**Vapor**	**Stinger-hawk**	**Aegis**	**Cross-blade**	**SI Ballistic M-Frame**	**Uvex XMF**
Usability	Compatibility with Hearing Protection						
	Compatibility with Masks/Respirators						
	Compatibility with Headgear						
	Accommodates Vision Correction					N/A	
	Comfort						
	Field of View						
	Use with Optical Aids						
	Retention System						
Capability	Fit						
	Visual Acuity						
	Adaptability (Multi-Use)						
	Lens Type Options						
	Anti-fog						
	Stylish						
	Frame Color						

Lowest Rating → Highest Rating		Product Name					
Category	Evaluation Criteria	Vapor	Stinger-hawk	Aegis	Cross-blade	SI Ballistic M-Frame	Uvex XMF
Maintainability	Durability						
	Scratch Resistance						
	Ease of Cleaning and Disinfecting						
	Resistance to Chemicals					N/A	
Deployability	Ease of Changing Lenses						
	Carrying Case Quality						
	Stowability on the Head						

Table 4-3 presents vendor-provided key specifications for the assessed products.

Table 4-3 Key Product Specifications

Key Specification	Vapor	Stinger-hawk	Aegis	Crossblade	SI Ballistic M-Frame	Uvex XMF
Kit MSRP	$60	$70	$40	$125	$190	$40
Replacement Lens Cost	$15	$18	$10	$30	$65	$11
Warranty Duration	Limited Lifetime Warranty	3 years	Lifetime Warranty	5 years	2 years	Lifetime Frame Guarantee
Size Availability	One size	Regular, Large	Regular, Compact, Wide	Regular, Narrow	One size	One size
Frame Color Options	Black, Tan	Black	Black, Tan	Black, Tan	Black, Bone, Dark Bone, MultiCam[iv]	Black
Lens Type Options	Clear, Dark Gray, Rust	Clear, Dark Gray, Yellow, Vermillion, Green (laser)	Clear, Dark Gray, Yellow, Ignitor (red)	Clear, Dark Gray, Yellow, Bronze, Copper	Clear, Dark Gray, Persimmon, Rust, Purple, Light Red	Clear, Dark Gray, Yellow

[iv] Multicam is a camouflage pattern design

4.1.1 Wiley-X Inc. Vapor Spectacle

The Vapor Spectacle (Figure 4-1) received an overall assessment score of 4.0 and costs $60 for a kit with frames, clear and dark lenses, a cleaning cloth and a carrying case. A replacement lens costs $15.

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

Figure 4-1 Vapor Spectacle
Courtesy of Wiley-X Inc.

Usability

The Vapor Spectacle received a usability score of 3.9. The following information is based on evaluator comments[v]:

Hearing Protection: Evaluators felt that the Vapor worked well with in-ear and over-the-ear hearing protection devices. One evaluator noted that even with thick temples on the Vapor, they still held snug to the face when used with over-the-ear hearing protection.

Masks/Respirators: Most evaluators thought that the Vapor fit well with their mask; however, one evaluator stated that his mask and respirator pushed the prescription inserts up too high and caused some distortion of vision.

Headgear: All evaluators reported good compatibility with headgear.

Vision Correction: While most evaluators gave a high rating to the prescription insert capability on the Vapor, one commented that it was slightly difficult to install and another stated that the prescription lenses were a little too close to the face and made contact with his eyelashes.

Comfort: Some evaluators found the Vapor to be very comfortable and others were bothered by the hard-plastic temples that put pressure on the ears and tended to slide back and forth.

Field of View: All evaluators agreed that the vapor gave them a wide field of view.

Optical Aids: The Vapor did well with the night vision and rifle scope, but evaluators thought that vision was distorted somewhat with the binoculars due to the large width and vertical curvature of the spectacles. One evaluator stated that they pushed into his eyes when using the binoculars.

Retention System: The Vapor came with an elastic retention strap that evaluators found adequate.

Capability

The Vapor Spectacle received a capability score of 4.0. The following information is based on evaluator comments:

Fit: One of seven evaluators reported that water got in during the CPR spray test and another reported feeling a lot of wind get under the spectacles.

[v] Comments are organized under criteria headings for each product. Criteria headings are not included if there were no significant comments recorded.

One evaluator commented that the lenses sat farther away from the face than with other products. Two evaluators thought the fit might be improved with less width and that they would stay in place better by eliminating the hard plastic on the temples.

Visual Acuity: Evaluators thought that the visual acuity of the Vapor exceeded expectations and that the tint on the dark gray lenses was the proper amount for reducing sunlight and still being able to distinguish colors in low-light areas.

Lens Type Options: A rust colored lens was available as an option. Evaluators would have liked to have a yellow lens option as well.

Anti-fog: The lenses on the Vapor did not fog at all during physical training or other scenarios. This exceeded expectations.

Stylish: The Vapor got mixed reviews on style with scores ranging from 1 to 4. Some evaluators would choose to wear the Vapor off duty and others definitely would not.

Frame Color: Black and tan frame color options were adequate for the evaluators.

Maintainability

The Vapor Spectacle received a maintainability score of 4.1. The following information is based on evaluator comments:

Durability: The Vapor held up well over the two days of testing and survived the fold-and-bend destructive test.

Scratch Resistance: The Vapor had only minor damage even after the stainless-steel scrubbing pad was applied, exceeding evaluator expectations.

Ease of Cleaning: The Vapor came with a cleaning cloth and was fairly easy to clean with water.

Resistance to Chemicals: The Vapor lenses had minor damage that could be seen only with a careful inspection after an overnight application of sunscreen, insect repellant and alcohol.

Deployability

The Vapor Spectacle received a deployability score of 3.8. The following information is based on evaluator comments:

Ease of Changing Lenses: Four evaluators found it easy to change lenses while three had some difficulty getting the lenses into the notches in the frame and snapping them in. One evaluator commented that the nosepiece had to be taken off to change lenses and it was difficult to put back on.

Carrying Case Quality: The Vapor came with a rigid zippered carrying case that met evaluator expectations.

4.1.2 Revision Military Inc. Stingerhawk Spectacle

The Stingerhawk Spectacle (Figure 4-2) received an overall assessment score of 3.7 and costs $70 for a kit with frames, clear and dark lenses, cleaning liquid, cleaning cloth and a carrying case. A replacement lens costs $18.

Figure 4-2 Stingerhawk Spectacle
Courtesy of Revision Military Inc.

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

Usability

The Stingerhawk Spectacle received a usability score of 3.7. The following information is based on evaluator comments:

Hearing Protection: The thin frames and temples on the Stingerhawk made it highly compatible with in-ear and over-the-ear hearing protection devices, according to evaluators.

Masks/Respirators: Evaluators stated that the N95 mask and half-faced respirator pushed the lenses up. Some evaluators were not bothered by this because the corrective lenses sit lower on the Stingerhawk and so were pushed up to an acceptable height. However, one evaluator said that the corrective lenses were pushed up too high, making it difficult to see. Another evaluator could not get a good fit with the respirator on.

Headgear: Evaluators felt that there was generally good compatibility with their headgear. One evaluator, however, stated that his fire helmet tended to push the lenses up and caused discomfort by pushing the hard-plastic temples down on his ears.

Vision Correction: Evaluators liked the adjustable nosepiece on the Stingerhawk, which allowed the prescription insert to be adjusted for a proper fit for most evaluators. With other products, the insert positioning was hit or miss and could not be adjusted. Some evaluators could not get a good fit even with the adjustment. One stated that the lenses were too close and brushing against his eyelashes and another had limited downward vision.

Comfort: Evaluators were generally satisfied with the comfort of the Stingerhawk and liked the thin temples. One evaluator, however, still felt pressure and discomfort around the ears. Another stated that the temples were straighter than on other products and this was bothersome after a while.

Field of View: The Stingerhawk scored well on field of view; however, one evaluator noticed some peripheral vision distortion that was perhaps due to the width of the spectacles.

Optical Aids: Evaluators felt that the Stingerhawk performed very well with binoculars and provided a better field of view through binoculars than other products. This was especially true with the darker lenses. They also performed well with night vision and rifle scopes.

Retention System: The Stingerhawk had an elastic retention strap that secured the spectacles well, but one evaluator said it pinched his face when performing CPR.

Capability

The Stingerhawk Spectacle received a capability score of 3.8. The following information is based on evaluator comments:

Fit: The Stingerhawk fit evaluators differently, with some more satisfied than others. Several evaluators thought they were too low-cut and that foreign objects could get in from the bottom. On the other hand, the adjustable nosepiece was a nice feature and allowed the prescription inserts to be adjusted.

Visual Acuity: One evaluator noticed peripheral vision distortion and another commented that outside light got in at times due to the low-cut shape of the spectacles. Other evaluators were not bothered by those issues. Evaluators agreed that the tint on the dark gray lenses was the right amount as they could see well in sunshine and still distinguish objects in shade and indoors.

Lens Type Options: Besides the standard clear and dark gray lenses that come with the kit, options of yellow, vermillion and green laser protection lenses are available. Only the yellow lenses were purchased for the assessment. Evaluators were satisfied with these options.

