DRDC Toronto No. CR-2005-065

HUMAN FACTORS TECHNICAL MEMORANDUM:

USER TRIAL FOR BALLISTIC EYEWEAR R/x SOLUTION

by:

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PWGSC Contract No. W7711-3-7879/01-TOR
Call-Up 7879-03

On behalf of
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September 2005

Abstract

This trial was conducted to determine if the prescription (R/x) Ballistic Eye Wear (BEW) solution was acceptable for employment by soldiers performing mission essential tasks operating throughout the 24-hour continuum.

Nine regular force infantry soldiers from the 3rd Battalion Princess Patricia's Canadian Light Infantry, Edmonton, Alberta, participated in this trial. They wore the R/x inserts while performing various tasks. Four participants from NDHQ also wore and evaluated the R/x inserts. This report presents the data from the 3rd Battalion Princess Patricia's Canadian Light Infantry participants.

The R/x insert was evaluated on the following criteria: visual acuity, field of view, special features, fit, compatibility with activities and equipment, environmental suitability, care, protection, adjustment, visual characteristics, comfort, and overall ratings. Data collection included questionnaires, performance measures, and HF observer assessments.

Overall the soldiers found the R/x insert to be acceptable for all criteria. The main concern regarding the R/x insert was its durability. During the trial a few of the inserts broke at the attachment point to the BEW nose bridge. The soldiers stated that they found the R/x solution to be acceptable except for this durability issue.

It is recommended that this attachment mechanism be made more durable.

Résumé

Le présent essai a été effectué afin de déterminer si les lunettes de protection balistique (LPB) avec verres de prescription sont un équipement approprié pour les soldats dans l'accomplissement de tâches essentielles à la mission au cours d'une période continue de 24 heures.

Neuf soldats d'infanterie de la Force régulière affectés au 3e Bataillon, Princess Patricia's Canadian Light Infantry (Edmonton, en Alberta) ont participé à cet essai. Chacun d'eux portait les verres insérés pour exécuter différentes tâches. Des participants venant du QGDN ont également porté et évalué des verres insérés de prescription. Quatre personnes de NDHQ portait et évalué des verres insérés aussi. Le présent rapport contient les données recueillies auprès des membres du 3e Bataillon, Princess Patricia's Canadian Light Infantry.

L'évaluation des verres insérés de prescription était basée sur les critères suivants : acuité visuelle, champ de vision, caractéristiques spéciales, ajustement, compatibilité aux activités et à l'équipement, degré d'adaptabilité à l'environnement, entretien, protection, réglage, caractéristiques visuelles, confort et appréciation globale. La collecte des données s'est effectuée à l'aide de questionnaires, de mesures du rendement et d'évaluations ergonomiques faites par des observateurs.

Dans l'ensemble, les soldats considèrent que les verres insérés de prescription répondent de façon acceptable à tous les critères. La principale préoccupation touchant cet équipement était sa durabilité. Au cours des essais, quelques verres insérés se sont brisés au point de fixation avec le pont des LPB. Selon les soldats, ces verres de prescription sont une solution acceptable, sauf en ce qui a trait à la question de leur durabilité.

On recommande que le mécanisme de fixation soit conçu de façon à être plus durable.

Executive Summary

This trial was conducted to determine if the prescription (R/x) BEW solution was acceptable for employment by soldiers performing mission essential tasks operating throughout the 24-hour continuum.

Nine regular force infantry soldiers from the 3rd Battalion Princess Patricia's Canadian Light Infantry (3 PPCLI), Edmonton, Alberta, participated in this trial. They wore the R/x inserts while performing various tasks. Four participants from NDHQ wore and evaluated the R/x inserts as well. This report presents the data from the 3 PPCLI participants.

This study consisted of a longitudinal portion and a standardized test portion. For the longitudinal portion, the participants were asked to wear the R/x inserts as often as possible and to fill out a log of their activities and comments on the R/x inserts over three months. For the standardized test portion only the soldiers from 3 PPCLI participated. In Fort Benning, Georgia, the soldiers performed the following tasks: section attacks, Fighting In Built-Up Areas (FIBUA), day patrolling and obstacle course. The soldiers completed task and exit questionnaires and participated in a focus group discussion.

The R/x insert was evaluated on the following criteria: visual acuity, field of view, special features, fit, compatibility with activities and equipment, environmental suitability, care, protection, adjustment, visual characteristics, comfort, and overall ratings. Data collection included questionnaires, performance measures, and HF observer assessments.