Anti-fog: The lenses on the Stingerhawk did not fog for any of the evaluators even though the prescription insert lenses, which did not have anti-fog coating, fogged during the physical training scenarios.

Stylish: The Stingerhawk received scores ranging from 1 to 4. Some evaluators would choose to wear these spectacles off duty and others definitely would not.

Frame Color: The Stingerhawk comes with black frames only. Evaluators would have liked to see at least a tan option.

Maintainability

The Stingerhawk Spectacle received a maintainability score of 3.8. The following information is based on evaluator comments:

Durability: The Stingerhawks held together well when dropped and folded and were fully functional with just a small crease in the frames.

Scratch Resistance: The Stingerhawk scratched slightly with the plastic scrubbing pad and worse with the stainless-steel scrubber.

Ease of Cleaning: The supplied cleaner and cloth worked well.

Resistance to Chemicals: After an overnight application, insect repellant caused significant delamination of the lens coating, and sunscreen left streaks that looked as though acid had eaten through the material on the lenses.

Deployability

The Stingerhawk Spectacle received a deployability score of 3.6. The following information is based on evaluator comments:

Ease of Changing Lenses: Scores for changing lenses ranged from 2 to 4.

Evaluators felt that they had to pull hard on the lenses to get them off and it was difficult to do this without getting fingerprints on the lenses; however, the process was easier as they became familiar with it, and the lenses popped in easily.

Carrying Case Quality: The Stingerhawk came with a soft zippered carrying case. Evaluators stated that the zipper was easy to use, but there was no crush protection whatsoever from the case.

4.1.3 Smith Optics Inc. Aegis Spectacle

The Aegis Spectacle (Figure 4-3) received an overall assessment score of 3.6 and costs $40 for a kit with clear and dark gray lenses, $30 for the compact size kit, and $45 for the wide kit. Each kit comes with the frame, lenses, cleaning cloth and a carrying case. A replacement lens costs $10.

Figure 4-3 Aegis Spectacle
Courtesy of Smith Optics Inc.

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

Usability

The Aegis Spectacle received a usability score of 3.6. The following information is based on evaluator comments:

Hearing protection: Evaluators indicated the Aegis spectacle was generally compatible with hearing protection.

Masks/Respirators: Several evaluators noted that the spectacles were pushed up when worn with the masks/respirators, so they had issues with the prescription inserts being too high or the spectacles sliding off their faces. Another evaluator noted there was a large gap present with both masks, allowing the risk of debris entrance. On a positive note, two evaluators stated that the rubber on the nose piece of the spectacles helped secure the respirator firmly in place.

Headgear: Evaluators found that the Aegis was compatible with their headgear.

Vision Correction: Evaluators thought the prescription insert system on the Aegis could use improvement. The inserts were not entirely compatible with the rubber nose bridge and were difficult to clip in place. They sat farther from the face than with other spectacles, and this put the inserts frame in the field of vision of some evaluators.

Comfort: The Aegis got mixed reviews on comfort, as some evaluators thought the rounded shape made for a comfortable fit, but others felt pressure on the ears from the hard temples. One evaluator noted that discomfort around the ears got worse over time.

Field of View: The Aegis had an adequate field of view with some limitations when used with masks, which pushed the spectacles up. One evaluator commented that the hinge at the top of the frame was in the field of view and became a distraction.

Capability

The Aegis Spectacle received a capability score of 3.7. The following information is based on evaluator comments:

Fit: Most evaluators had problems with the fit of the Aegis despite being able to choose from three available sizes. They noted that there was a gap between the spectacles and their face, and some had water get in during the CPR spray test. Others noted that there was movement of the spectacles during the physical training scenario.

Visual Acuity: A few evaluators felt the dark lenses were too dark for indoor operational use and that there was bad color saturation in low-light situations.

Lens Type Options: Besides the standard clear and dark gray lenses, yellow and red options are available. Evaluators were satisfied with these options.

Anti-fog: Only one evaluator had fogging on his lenses and only after very hard exertion.

Stylish: The Aegis had style scores ranging from 1 to 4. Some evaluators would choose to wear them off duty, others would not.

Frame Color: Frames were available in black and tan, meeting evaluators' expectations.

Maintainability

The Aegis Spectacle received a maintainability score of 3.4. The following information is based on evaluator comments:

Durability: The spectacle generally felt durable. Though the frames perhaps could have been designed better, the spectacles were made with good material and did not move around too much.

Scratch Resistance: The Aegis had significant scratching from the plastic scrubbing pad.

Resistance to Chemicals: After an overnight application, the insect repellent caused bubbling of the lens material while the sunscreen left a few small streaks on the lenses.

Deployability

The Aegis Spectacle received a deployability score of 4.0. The following information is based on evaluator comments:

Ease of Changing Lenses: The Aegis scored best among all spectacles in this category. Evaluators liked the locking system, stating that it was intuitive and easy to use. This made lens changing quick and easy and not a struggle as it was with other products.

Carrying Case Quality: The soft carrying case was adequate but did not provide as much protection as evaluators would have liked.

4.1.4 Eye Safety Systems Inc. Crossblade Spectacle

The Eye Safety Systems Inc. (ESS) Crossblade Spectacle (Figure 4-4) received an overall assessment score of 3.6 and costs $125 for a kit with frames, clear and dark gray lenses, cleaning cloth and a carrying case. Frames and lenses are available in regular and narrow configurations. A replacement lens costs $30.

Figure 4-4 Crossblade Spectacle
Courtesy of Eye Safety Systems Inc.

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

Usability

The Crossblade Spectacle received a usability score of 3.8. The following information is based on evaluator comments:

Hearing Protection: Evaluators indicated that the Crossblade was relatively compatible with in-ear hearing protection.

Masks/Respirators: Several evaluators found that the masks and respirators pushed the spectacles up a fair amount, causing the prescription inserts to impact their vision. One evaluator noted some slight fogging when worn with the respirator.

Headgear: Collectively, evaluators found the Crossblade to be compatible with their headgear.

Vision Correction: Although the spectacles were found to be generally compatible with the universal prescription lens inserts, several evaluators noted that the inserts sat a little too high in the Crossblade. This was exacerbated when the spectacles were pushed up by masks and respirators.

Comfort: Most evaluators found that the Crossblade was comfortable because they had a deep cut, were generally well positioned on the face and had rounded temple arms that allow for long-term comfort. Two evaluators, however, found that the spectacles squeezed tightly on their faces in an uncomfortable way, and noted that a retention strap would have increased comfort.

Field of View: Evaluators found that the spectacles gave an un-skewed field of view for peripheral and top-to-bottom range of vision. However, the prescription lens inserts tended to limit the field of view because they were not centered properly in the spectacles. An evaluator commented that if the inserts could be curved in some way to better fit inside the spectacles, this could provide an increased field of view.

Optical Aids: Evaluators found that the Crossblades were highly compatible with the rifle scope and mostly worked well with the binoculars, given that it is generally harder to see through binoculars while wearing spectacles. One evaluator commented that the spectacles pushed too close to his face when used with the binoculars and night vision monocle.

Retention System: Two evaluators identified that the spectacles would be more secure if worn with a retention strap, or with a rubber insert on the sides of the spectacles.

The prescription inserts affected the evaluators' ability to wear a retention strap with these goggles; however, despite this feedback, most evaluators agreed that the Crossblade's retention strap met their expectations.

Capability

The Crossblade Spectacle received a capability score of 4.1. The information below is based on evaluator comments:

Fit: Evaluators found that the spectacles fit well and met at least most of their expectations, with one noting the Crossblade exceeded his expectations in providing protection from the hazardous simulations throughout the assessment. However, a few evaluators noted that the spectacles did not fully protect against water and wind during the medical scenario as some water/wind made it past the spectacles to their faces. One evaluator noted a gap between his face and the top of the spectacles; a second evaluator attributed it to the spectacles riding up during the CPR scenario.

Visual Acuity: On average, the evaluators found that the spectacles met their visual acuity needs, and they could see objects clearly both nearby and at a distance, with three even noting that the visual acuity of the Crossblade exceeded their expectations. Regarding the different shades of the spectacles, evaluators noted respectively that the color of the dark lenses was appropriate for varying light levels, the clear lenses appeared to have a tannish tint and the grey lenses were darker than the evaluators would have liked. This made it difficult to differentiate colors in low-light settings when wearing the dark lenses. The copper lenses made both light and dark objects outside more vibrant and were the preferred lenses for the firearms scenario, but these lenses made everything less clear in the dark room during the inside search activity.

Adaptability (Multi-Use): All evaluators agreed that the spectacles would be suitable for a range of first response activities.

Lens Type Options: Most evaluators said that the lens type offered with the Crossblade exceeded their expectations for what they need when engaging in emergency response work, while two individuals concluded that it met their expectations.

Anti-fog: Only one evaluator noted experiencing minor fogging along the top of the spectacles when perspiration got into the frames/lenses. Another experienced initial fogging that quickly dissipated during the medical scenario.

Stylish: Evaluators had a range of opinions about the spectacle's stylishness. Some thought the spectacles had a pleasing aesthetic appearance and would possibly wear them off-duty based on their appearance. Two of the evaluators said that most tactical spectacles are not very aesthetically pleasing and typically would not be worn off-duty.

Frame Color: The evaluators all said the spectacles' frame color would be appropriate for use on-duty and for their departments.

Maintainability

The Crossblade Spectacle received a maintainability score of 2.5. The information below is based on evaluator comments outlined below (following destructive testing of the spectacles).

Durability: All evaluators said that the Crossblade was not durable and did not believe that they would be able to withstand heavy usage and rough handling and remain in good condition. The spectacles were damaged during regular usage in the scenarios.

Scratch Resistance: One evaluator noted that one of the lenses on a Crossblade became scratched during assessment activities. During destructive testing, the Crossblade lenses held up well to the plastic scrubber but were damaged by the stainless-steel scrubbing pad.

Ease of Cleaning: Evaluators found that the Crossblades were easy to clean and disinfect.

Resistance to Chemicals: The Crossblade with clear lenses was tested with an overnight application of alcohol, insect repellent and sunscreen. The inside film of the lenses was completely stripped by the sunscreen and partially damaged by the insect repellent.

Deployability

The Crossblade Spectacle received a deployability score of 4.0. The information detailed below is based on evaluator comments.

Ease of Changing Lenses: There was a range of evaluator feedback on how easy it was to change out the different lenses without damaging the spectacles. One evaluator said it was easy to change the lenses. Those that had issues with changing the lenses made the following comments: the hook pieces on the ends of the spectacles were difficult to put in place, it was impossible to change the lenses without smudging them and changing lenses was overly complicated and required significant flexing.

Carrying Case Quality: Evaluators all agreed that the Crossblade carrying case provided adequate protection and enabled easy deployment.

Stowability: All but one evaluator said that the spectacles were easy to stow on their heads in a stable manner. The outlier found the Crossblade to be floppy and unstable when positioned on the top of his head.

4.1.5 Oakley Inc. SI Ballistic M-Frame 2.0 Spectacle

The Oakley SI Ballistic M-Frame 2.0 Spectacles (Figure 4-5) received an overall assessment score of 3.3 and costs $190 for a kit with black frames, clear and dark lenses, liquid cleanser, a cleaning cloth and a carrying case. A replacement lens costs $65.

Figure 4-5 SI Ballistic M-Frame 2.0
Courtesy of Oakley Inc.

The following sections are broken out by SAVER category.

Usability

The SI Ballistic M-Frame 2.0 Spectacle received a usability score of 3.4 and the following information is based on evaluator comments:

Hearing Protection: All the evaluators found the Oakley spectacles to be compatible with in-ear and over-the-ear hearing protection devices, noting how the thinness of the frame arms did not get in the way or hinder the hearing protection.

Masks/Respirators: Overall, the evaluators felt the Oakley spectacles met almost all of their expectations for compatibility with face masks/respirators. Two evaluators felt the spectacles were pushed up too much by the mask and respirator during physical activity, while two others felt the spectacles were secure and had a good fit.

Headgear: Collectively, evaluators found the Oakley spectacles to be compatible with their headgear.

Vision Correction: The Oakley spectacles were not tested with prescription inserts because they were not compatible with the universal prescription lens carrier and required a propriety nosepiece connector that was not purchased for the assessment.

Comfort: Three evaluators thought the spectacles were comfortable, with one noting that they had no pressure around the temples, while four evaluators did not feel the spectacles were comfortable; two of them attributed their discomfort to the material of the arms, which caused pressure on top of the ears. One evaluator noted the Oakley spectacles would only be good for short team wear.

Field of View: Most of the evaluators found that the Oakley spectacles provided a good field of view. However, two evaluators had issues with the locking mechanism at the top of the frames and mentioned it was noticeable and distracted their vision, especially when looking through the rifle scope. None of the other evaluators noted any such distraction during the use of the optical aids.

Optical Aids: Two evaluators had field of vision issues while using the rifle scope, as noted in the feedback for the field-of-view criterion. None of the other evaluators noted any such distraction during the use of the optical aids.

Capability

The SI Ballistic M-Frame 2.0 Spectacle received a capability score of 3.9 and the following information is based on evaluator comments:

Fit: Two evaluators felt the spectacles were very secure and another only had issues with fit when wearing the respirator. The spectacles did not fit right on one of the evaluators throughout the activities; the nose piece floated above the nose and the spectacles had to be continually pressed up close to the face to fit. Another evaluator took issue with the lack of coverage the spectacle lenses provided, as wind got to the eyes during the medical scenario.

Visual Acuity: Most of the evaluators felt the Oakley spectacles provided good optical quality, but had conflicting comments at times (note that evaluators did not have the correct prescription lens adapter). One evaluator felt that the clear lenses seemed to have a slight tint to them, but the dark lenses were not too dark and were good for transitioning from outdoors to indoors. An evaluator thought the dark lenses were too dark for good visual acuity inside darker rooms, while another thought the spectacles were very good in low-light conditions.

Lens Type Options: Bone, dark bone and MultiCam frames as well as persimmon, rust, purple and light red lenses are available for purchase. The evaluators liked the number of lens options that Oakley provides. Two evaluators commented that the persimmon lenses provided good color contrast between objects and made everything brighter without causing extra eye strain.

One evaluator thought the light-red lenses were interesting and made colors more vibrant, but noted yellow lenses were not offered, which are typical for law enforcement and shooting applications.

Anti-fog: One evaluator experienced some fogging of the spectacles while administering CPR during the medical scenario.

Maintainability

The SI Ballistic M-Frame 2.0 Spectacle received a maintainability score of 2.0 and the following information is based on evaluator comments:

Durability: Throughout the assessment, evaluators were concerned about the overall quality and durability of the Oakley spectacles. One evaluator broke the center tab on the frame when trying to change lenses. Another evaluator dropped the spectacles a few times during the activities and noticed they were cracked; this evaluator also pointed out the rigidity of the frames compared to other models assessed. On the second day of testing, an evaluator noticed that the arms were askew after only one day of usage and that the frame itself was warped. Additionally, the Oakley spectacles broke into several pieces when bent and folded during destructive testing.

Scratch Resistance: An evaluator found that the lenses had scuff marks following assessment activities. The lenses were scratched by the plastic scrubbing pad during destructive testing.

Ease of Cleaning: Evaluators found the Oakley spectacles were fairly easy to clean, but they came with a cleaning cloth that was low quality and shed material while being used.

Resistance to Chemicals*:* Due to an oversight, the Oakley spectacles were not tested overnight with chemicals as the other products were and therefore received a score of "N/A" in this category.

Deployability

The SI Ballistic M-Frame 2.0 Spectacle received a deployability score of 3.8 and the following information is based on evaluator comments:

Ease of Changing Lenses: The evaluators' opinions on the lens changing mechanism for the Oakley spectacles varied. Two evaluators found the lenses very easy to change and saw this as an advantage of the Oakley spectacles. Two other evaluators found the lenses easy to change. Conversely, two evaluators found it difficult to change out the lenses of the spectacles and thought the locking mechanism (hole in center/top of the lens) had the potential to cause the lenses to splinter. The final evaluator found the lenses fairly simple to remove, but broke the center tab of the locking mechanism when trying to put new lenses in.

Carrying Case Quality: The evaluators liked the hardened carrying case; however, the zipper on one of the cases was not functional by the time one of the evaluators assessed the product.

4.1.6 Honeywell Safety Products SAS Uvex XMF Spectacle

The Honeywell Safety Products SAS Uvex XMF spectacle (Figure 4-7) received an overall assessment score of 2.9 and costs $40 for a kit with black frames, clear and dark lenses, cleaning cloth, and a carrying case. A replacement lens costs $11.

The following sections are broken out by SAVER category.

Figure 4-6 Uvex XMF Spectacle
Courtesy of Honeywell Safety Products SAS

Usability

The Uvex XMF Spectacle received a usability score of 3.1 and the following information is based on evaluator comments:

Masks/Respirators: Overall, the evaluators indicated that the spectacles were not compatible with PPE. While wearing masks, both N95 and half face respirators, the spectacles rode high on the face, pushed the spectacles outward and did not hold well on the head.

Headgear: Two evaluators noted that the spectacles were not compatible with SWAT style helmets, as the entire weight of the helmet was pushing down on the spectacles, putting pressure on the bridge of the nose.

Comfort: Most evaluators expressed at least slight discomfort while wearing the Uvex XMF spectacles, while one determined them to be comfortable. The discomfort was attributed to the prescription inserts sitting up too high in the frames (one responder indicated that this narrowed their field of view), spectacles riding high on the face and the general shape resulting in slippage on the nose and pressure at the top of the head and ears. Two evaluators indicated that the product sat unevenly on the face, resulting in nausea.

Optical Aids: Most of the evaluators indicated that the Uvex XMF spectacles met most of their needs when used with optical aids. One evaluator mentioned that the curve of the spectacles made it difficult to see straight through the night vision monocle; they needed to look through at an angle to use it effectively. Another evaluator said that when using the night vision monocle, the spectacles pushed tightly into their face resulting in discomfort.