Overall the soldiers found the R/x insert solution to be acceptable for all criteria. The main concern regarding the R/x insert was its durability. During the trial a few of the inserts broke at the attachment point to the BEW nose bridge. The soldiers stated that they found the R/x solution to be acceptable except for this durability issue.

It is recommended that this attachment mechanism be made more durable.

Sommaire

Le présent essai a été effectué afin de déterminer si les LPB avec verres de prescription sont un équipement approprié pour les soldats dans l'accomplissement de tâches essentielles à la mission au cours d'une période continue de 24 heures.

Neuf soldats d'infanterie de la Force régulière affectés au 3e Bataillon, Princess Patricia's Canadian Light Infantry (3 PPCLI), à Edmonton, en Alberta, ont participé à cet essai. Chacun d'eux portait les verres insérés pour exécuter différentes tâches. D'autres participants venant du QGDN ont également porté et évalué des verres insérés de prescription. Le présent rapport contient les données recueillies auprès des membres du 3 PPCLI.

L'étude comportait deux volets : une portion longitudinale et une portion de tests standardisés. En ce qui concerne la portion longitudinale, on a demandé aux participants de porter les verres insérés de prescription le plus souvent possible et, sur une période de trois mois, de tenir un registre de leurs activités où ils noteraient leurs commentaires sur ces verres. Seuls les soldats du 3 PPCLI ont participé à la portion de tests standardisés. À Fort Benning, en Géorgie, les soldats ont effectué les tâches suivantes : attaques de section, opérations dans les zones bâties (Op ZB), patrouille de jour et parcours d'obstacles. Les soldats ont accompli les tâches, rempli les questionnaires de départ et participé à un groupe de discussion.

L'évaluation des verres insérés de prescription était basée sur les critères suivants : acuité visuelle, champ de vision, caractéristiques spéciales, ajustement, compatibilité aux activités et à l'équipement, degré d'adaptabilité à l'environnement, entretien, protection, réglage, caractéristiques visuelles, confort et appréciation globale. La collecte des données s'est effectuée à l'aide de questionnaires, de mesures du rendement et d'évaluations ergonomiques faites par des observateurs.

Dans l'ensemble, les soldats considèrent que les verres insérés de prescription répondent de façon acceptable à tous les critères. La principale préoccupation touchant cet équipement était sa durabilité. Au cours des essais, quelques verres insérés se sont brisés au point de fixation avec le pont des LPB. Selon les soldats, ces verres de prescription sont une solution acceptable, sauf en ce qui a trait à la question de leur durabilité.

On recommande que le mécanisme de fixation soit conçu de façon à être plus durable.

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1. Background

ReVision Eyewear has been awarded a contract to produce Ballistic Protective Eyewear (BEW) for the Land Forces as part of the Clothe the Soldier (CTS) project. The BEW is capable of incorporating prescription lenses through a contract option, but is not linked to the procurement of the BEW. DLR is considering purchasing this option as an interim solution for prescription (R/x) eyewear if it is considered acceptable.

The BEW will provide ballistic, solar and UV protection in day or night and in all weather conditions. Ocular protection will be further enhanced through the Ballistic Protective Visor (BPV) project. However, approximately 40% of the Land Forces require prescription (R/x) lenses. The existing combat spectacles, which are compatible with the C4 gas mask, are not compatible with BEW. The combat spectacles are due to be replaced by the Operational Integrated Corrective Spectacles (OPTICS). An interim R/x lens is being developed for the C4 gas mask that again will not be compatible with BEW. In order to reduce the project risk an interim R/x solution was incorporated into the project and will remain in service until OPTICS is ready. OPTICS will complete development after the BEW is selected so that the two systems are fully compatible.

This trial was conducted from March to May 2004 and assessed the acceptability of the R/x solution.

2. Aims

The main aim of this trial was to determine if the R/x solution tested was acceptable for employment by soldiers performing mission-essential tasks operating throughout the 24-hour continuum. Secondary goals of this trial included:

- Preliminary assessment of the level of comfort and ease of use of the R/x solution;
- Preliminary assessment of durability and long-term maintenance; and
- Preliminary assessment of the overall acceptability of the R/x solution.

3. Method

The following description provides a general overview of the trial method. Further details are provided in subsequent sections.

Participants from the 3rd Battalion Princess Patricia's Canadian Light Infantry, Edmonton, Alberta and participants from NDHQ in Ottawa, Ontario were issued R/x BEW in March 2004 to assess their use in cold weather for everyday activities. They wore the eyewear for the months of March, April and May, 2004.