Capability

The Uvex XMF Spectacle received a capability score of 3.3 and the following information is based on evaluator comments:

Fit: There were some concerns about the fit of the spectacles, as they needed to be adjusted by one evaluator following the physical training scenario. Two evaluators indicated that air got in between the frames and their eyes during the medical scenario, and another stated that they were loose. Yet another evaluator said that the spectacles sat too close to their brow and resulted in the lenses fogging.

Visual Acuity: The dark tint lenses were well received and had good acuity. Search objects were visible in both sunny and shaded areas.

Maintainability

The Uvex XMF Spectacle received a maintainability score of 1.8 and the following information is based on evaluator comments:

Durability: Throughout the assessment the evaluators did not think the Uvex XMF spectacles were as sturdy as other models assessed. Three evaluators stated that they felt flimsy and noticed scuffed frames and scratched lenses following the scenarios, and one said it felt like the spectacles were going to fall off during the physical activities. During destructive testing, the frames snapped in half during the bend and fold test.

Scratch Resistance: The lenses on the Uvex XMF were badly scratched when rubbed with the plastic scouring pad.

Resistance to Chemicals: The Uvex XMF Spectacle with clear lenses was tested with alcohol, insect repellent and sunscreen applied overnight. The lenses were severely delaminated from the sunscreen, but the alcohol and insect repellent had no effect.

Deployability

The Uvex XMF spectacle received a deployability score of 3.8 and the following information is based on evaluator comments:

Ease of Changing Lenses: Most evaluators felt that the lens changing process met at least most of their needs. Two evaluators struggled with changing the lenses, noting that they needed to pull very hard on the lenses to release them to the point where they felt like they were going to break.

Carrying Case Quality: The evaluators rated the carrying case very highly for the Uvex XMF spectacle. The case is sturdy, zips closed and has individual foam slots for the spectacles and lenses.

4.2 Goggles Results

Overall scores for the assessed goggles products ranged from 3.9 to 2.8. Table 4-4 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 4-4 Assessment Results for Goggles

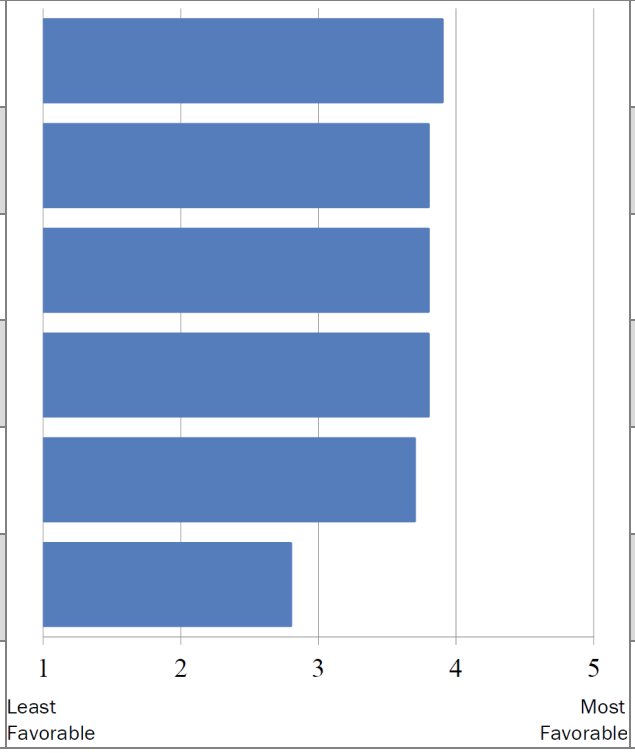
Product	Overall Score	Overall	Usability	Capability	Maintainability	Deployability
Smith Optics Inc. Outside the Wire Goggle		**3.9**	3.6	4.0	4.4	3.9
Revision Military Inc. Bullet Ant Goggle		**3.8**	4.0	4.0	3.8	2.9
Wiley-X Inc. Spear Goggle		**3.8**	3.7	3.9	4.3	3.0
Eye Safety Systems Inc. Influx Goggle		**3.8**	3.9	4.1	3.4	3.9
Oakley Inc. SI Ballistic Goggle 2.0		**3.7**	3.9	3.9	3.3	3.7
Honeywell Safety Products SAS Uvex XMF Goggle		**2.8**	3.0	3.4	1.9	2.9

Table 4-5 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 4-5 presents vendor-provided key specifications for the assessed products.

Table 4-5 Assessment Results for Goggles

Lowest Rating → Highest Rating		Product Name					
Category	**Evaluation Criteria**	**Outside the Wire**	**Bullet Ant**	**Spear**	**Influx**	**SI Ballistic**	**Uvex XMF**
Usability	Compatibility with Hearing Protection						
	Compatibility with Masks/Respirators						
	Compatibility with Headgear						
	Accommodates Vision Correction						
	Comfort						
	Field of View						
	Use with Optical Aids						
	Retention System						
Capability	Fit						
	Visual Acuity						
	Adaptability (Multi-Use)						
	Lens Type Options						
	Anti-fog						
	Frame Color						
Maintainability	Durability						
	Scratch Resistance						
	Ease of Cleaning and Disinfecting						
	Resistance to Chemicals						
Deployability	Ease of Changing Lenses						
	Carrying Case Quality						
	Stowability on the Head						

Table 4-6 Key Specifications for Goggles

Key Specification	Outside the Wire	Bullet Ant	Spear	Influx	SI Ballistic	Uvex XMF
Kit MSRP	$40	$70	$66	$125	$190	$56
Replacement Lens Cost	$10	$14	$18	$30	$40	$12
Warranty Duration	Lifetime	3 years	Limited lifetime	5 years	2 years	Lifetime frame guarantee
Size Availability	One size	One size	One size	Regular, Narrow	One size	One size
Frame Color Options	Black, Tan, Green, MultiCam	Black, Tan	Black, Tan, Green	Tan	Black, Tan, Bone	Black, Green
Lens Type Options	Clear, Dark Gray	Clear, Dark Gray, Yellow, Vermillion, Green (laser)	Clear, Dark Gray, Rust	Clear, Dark Gray, Yellow	Clear, Dark Gray, Red	Clear, Dark Gray, Yellow

4.2.1 Smith Optics Inc. Outside the Wire Goggle

The Outside the Wire Goggle (Figure 4-7) received an overall assessment score of 3.9 and costs $40 for a kit with frames, clear and dark lenses, a cleaning cloth, and a carrying case. A replacement lens costs $10.

Figure 4-7 Outside the Wire Goggle
Courtesy of Smith Optics Inc.

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

Usability

The Outside the Wire Goggle received a usability score of 3.6. The following information is based on evaluator comments:

Hearing Protection: The Outside the Wire Goggle was deemed to be compatible with in-ear and over-the-ear hearing protection devices.

Masks/Respirators: There were two issues that affected the scoring of the Outside the Wire Goggle in this category. Several evaluators noted that the masks and respirators pushed the goggles up, which raised the prescription inserts to a point where the bottom of the insert was in line with their vision, obscuring their view. The goggles also tended to push the respirator down to a slightly awkward position.

Headgear: There were some headgear incompatibility issues with the Outside the Wire Goggle. Evaluators noted that their helmets would push the goggles down, making them uncomfortable. The firefighters stated that the suspension strap on their helmets interfered with the normal goggle strap placement, which affected the fit and comfort of the goggles.

Vision Correction: Evaluators gave mixed reviews for the vision correction capability of the Outside the Wire Goggle. While three evaluators rated it highly, three rated it poorly with the complaint that the prescription inserts sat up too high and they were often looking through the bottom of the inserts.

Comfort: Some evaluators found the Outside the Wire Goggle very comfortable, as the lenses had a foam padding, seemed sturdy and durable, did not slide and did not fog much. They found the straps moved around freely but still attached firmly and even had room around the side edge to go around hearing protection. However, a few evaluators found that pressure points caused some discomfort.

Optical Aids: Some evaluators noted that use with the binoculars resulted in a smaller field of view, as the goggles sit farther from the face. However, they also had no issue with seeing in low-light settings even with the dark lenses and binoculars or night vision.

Retention System: Evaluators thought that the retention straps on the Outside the Wire Goggle were of high quality. Two evaluators deemed them the best retention straps among the various products. One evaluator felt that they were more secure than some of the other goggles and the swivel connection was good, while another felt that despite staying in place, they were not in a comfortable position due to interference from his fire helmet.

Capability

The Outside the Wire Goggle received a capability score of 4.0. The following information is based on evaluator comments:

Fit: Most evaluators were pleased with the fit of the Outside the Wire Goggle. However, one evaluator noted that some water spray came through the goggles and that they were a little too tall. Another noted that it generally was not a good fit and that the connection points were too wide.

Visual Acuity: The Outside the Wire Goggle had adequate visual acuity, according to evaluators. There were no color or distortion issues, although one evaluator found the tint to be a little too dark when going from outside to inside.

Lens Type Options: Only clear and dark gray lens options are available.

Anti-fog: Evaluators did not have any fogging on the goggle lenses during the physical training scenario. One evaluator had some fogging on the goggle lenses while wearing the medical N95 mask.

Frame Color: The Outside the Wire Goggle had the most options for frame color. They are available in black, tan, green and MultiCam.

Maintainability

The Outside the Wire Goggle received a maintainability score of 4.4. The following information is based on evaluator comments:

Durability: Though the Outside the Wire Goggle generally seemed durable, some evaluators felt the foam on the goggles would deteriorate over time, as the foam gasket around the goggles was already flaking off. However, during destructive testing the goggles held up to dropping and folding with no damage affecting their use.

Scratch Resistance: The Outside the Wire Goggle had essentially no scratches during destructive testing with the plastic and stainless-steel scrubbers.

Ease of Cleaning: The lenses were fairly easy to clean. Some evaluators noted the foam on the goggles would make disinfecting more difficult.

Resistance to Chemicals: The Outside the Wire Goggle was tested with alcohol, insect repellent and sunscreen applied overnight. There was no significant damage and evaluators could still see through the lenses without distortion.

Deployability

The Outside the Wire Goggle received a deployability score of 3.9. The following information is based on evaluator comments:

Ease of Changing Lenses: Evaluators found that the lens changing system was well designed and that lenses were fairly quick and easy to change.

Carrying Case Quality: The evaluators would have liked a better carrying case, noting that it was soft, hard to use and difficult to put the goggles back into.

4.2.2 Revision Military Inc. Bullet Ant Goggle

The Revision Military Inc. Bullet Ant Goggle (Figure 4-8) received an overall assessment score of 3.8 and costs $70 for a kit with frames, clear and dark lenses, cleaning fluid, cleaning cloth, and a carrying case. A replacement lens costs $14.

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

Figure 4-8 Bullet Ant Goggle
Courtesy of Revision Military Inc.

Usability

The Bullet Ant Goggle received a usability score of 4.0. The following information is based on evaluator comments:

Masks/Respirators: Evaluators noted that the Bullet Ant Goggles worked well with their masks and respirators due to their smaller size, which took up less space below their eyes.

Vision Correction: The vision correction inserts snapped in easily and seemed to have the best fit according to several evaluators. The narrow profile of the goggles kept the prescription inserts from moving.

Comfort: The Bullet Ant Goggles were comfortable for the most part, but there was some discomfort around each eye for one evaluator. Another stated that when worn with his helmet, the strap had to be worn lower and this caused some pressure points.

Field of View: The Bullet Ant is a dual-lens goggle, and the field of view was marginally worse than single-lens goggle systems according to most evaluators. The other evaluators thought the field of view was fine and they did not notice the separated lenses. Evaluators also noted that lower vision was limited, making it difficult to see objects while looking down.

Optical Aids: The Bullet Ant worked well with binoculars, night vision and rifle scopes. Evaluators felt the field of view through these devices was less obstructed.

Retention System: Evaluators had trouble with the locking system on the retention strap, which did not lock properly and left the goggles loose. They also noted that there was no vertical adjustment available.

Capability

The Bullet Ant Goggle received a Capability score of 4.0. The following information is based on evaluator comments:

Fit: For the most part the Bullet Ant Goggles stayed in place, fit well and felt secure. One evaluator had water spray get in under the lenses during the CPR scenario.

Visual Acuity: Evaluators could see well through the Bullet Ant Goggles. They liked the tint on the lenses, noting that the clear lenses seemed clearer than those of other products, and the dark lenses had the right amount of tint to distinguish objects and colors indoors.

Lens Type Options: Evaluators were satisfied with the lens options provided. They tested the clear, dark gray and yellow lenses at the assessment and were notified of the additional vermillion and green (laser protection) lens options.

Anti-fog: Some evaluators noted slight fogging on the Bullet Ant lenses during the physical training scenario, while others had no fogging.

Frame Color: Evaluators were satisfied with the frame color choices of tan and black.

Maintainability

The Bullet Ant Goggle received a maintainability score of 3.8. The following information is based on evaluator comments:

Durability: The Bullet Ant frames held up to destructive testing very well. Due to the dual-lens design, the goggles were easily foldable and suffered no damage. Evaluators stated that the product was still usable after destructive testing; however, the retention straps looked like they could wear out over time.

Ease of Cleaning: The lack of foam inserts on the goggles made them easier to clean.

Scratch Resistance: The Bullet Ant lenses were only slightly scratched from the stainless-steel scouring pad.

Resistance to Chemicals: The Bullet Ant Goggle was tested with alcohol, insect repellent and sunscreen applied overnight. The lenses were damaged from the sunscreen and insect repellent. There was no delamination, but the lenses were blurry. One evaluator stated it was like looking through a kaleidoscope.

Deployability

The Bullet Ant Goggle received a deployability score of 2.9. The following information is based on evaluator comments:

Ease of Changing Lenses: Evaluators found that changing the lenses was more complicated and time consuming than with the other products. The dual-lens system made it twice as much work. The lenses had to be lined up precisely when inserted and evaluators got smudge marks on them in the process. One evaluator described changing the lenses as, “a pain.”

Carrying Case Quality: Evaluators thought that the soft carrying case was a little small and cramped but generally met their expectations.

4.2.3 Wiley-X Inc. Spear Goggle

The Wiley-X Inc. Spear Goggle (Figure 4-9) received an overall assessment score of 3.8 and costs $66 for a kit with frames, clear and dark lenses, cleaning cloth and a carrying case. A replacement lens costs $18.

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

Figure 4-9 Spear Goggle
Courtesy of Wiley-X Inc.

Usability

The Spear Goggle received a usability score of 3.7. The following information is based on evaluator comments:

Masks/Respirators: Three evaluators stated that the Spear Goggle pushed the half-faced respirator down to a point where it was difficult to breathe through the nose on the respirator. Two other evaluators found that the medical mask pushed the goggles up, causing the prescription inserts to be out of place and ineffective.

Headgear: Two evaluators stated that the straps had to be placed in an awkward position to be compatible with their helmets, and this reduced comfort.

Vision Correction: Most evaluators were satisfied with the corrective inserts on the Spear Goggle and stated that they worked fine aside from mask compatibility issues. One evaluator could not get them into a position in which there was good vision for all head angles, and had trouble doing the balance beam portion of the physical training scenario.

Comfort: Evaluators found that the foam insert on the Spear Goggle made the product comfortable. However, sometimes it fell out and the goggles were not comfortable without them. An evaluator commented that they did not vent well, resulting in some fogging on the foam insert, and were hot to wear.

Field of View: Several evaluators found that their downward vision was impeded with the Spear Goggle. It was somewhat improved by taking the foam insert out, but this reduced comfort.

Optical Aids: Evaluators thought that there was good clarity through the binoculars and night vision monocle, but some also thought that the field of view was somewhat limited by these devices.

Retention System: The retention straps were adequate, but the connectors were not.

Capability

The Spear Goggle received a capability score of 3.9. The following information is based on evaluator comments:

Fit: Evaluators felt that the fit was good for the most part, but the goggles would move around during activities if the foam insert became loose. One evaluator felt that there were too many moving parts and too many degrees of freedom in the design, which made the goggles unstable and difficult to get situated.

Lens Type Options: Optional rust-colored lenses are available for purchase. Evaluators would have liked to see a yellow lens option instead of rust.

Anti-fog: Several evaluators had heavy fogging during the physical training activities, with one evaluator stating that they were the worst product for fogging. The venting on the Spear Goggle did not seem to work well.

Frame Color: Frames on the Spear Goggle are available in black, tan and green.

Maintainability

The Spear Goggle received a maintainability score of 4.3. The following information is based on evaluator comments:

Durability: Evaluators were concerned about the removable foam insert that did not seem sturdy and fell out at times. They also identified the connectors as weak points that could break. The goggles stood up well to destructive testing. The dual-lens design allowed easy folding of the goggles without damage.

Ease of Cleaning: The removable foam inserts make the goggles easier to clean.

Scratch Resistance: The Spear Goggle held up well to scratch testing with no damage from the plastic scrubber and light scratches from the stainless-steel scrubber.

Resistance to Chemicals: The Spear Goggle was tested with alcohol, insect repellent and sunscreen applied overnight. The lenses were significantly delaminated by the insect repellent and had some minor damage from the sunscreen.

Deployability

The Spear Goggle received a deployability score of 3.0. The following information is based on evaluator comments:

Ease of Changing Lenses: Most evaluators struggled with the lens changing process for the Spear Goggle. One commented that it took too much effort and was a hassle, while another stated there were too many notches around the frame and it was difficult to line them up with the slots on the lenses. Two others stated that it is difficult to know when the lenses are snapped in properly, and that this can be a safety hazard because they may be in place but not properly secured.

Carrying Case Quality: The carrying case was soft and provided minimal protection but provided adequate space and was easy for evaluators to use.

4.2.4 Eye Safety Systems Inc. Influx Goggle

The Influx Goggle (Figure 4-10) received an overall assessment score of 3.8 and costs $125 for a kit with tan frames, clear and dark gray lenses, a cleaning cloth and a carrying case. They are available in regular and narrow sizes. A replacement lens costs $30.

Figure 4-10 Influx Goggle
Courtesy of Eye Safety Systems Inc.