A fifteen-day field trial was undertaken at Fort Benning, Georgia over the period of April to May 2004. Nine regular force infantry soldiers from the 3rd Battalion Princess Patricia's Canadian Light Infantry, Edmonton, Alberta, participated in this trial. They wore the R/x inserts while performing various tasks. The participants from NDHQ wore and evaluated the R/x inserts but did not participate in the testing at Fort Benning Georgia.

Human factors tests assessed visual acuity, field of view, special features, fit, compatibility with activities and equipment, environmental suitability, care, protection, adjustment, visual characteristics, comfort, and overall ratings. Data collection included questionnaires, performance measures and HF observer assessments.

3.1 R/x Ballistic Eye Wear

The ReVision MIL-001 (ReVision) consisted of a lens carrying browbar, straight temples, a nosepiece, and interchangeable lenses. The temples had adjustable length arms but were not capable of pantoscopic tilt adjustment. The ReVision BEW were also equipped with an elastic retention strap. Lenses were available in clear, and sunglass (neutral grey). All lenses were ballistic protective and capable of defeating a 5.8-grain, T-37 shaped fragment-simulating projectile at 650 feet per second. The eyewear were designed to accommodate the 5th percentile female to the 95-percentile male in one size. The R/x solution had an R/x insert that clipped onto the nose bridge of the ReVision BEW. Refer to Figure 1.

Figure 1: BEW with R/x Inserts

3.2 Approach

This trial consisted of a longitudinal portion and a standardized test portion.

3.2.1 Longitudinal Portion

At the beginning of March 2004, the BEW with R/x inserts were issued to 16 participants from the 3rd Battalion Princess Patricia's Canadian Light Infantry, Edmonton, Alberta. They were instructed to wear the eyewear as often as possible. They were asked to fill out a log of their activities, the amount of time they wore the R/x inserts glasses, and any additional comments. Only 6 of these 16 participants were able to participate in the standardized test portion in Georgia.

Four participants from NDHQ were also issued the R/x inserts in March 2004. They were instructed to fill out a log of the activities, the amount of time they wore the R/x inserts glasses, and any additional comments. The experimenter collected this log at a later date and at that time the participants were asked to fill out an Exit Questionnaire.

3.2.2 Standardized Test Portion

The standardized test portion took place in Fort Benning, Georgia in conjunction with the Soldier Information Requirements Technology Demonstration (SIREQ TD) experimental series FBES VII. Nine soldiers (six from the longitudinal portion and three additional participants) from the 3rd Battalion Princess Patricia's Canadian Light Infantry (3 PPCLI), Edmonton, Alberta performed the following tasks: section attacks, FIBUA (Fighting in Built-up Areas), day patrolling, obstacle course. These participants completed task and exit questionnaires and participated in a focus group discussion. The NDHQ participants did not participate in this testing portion.

3.2.2.1 Objective Tests

The following tests were planned but unable to be conducted due to technical constraints:

Visual Acuity: Near and far acuity while wearing the trial R/x inserts and, for baseline, regular glasses were measured. These measurements were done with the Optic 3500 Vision Tester.

Rifle Firing Performance: Rifle firing accuracy (hits) was recorded automatically for each target through the controller interface. Targets were programmed such that one hit would drop the target. Rifle firing accuracy was collected for baseline (wearing regular glasses) and for the R/x inserts.

3.2.2.2 Subjective Tests

Task Questionnaires: Task Questionnaires assessed various eyewear features as well as a number of visual acuity and field of view traits. Participants filled out Task Questionnaires at the end of day for the tasks they performed that day. Refer to Annex A.

Exit Questionnaire: The Exit Questionnaire assessed the overall acceptability of the eyewear for comfort, ease of use, durability, long-term maintenance, and features of the R/x insert glasses. Exit Questionnaires were filled out during the focus group at the end of the trial. Refer to Annex B.

Focus Group: A focus group discussion took place at the end of the trial.

3.2.2.3 Participants

Data was collected from nine regular force infantry soldiers from 3rd Battalion Princess Patricia's Canadian Light Infantry (4 Privates, 2 Cpls, 2 Sgts and 1 Lt). The average age of the participants was 30.8±4.8 and the average length of service was 9.5±6.4. Four participants at NDHQ (1 Sgt, 1 Capt, 1 Maj and 1 civilian) were also issued eyewear. Only exit questionnaire and focus group data was collected for these participants.

3.3 Questionnaire Rating Scale

Participants rated acceptability for all questionnaires using the following seven-point scale – see Figure 2.