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

Usability

The Influx Goggles received a usability score of 3.9. The following information is based on evaluator comments:

Hearing Protection: Evaluators found that these goggles were mostly compatible with hearing protection. One noted that the goggle straps interfered with the over-the-ear hearing protection.

Masks/Respirators: There were a range of opinions on compatibility of the goggles with medical masks and half-faced-respirators. Evaluators individually noted when worn with the Influx Goggles, the respirator almost moved off an evaluator's face and the respirator impeded another evaluator's ability to breathe through the nose. The goggles sat high up on one evaluator's face, so they did not weigh down on the respirator as other evaluators experienced; this individual found the goggles to also be compatible with the medical mask. However, another evaluator noted that the respirator pushed the goggles high up on the face, which made it difficult to see when looking through the inserts. When worn with a helmet in these situations, the goggles rode up.

Headgear: The evaluators generally found the Influx Goggles to be compatible with helmets, though a few did not believe them to be fully compatible and said:

- Goggles sat too high up on the head to wear with a helmet.
- Two other evaluators noted that there were issues with the goggle straps being too tight or too loose and getting in the way when worn with a helmet.

Vision Correction: Most evaluators found that the goggles accommodated the universal prescription lens inserts or exceeded their expectations in this area. Two evaluators did wonder how many times the prescription insert tab could be removed and replaced without affecting the structural integrity of the goggles. The one individual who did not find the goggles to accommodate the prescription inserts said they sat up too high. This individual also had issues with the goggles riding up when worn with the half-faced respirator.

Comfort: All but two evaluators found the Influx Goggles to be comfortable and one individual found the goggles to exceed his expectations for comfort. Two evaluators commented that they liked having the ability to control the lever in the middle-top part of the goggles to open vents within the goggles, which would prevent fogging and add a level of comfort from extra airflow when necessary. They noted that this was a unique capability in goggles that they had not seen before. The two evaluators that found the goggles to be uncomfortable cited issues with the straps not fitting properly, as described above.

Field of View: All evaluators found that the goggles either exceeded their expectations or met all expectations pertaining to having an un-skewed field of view and peripheral and top-to-bottom range of vision. Two evaluators noted that the prescription inserts could be curved to enable a wider field of view with the goggles, but generally there was a wide peripheral field of view, and it was easy for these evaluators to look down without having to fully move their faces. Evaluators identified the information below when the Influx Goggles were used with the following optical aids:

- Binoculars–A few evaluators said that they had a decent field of view with the binoculars; however, many evaluators commented that the goggles restricted their fields of view when used with the binoculars, and one mentioned they sat far off his face and were thick, thus restricting view.
- Rifle Scope–Most evaluators found the goggles compatible with the rifle scope.
- Night Vision–Those evaluators who tested with night vision said that the goggles were compatible with the monocle.

Retention System: Evaluators provided mixed feedback about the Influx's retention system. One evaluator stated that the connectors seemed sturdy. However, those that disagreed with this statement felt that the straps fit weirdly, were not very secure and there was no compatibility or comfort when worn with the mask.

Capability

The Influx Goggles received a capability score of 4.1. The following information is based on evaluator comments:

Fit: Most evaluators found that the goggles fit securely and provided protection from hazards during the emergency response simulations, with three evaluators saying the goggles exceeded expectations in this area. One evaluator noted that the goggles were secure so that no water broke through during the medical scenario. However, a few evaluators reiterated earlier comments about the fit of the goggles on the nose and identified issues with the straps not securing the goggles properly.

Visual Acuity: Evaluators found that the Influx Goggles met at least most of their visual acuity needs, and they could mostly see objects clearly both nearby and at a distance. A few evaluators indicated that the goggles exceeded expectations in this area. One individual said that he could move from outside to inside under an ambient light and still see objects clearly with the Influx's dark lenses. The only issue of note was that one evaluator felt that there was a slight tannish tint on the clear lenses.

Adaptability (Multi-Use): On average, evaluators found that the goggles were suitable for different types of emergency operations.

Lens Type Options: The Influx has a yellow lens option in addition to the clear and dark lenses that came with the kit. Evaluators found the lens options sufficient for conducting emergency response work, and a few evaluators noted that the product exceeded their expectations in this area. However, one evaluator thought that the yellow lens made objects appear in a gray tint.

Anti-Fog: All evaluators were pleased with the Influx's anti-fog capabilities, and a few commented on how the goggle's previously mentioned ventilation system was a nice feature in preventing the lenses from fogging and providing responders with good ventilation. No evaluators experienced fogging during the scenarios.

Frame Color: Frames on the Influx are only available in tan. Three evaluators stated this color is not suitable for their agency and that there should be a black frame option.

Maintainability

The Influx Goggles received a maintainability score of 3.4. The following information is based on evaluator comments following destructive testing of the goggles:

Durability: All evaluators thought that the goggles were durable during assessment activities.

Scratch Resistance: Evaluators said that the Influx Goggles were mostly scratch resistant during assessment activities. During destructive testing, the frames had small scratches with the plastic scrubbing pad and were significantly scratched by the stainless steel.

Ease of Cleaning: All evaluators said that these goggles were easy to clean, though one noted that the foam padding inside of the goggles made cleaning slightly more difficult.

Resistance to Chemicals: After exposing the lenses to substances overnight, most evaluators did not find the goggles to be chemically resistant, as the insect repellent that was applied to the outer half of the right lens caused optical distortion and degradation. Only one evaluator said that the goggles met most of their expectations in this area.

Deployability

The ESS Influx goggles received a deployability score of 3.9. The following information is based on evaluator comments:

Ease of Changing Lenses: On average, evaluators said that this was easy to do. One evaluator said that the lenses did not always securely click into a tab on the frame and this could potentially be dangerous.

Carrying Case Quality: Evaluators generally agreed that the goggle's carrying case could be sturdier; it was soft and a bit flimsy, which meant there is a higher chance that the goggles could break if not stowed properly. However, despite this feedback most evaluators felt that the carrying case quality met most of their expectations.

Stowability: All evaluators said that the goggles were easy to stow stably on their heads.

4.2.5 Oakley Inc. SI Ballistic Goggle 2.0

The SI Ballistic Goggle 2.0 (Figure 4-11) received an overall assessment score of 3.7 and costs $190 for a kit with black frames, clear and dark lenses, cleaning liquid, cleaning cloth, and a carrying case. A replacement lens costs $40.

Figure 4-11 SI Ballistic Goggle 2.0
Courtesy of Oakley Inc.

Note: During the assessment, one evaluator used the Oakley SI Ballistic Goggle 1.0; this model uses the same lens technology with slightly different lens shape, locking mechanism and frame construction. As such, the scores from the evaluator were not included in the overall scoring for the SI Ballistic Goggle 2.0. All feedback in the below SAVER Category sections are relevant to the SI Ballistic Goggle 2.0.

The following sections are broken out by SAVER category.

Usability

The SI Ballistic Goggle 2.0 received a usability score of 3.9 and the following information is based on evaluator comments:

Hearing Protection: Most evaluators thought the goggles worked well with other gear, including hearing protection. However, one evaluator said the buckles on the retention strap interfered with the seal of their over-the-ear protection.

Masks/Respirators: Many evaluators had issues with the goggles while wearing a respirator/mask.

One evaluator stated the goggles became uncomfortable when wearing a respirator as the frames sat too high and no longer had a good seal on their face. Three other evaluators noted that they could not wear the goggles in the appropriate location while wearing a medical mask and constantly had to readjust the positioning; this caused discomfort, ear fold, fogging and nose pressure to one of the evaluators.

Headgear: Two evaluators noted that the goggles pushed down on and pinched the bridge of their nose when worn with headgear. Others felt the goggles were compatible with headgear and felt the frame was able to move/flex over the helmet.

Vision Correction: There were mixed opinions on the goggle's ability to accommodate for vision correction lenses. One evaluator said the inserts sat up too high, while another felt the comfort of the vision correction mechanism was an advantage.

Comfort: Most of the evaluators found the Oakley goggles to be comfortable during the various activities, with one evaluator noting that the interior foam seal on the face was very comfortable. The primary discomfort experienced by two evaluators with the goggles was increased nose pressure caused by use with headgear, as stated previously.

Field of View: Five evaluators thought the goggles provided a good field of view, with one noting that it was excellent because the goggles sat close to the face. One evaluator felt the Oakley's did not provide the best peripheral view and that their vision was obstructed when looking down, noting a protruding lip of the goggles that obstructed their vision when slightly tilting forward to see the ground. Additionally, one evaluator noticed a limited field of view when using the binoculars.

Retention System: Evaluators noted both positives and negatives about the retention strap of the Oakley goggles. One evaluator felt that it was a strong plus that the Oakley's had the narrowest retention strap of all the goggle models. Another evaluator liked the way the strap sat and kept firmly in place, but could see them becoming uncomfortable and likely to break when using other gear. They also felt the goggle connectors/buckles seemed cheap. One evaluator liked the way the strap articulated; however, did not like the placement of the buckles.