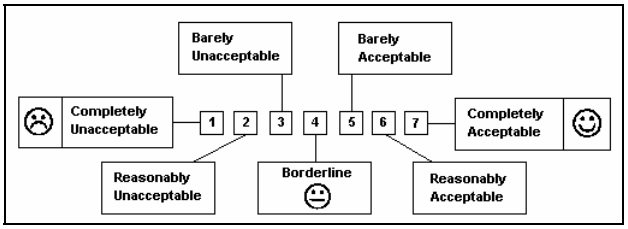


Figure 2: Standard Rating Scale

4. Limitations

The small number of participants in this study amplified the effects of any individual participant's ratings on the overall results. This effect should be considered when evaluating the results.

Three soldiers in the Fort Benning trial and one soldier in the NDHQ trial thought they had received the wrong prescription. These soldiers did not wear their R/x insert for very long and thus were not able to fully evaluate the eyewear.

Five of the soldiers' R/x inserts broke early in the trial. These soldiers did not wear the R/x insert throughout the trial and thus were not able to fully evaluate the eyewear.

Because this study was conducted in conjunction with the SIREQ FBES #7 experiment in Fort Benning, Georgia, there were limited resources and time constraints. Due to this limitation, the intended objective tests (visual acuity and rifle firing accuracy tests) while wearing the R/x inserts were not conducted.

5. Results

5.1 This report presents statistical results only from the soldiers of the 3rd Battalion Princess Patricia's Canadian Light Infantry that participated in the testing at Fort Benning, Georgia. Although 16 systems were issued to soldiers from 3 PPCLI, only nine soldiers attended the Fort Benning trial. Of the nine soldiers attending the trial only five soldiers were able to complete the majority of the tests with the insert systems. The focus group feedback in this report is from both the testing at Fort Benning and the NDHQ participants.

In total, five participants filled out the task questionnaire. Three of these participants filled out the task questionnaire twice, on two different days. The average of these two questionnaires was used as the data for these participants. The results below indicate the percentage of the five participants rating the criteria greater than or equal to 4 ("borderline"). Please note the shading indicates those criteria that failed to meet the minimum 80% user acceptance level. The 80% user acceptance level has been utilized as a compliance standard in other BEW human factors requirements testing.

5.1.1 Overall Ratings

All of the participants rated the R/x inserts acceptable (i.e. ≥ 4) for the following overall criteria: task performance, eyewear stability, adjustment retention, eyewear compatibility, thermal comfort, physical comfort, weight, fit, adjustability, and protection afforded. Less than 80% of the participants rated the durability of the R/x inserts to be acceptable. Refer to Table 1.

Table 1: Overall - Task Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
Task Performance	100%
Eyewear Stability	100%
Adjustment Retention	100%
Eyewear Compatibility	100%
Thermal Comfort	100%
Physical Comfort	100%
Weight	100%
Fit	100%
Adjustability	100%
Protection Afforded	100%

Durability	60%

5.1.2 Visual Acuity

All of the participants rated the visual acuity criteria acceptable (i.e. ≥ 4). The criteria included: near distance (0-2'), mid distance (10'-25'), far distance (50' to horizon), large objects, small objects, low contrast, low light, well lit, high glare, colour perception, and depth perception. Refer to Table 2.

Table 2: Visual Acuity - Task Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
Visual Acuity	
Near distance (0-2')	100%
Mid distance (10'-25')	100%
Far distance (50' to horizon)	100%
Large objects	100%
Small objects	100%
Low contrast	100%
Low light	100%
Well lit	100%
High glare	100%
Colour perception	100%
Depth perception	100%

5.1.3 Field of View

Greater than or equal to 80% of the participants found the following field of view criteria to be acceptable (i.e. ≥ 4): visual distortion, blind spots, looking up/down, looking side to side, and overall vision. Refer to Table 3.

Table 3: Field of View - Task Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
Field of View	
Visual distortion	100%
Blind spots	100%
Looking up / down	100%
Looking side to side	80%
Overall Vision	100%

5.1.4 Overall Rating for this Task

All of the participants gave an acceptable rating (i.e. ≥ 4) for the 'overall rating for this task' criterion. Refer to Table 4. 'This task' refers to a day of wearing the R/x inserts while performing various infantry duties.

Table 4: Overall Rating for this Task – Task Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
Overall Rating for this Task	
Overall Rating for this Task	100%

5.1.5 Discomfort

The participants rated the discomfort level of the R/x inserts on a 5-pt scale where one represented a 'neutral' rating and five represented an 'extreme pain' rating (Figure 3). The participants found the discomfort level to be 'neutral' with an average rating of 1.3. One participant mentioned slight discomfort over his left ear when wearing the eyewear with a helmet and headset.