Capability

The SI Ballistic Goggle 2.0 received a capability score of 3.9 and the following information is based on evaluator comments:

Fit: All evaluators agreed that the fit of the goggles met all their expectations, with varying comments, including two evaluators, that felt the goggles were secure and did not move around, which was thought to be due to the foam insert inside the goggles. Another evaluator saw an advantage with how close the goggles sat on the face; goggle coverage varies, as one evaluator had no water spray enter the goggles during the medical scenario, while another had spray enter through the locking mechanism at the top of the frame. One evaluator liked the handiness and movement of the retention strap connectors; another evaluator felt the goggles were a bit small and light; and felt that the goggles sat up high while they were wearing the respirator, but after adding their helmet the goggles were pushed down into a good position.

Another evaluator noted the APR mask and goggles combination was the first that did not prevent breathing through the nose.

Visual Acuity: The evaluators had no issues with the dark lenses in the goggles. They noted the dark lenses were not too dark and were good for transitioning from sunny to low-light conditions while providing good color contrast. Two evaluators felt the clear lenses were not fully clear, as they seemed to have a slight tint to them.

Lens Type Options: One evaluator gave a low score for lens type options because the goggles do not have a yellow lens option that is often used by law enforcement.

Anti-fog: Only one evaluator had fogging occur; this happened while wearing the N95 mask during the medical scenario.

Maintainability

The SI Ballistic Goggle 2.0 received a maintainability score of 3.3 and the following information is based on evaluator comments:

Durability: Although the goggles met all the evaluators' expectations for durability, there was some concern about their longevity. Two evaluators were concerned about the deterioration of the interior foam, with one noting they could almost pull the foam padding from the goggle. One evaluator thought the goggle strap connectors seemed cheap and another felt the goggles were likely to break.

Ease of Cleaning: Evaluators' opinions were mixed on the ease of cleaning and disinfecting the goggles, with one evaluator noting that the foam interior makes cleaning the frames more difficult.

Scratch Resistance: During destructive testing, lenses on the Oakley goggles were not scratched until the stainless-steel scrubbing pad was used.

Resistance to Chemicals: The Oakley goggles were seriously delaminated by sunscreen and insect repellent applied overnight.

Deployability

The SI Ballistic Goggle 2.0 received a deployability score of 3.7 and the following information is based on evaluator comments:

Ease of Changing Lenses: Evaluators were mixed in their opinions of the goggle's lens changing mechanism. One evaluator found that changing lenses was quick and easier than anticipated. Other evaluators found it difficult to change out the lenses and did not like the way the lenses clipped into the frame. One evaluator thought the center piece of the goggle frame could easily break the lens if it was not removed properly.

Carrying Case Quality: Evaluators generally liked the carrying case the goggles came with, but two noted that the zipper was not the best. One evaluator thought the case was too big and bulky and was not as easy to manage as other cases assessed.

4.2.6 Honeywell Safety Products SAS Uvex XMF Goggle

The Uvex XMF Goggle (Figure 4-12) received an overall assessment score of 2.8 and costs $56 for a kit with black frames, clear and dark lenses, cleaning cloth and a carrying case. A replacement lens costs $12.

Figure 4-12 Uvex XMF Goggle
Honeywell Safety Products

The following sections are broken out by SAVER category.

Usability

The Uvex XMF Goggle received a usability score of 3.0 and the following information is based on evaluator comments:

Masks/Respirators: Collectively, the evaluators did not find the goggles compatible with the respirator and medical mask. The goggles would not sit in the right position with a mask or respirator; some noted the goggles were pushed up too high and caused discomfort, while others said the goggles pushed down on the respirator, which caused one evaluator to be unable to breathe through their nose.

Headgear: Most of the evaluators found the goggles uncomfortable when worn with protective headgear. Two evaluators noted strong pressure points at the cheekbones and nose when worn with their helmets, with one noticing a large gap in the seal, which effects protection. Another evaluator found them very painful to wear when pushed down by a helmet.

Vision Correction: Most evaluators noticed that the prescription insert adapter was a four-connection-point mount and required extra work to install. Two evaluators felt the mount was easy to lose during certain operational conditions. In addition, three evaluators felt the prescription insert was either uncomfortable or sat up too high.

Comfort: Four of the evaluators found the Uvex XMF Goggle to be very uncomfortable. Feedback included that the goggles pinched the evaluator's nose during physical activity and the nose bridge is not generally the most comfortable. Three evaluators had pressure points on their cheeks, as there was no padding on the cheekbones. And one evaluator had slight discomfort with the strap on their ears. Additionally, comfort became an issue for two evaluators when paired with other gear including masks and helmets, with one noting that their nose got crushed and became very uncomfortable.

Field of View: All the evaluators, aside from one, did not have an issue with the field of view, with one calling it an advantage of the goggles. The other evaluator felt they had bad field of view looking down. Two evaluators felt they had a restricted field of vision when using the goggles with binoculars.

Retention System: There were mixed opinions on the goggle's retention system. One evaluator felt the adjustment of the strap was an advantage of the goggles. Two evaluators felt the goggles dug into their face and did not like how there was only one adjustment point, and another had an issue with how the strap sat on their head.

Capability

The Uvex XMF Goggle received a capability score of 3.4 and the following information is based on evaluator comments:

Fit: Most evaluators found some issue with the fit of the goggles. Two evaluators found the gap between the goggles and the temple to be uncomfortable and did not think the seal on the face was strong enough. One evaluator commented that the goggles stayed in place throughout the assessment but that the fit was a little narrow and not great. Another evaluator thought the goggles fit well but sat too far from the face. One evaluator did not think the goggles had good coverage as they were sprayed heavily in the face during the medical scenario.

Visual Acuity: Most evaluators thought the goggles provided good optical quality but had conflicting thoughts on the dark lenses. One evaluator felt the dark lenses performed well transitioning from sunny to low-light conditions, while two others thought the dark lenses were too dark for low-light conditions and had trouble making out items.

Lens Type Options: Two evaluators would have liked having a lens color option besides amber.

Anti-fog: Four evaluators experienced fogging at some point during the assessment activities. Of the four, three evaluators provided further detail about their fogging experiences, two of which only experienced slight fogging at a point during the physical activity, while the other one experienced fogging during most activities after a certain period.

Maintainability

The Uvex XMF Goggle received a maintainability score of 1.9 and the following information is based on evaluator comments:

Durability: Evaluators did not feel the goggles were durable, commenting that the vent foam would deteriorate over time and had a general low-grade feel. When folded during destructive testing, the lenses came loose and could not be put back in due to deformation in the frames.

Scratch Resistance: The goggle lenses were almost instantly scratched with the plastic scrubbing pad, so there was no need to assess this with the stainless steel.

Resistance to Chemicals: The Uvex XMF Goggle lenses were undamaged by insect repellent and alcohol but were delaminated by the sunscreen applied overnight.

Deployability

The Uvex XMF Goggle received a deployability score of 2.9 and the following information is based on evaluator comments:

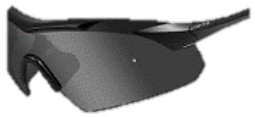
Ease of Changing Lenses: There were mixed opinions on the ease of changing lenses. Three evaluators found the lenses easy to change out, with one commenting that the process was not super quick, however. One evaluator found the lenses difficult to change and expressed a problem with the prescription lens inserts, as described under the accommodates vision correction criterion.

Carrying Case Quality: All the evaluators felt the carrying case could be improved. One evaluator commented that he would prefer a hard case and did not like the way the Velcro closure is set up; he felt the case was not as easy to close as it should be.

5.0 SUMMARY

The advantages and disadvantages for the assessed products are highlighted in Table 5-1 and Table 5-2 for tactical spectacle and googles, respectively. Emergency responder agencies that consider purchasing tactical eyewear (spectacles or goggles) should carefully research each product's overall capabilities and limitations in relation to their agency's operational needs.

Table 5-1 Spectacle Advantages and Disadvantages

Vendor/Product		Advantages	Disadvantages
	Wiley-X Inc. Vapor Spectacle	• Good compatibility with other equipment • No fogging occurred during the assessment • Good visual acuity and wide field of view	• Nosepiece difficult to get in place and slightly uncomfortable • Hard plastic on temples caused discomfort and movement
MSRP: $ 60	Overall Score: 4.0		
	Revision Military Inc. Stingerhawk Spectacle	• Adjustable nosepiece allows for proper fit • Very good prescription insert positioning • No fogging occurred during the assessment • Higher flexibility and durability	• Low profile of lenses causes slight exposure and peripheral vision distortion • Difficult to change lenses initially
MSRP: $ 70	Overall Score: 3.7		
	Smith Optics Inc. Aegis Spectacle	• Intuitive locking mechanism and lens changing system • Rounded frame arms	• Improper fit when worn with face mask • Difficult prescription insert system and placement
MSRP: $ 40	Overall Score: 3.6		
	Eye Safety Systems Inc. Crossblade Spectacle	• Comfortable with round frame arms • Good lens depth provides un-skewed field of view	• Not durable and would not hold up to heavy usage • Improper fit when worn with respirator
MSRP: $ 125	Overall Score: 3.6		
	Oakley Inc. SI Ballistic M-Frame 2.0 Spectacle	• Most found the lenses quick and easy to change • Secure fit • Thin frame arms provide good compatibility with other equipment	• Durability concerns with the locking mechanism and rigid frames • Most evaluators found the spectacles uncomfortable
MSRP: $ 190	Overall Score: 3.3		

Vendor/Product		Advantages	Disadvantages
 Honeywell Safety Products SAS Uvex XMF Spectacle		• Most felt the lenses were easy to change • Good field of view	• Improper positioning when worn with headgear and masks • Uncomfortable • Durability concerns
MSRP: $ 40	Overall Score: 2.9		
Note that all product images in Table 5-1 are courtesy of their respective vendors.			

Table 5-2 Goggle Advantages and Disadvantages

Vendor/Product		Advantages	Disadvantages
 Smith Optics Inc. Outside the Wire Goggle		• Well-designed lens changing system • Interior foam padding and sturdy straps provide good comfort and fit	• Durability concerns with surrounding foam gasket
MSRP: $ 40	Overall Score: 3.9		
 Revision Military Inc. Bullet Ant Goggle		• Dual-lens design delivers durability • Clear lenses provide good visual acuity • Best mechanism for prescription insert • Compatible with PPE due to lower profile	• Changing dual-lenses is time consuming • Difficult retention strap system • Slightly hindered field of view
MSRP: $ 70	Overall Score: 3.8		
 Wiley-X Inc. Spear Goggle		• Comfortable with interior foam padding • Lenses provide good visual clarity	• Insecure foam insert • Inadequate venting led to heavy fogging during assessment • Complicated lens changing system
MSRP: $ 66	Overall Score: 3.8		

Vendor/Product		Advantages	Disadvantages
	Eye Safety Systems Inc. Influx Goggle	• Secure fit and protection against hazards • Very good anti-fog capabilities • Controllable ventilation system	• Sub-par retention strap system • Thickness of frame limits field of vision when using optical devices and with headgear
MSRP: $ 125	Overall Score: 3.8		
	Oakley Inc. SI Ballistic Goggle 2.0	• Secure fit • Closeness to face provided good field of view • Good strap articulation	• Concern with quality of materials • Compatibility issues with mask/respirator
MSRP: $ 190	Overall Score: 3.7		
	Honeywell Safety Products SAS Uvex XMF Goggle	• Good overall field of view • Good optical quality	• Compatibility issues with mask/respirator • Uncomfortable with pressure points on nose bridge and cheeks • Fogging occurred during assessment activities • Concerns with material quality and durability
MSRP: $ 56	Overall Score: 2.8		

Note that all product images in Table 5-2 are courtesy of their respective vendors.

APPENDIX A. EVALUATION CRITERIA DEFINITIONS

The focus group identified 28 criteria, which they defined as follows.

Usability

Eight usability criteria were identified and defined by the focus group.

- **Compatibility with Hearing Protection** refers to the degree to which tactical eyewear is compatible with and can be worn with all types of hearing protection devices, including in-ear and over-the-ear devices.
- **Compatibility with Masks/Respirators** refers to the degree to which tactical eyewear is compatible with respiratory devices, such as air-tight N95 masks and half-face air purifying respirators (APRs). Focus group members noted that eyewear has to be worn over most N95 masks and can push half-face APR filters down.
- **Compatibility with Headgear** refers to the degree to which tactical eyewear interfaces and fits well with emergency response headgear, including fire helmets, ballistic helmets, face shields and hardhats.
- **Accommodates Vision Correction** refers to the method of allowing prescription vision correction and its effectiveness. Focus group members stated that there should be a prescription insert or prescription lens, as tactical eyewear will likely fit poorly over prescription spectacles. They also wanted vision correction to have extended width coverage.
- **Comfort** refers to the degree of comfort provided by the tactical eyewear when worn. Focus group members stressed the need for long-term comfort, freedom from nausea, lack of pressure points and lack of sharp edges.
- **Field of View** refers to the range of vision provided by the tactical eyewear, including peripheral and top-to-bottom range of vision. Focus group members stated that peripheral vision can be skewed with some eyewear products. They also stated that field of view is critical for maintaining situational awareness.
- **Use with Optical Aids** refers to the degree to which the tactical eyewear is compatible with and can be used effectively with optical aids, including binoculars, night vision goggles, thermal imagers, gunsights and other weapons optics.
- **Retention System** refers to the presence of a retention strap or some other method of keeping tactical eyewear in place on the head. This applies more to spectacles than goggles.

Capability

Eight capability criteria were identified and defined by the focus group.

- **Fit** refers to how well the tactical eyewear stays positioned on the face, ensuring that it provides protection during emergency response activities from top to bottom and along the sides.
- **Visual Acuity** refers to the optical quality of the tactical eyewear, including the ability to resolve objects from a distance, the presence or lack of distortion, and the ability to read maps and cell phones while looking straight ahead.

- **Adaptability (Multi-Use)** refers to the ability to use one tactical eyewear product for different emergency response operations, such as auto extrication, emergency medical services work, firefighting, weapons use, etc.
- **Lens Type Options** refers to the types of lenses that are available and can be used with the tactical eyewear product. Focus group members stated that they would like to have clear, dark tinted, polarized and yellow (for shooting) lens options at a minimum.
- **Heat and Cold Resistance** refers to the ability to withstand high and low temperatures during operational use and storage. The requirements would vary depending on the emergency response discipline. Firefighters in the focus group would like to see an operational and storage temperature range from -60°F to 200°F.
- **Anti-fog** refers to the quality of anti-fog coating in the tactical eyewear and the degree to which it provides protection from fogging. Focus group members would be open to evaluating other solutions, such as fans in goggles, but they caution that this would require electronics that may interfere with other operations, such as defusing a bomb.
- **Stylish** refers to the aesthetic appearance of the tactical eyewear, specifically as to whether responders would choose to buy it for off-duty usage based upon aesthetics. The product should also conform to department policy and not be too flashy, according to focus group members.
- **Frame Color** refers to the colors that tactical eyewear frames are available in. Focus group members stated that they want colors that match other gear and that certain departments prefer certain colors. For instance, SWAT team members stated that they prefer tan eyewear products.

Maintainability

Five maintainability criteria were identified and defined by the focus group.

- **Durability** refers to the ability of the tactical eyewear to remain in good condition over a long period of time and withstand heavy usage, wear and tear, drops, bumps, and rough handling.
- **Scratch Resistance** refers to how well the tactical eyewear resists scratching on the lenses in normal use, including cleaning the lenses with a shirt.
- **Ease of Cleaning and Disinfecting** refers to the ease with which the tactical eyewear can be cleaned with a liquid cleaner and a cloth or paper towel, and the ease with which it can be disinfected by wiping it with, or soaking it in, a chemical disinfecting agent. Focus group members stated that eyewear with many crevices and parts, such as rubber foam, are difficult to clean and disinfect.
- **Resistance to Chemicals** refers to the resistance of the lenses to damage from three chemical substances: sunscreen, insect repellent and rubbing alcohol.
- **Warranty** refers to the amount of time in which the vendor promises to repair or replace equipment that is not functioning properly, and the terms of such agreement. Focus group members would like to see a breakdown in warranty coverage for frames and lenses.

Deployability

Five deployability criteria were identified and defined by the focus group.

- **Ease of Changing Lenses** refers to the ease with which lenses can be changed on the tactical eyewear. Speed, simplicity and not having the lenses break or tear were listed as important considerations.
- **Carrying Case Quality** refers to the overall quality of the tactical eyewear carrying case, whether it provides adequate protection, and whether it allows easy deployment. Focus group members stated a preference for hard compact-size cases that can be worn on a gear belt and handled with gloves.
- **Stowability on the Head** refers to the ability to wear tactical eyewear so that the lenses are positioned on top of the head in a stable manner and will remain in place. Focus group members stated that it is desirable at times to uncover their eyes and stow the eyewear on their head until they need it again.
- **Availability in Different Sizes** refers to the size options (e.g., small, medium, large) available when choosing tactical eyewear. Focus group members stated that gender-based size options (e.g., men's large, women's large) are preferable. They emphasized that sizing is important because poorly fitting eyewear often bends and results in poor optics.
- **Compatibility with Body Cameras** refers to any features in the tactical eyewear that allow it to activate body cameras or be used as a body camera or with a body camera.

Affordability

Two affordability criteria were identified and defined by the focus group.

- **Initial Cost** refers to the price of the eyewear when purchased, including the base cost and the cost of kits and accessories that are part of the eyewear.
- **Replacement Lens Cost** refers to the cost of replacement lenses for the tactical eyewear quantified in dollars and in percentage of initial cost. Focus group members stated that they usually replace lenses every year or two and that the percentage of initial cost is important to them.

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

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

Category Score Example[vi]

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

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 Assessment Score Formula

$$\sum\left(\textit{Category Score} \times \textit{Category Percentage}\right) = \textit{Overall Assessment Score}$$

Overall Assessment Score Example

Capability		*Usability*		*Affordability*		*Maintainability*		*Deployability*		
$(4.0\times 33\%)$	+	$(4.2\times 27\%)$	+	$(4.2\times 20\%)$	+	$(3.8\times 13\%)$	+	$(4.5\times 7\%)$	=	4.1

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