Neutral	Slight Discomfort	Noticeable Discomfort	Pain	Extreme Pain
1	2	3	4	5

Figure 3: 5-pt Rating Scale of Discomfort

5.2 Exit Questionnaire

In total, nine participants filled out the exit questionnaire. Five of these individuals had also filled out the task questionnaire. The results below indicate the percentage of the nine participants rating the criteria greater than or equal to 4 ("borderline"). Please note the shading indicates those criteria that failed to meet the minimum 80% user acceptance level. The 80% user acceptance level has been utilized as a compliance standard in other BEW human factors requirements testing.

5.2.1 Special Features – Function

More than 80% of the participants rated the function of the following special features to be acceptable (i.e. ≥ 4): frame, temple arm, temple arm hinge, adjustable arm length, temple arm ends, nose bridge, R/x lens insert, and carrying case. Less than 80% of the participants rated the R/x lens function and the R/x lens retention system acceptable (i.e. ≥ 4). Refer to Table 5.

Table 5: Special Features – Function Exit Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
Special Features – Function	
Frame	100%
Temple Arm	100%
Temple Arm Hinge	100%
Adjustable Arm Length	100%
Temple Arm Ends	100%
Nose Bridge	89%
R/x Lens	67%
R/x Lens Insert	89%
R/x Lens Retention System	78%
Carrying Case	100%

5.2.2 Special Features – Durability

More than 80% of the participants rated the durability of the following special features to be acceptable (i.e. ≥ 4) for the following features: frame, temple arm, temple arm hinge, adjustable arm length, temple arm ends, nose bridge, and carrying case. Less than 80% of the participants found the durability of the following features to be acceptable (i.e. ≥ 4): R/x lens, R/x lens insert, and R/x lens retention system. Refer to Table 6.

Table 6: Special Features – Durability Exit Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
Special Features - Durability	
Frame	89%
Temple Arm	100%
Temple Arm Hinge	100%
Adjustable Arm Length	100%
Temple Arm Ends	100%
Nose Bridge	89%
R/x Lens	56%
R/x Lens Insert	44%
R/x Lens Retention System	56%
Carrying Case	100%

5.2.3 Fit

More than 80% of the participants rated the fit of the R/x inserts acceptable (i.e. ≥ 4) for the following features: temple arm length, frame width, nose bridge width, nose bridge height, clearance from cheeks, and over ears. Less than 80% of the participants rated the proximity to the eyes as acceptable (i.e. ≥ 4). Refer to table 7.

Table 7: Fit Exit Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
Fit	
Temple Arm Length	100%
Frame Width	100%
Nose Bridge Width	89%
Nose Bridge Height	89%
Clearance from Cheeks	89%
Over Ears	100%
Proximity to the Eyes	78%

5.2.4 Activities

More than 80% of the participants rated the R/x inserts acceptable (i.e. ≥ 4) for the following activities: crawling, looking down, obstacles, marching flat, marching rough terrain, running, fine movements, C7 fire, C7 handling, run down drills, sighting while standing, sighting while kneeling, sighting while prone, vehicle movement, rolling, and fire and movement. Refer to Table 8.

One participant wore the R/x inserts during a military parachuting exercise. He rated the R/x inserts as acceptable (i.e. ≥ 4) for this activity.

Table 8: Activities Exit Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
Activities	
Crawling	100%
Looking Down	89%
Obstacles	100%
Marching Flat	100%
Marching Rough Terrain	100%
Running	89%
Fine Movements (detailed hand movements)	100%
C7 Firing	100%
C7 Handling	100%
Run Down Drills	89%
Sighting While Standing	100%
Sighting While Kneeling	100%
Sighting While Prone	100%
Vehicle Movement	100%
Rolling	100%
Fire and Movement	100%

5.2.5 Compatibility

More than 80% of the participants found the compatibility of the R/x inserts to be acceptable (i.e. ≥ 4) for the following criteria: weapons sights, binoculars, helmets, and vehicle entry and exit. Less than 80% of the participants or less rated the compatibility of the R/x inserts with the section radio and weapons as acceptable (i.e. ≥ 4). Refer to Table 9.

Table 9: Compatibility Exit Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
Compatibility	
Weapon Sights	86%
Binoculars	83%
Helmets	100%
Section Radio	50%
Weapons	71%
Vehicle Entry and Exit	100%

5.2.6 Environmental Suitability

More than 80% of the participants found the environmental suitability of the R/x inserts to be acceptable (i.e. ≥ 4) for the following criteria: snow and wind. Less than 80% of participants found the environmental stability of the R/x inserts to be acceptable (i.e. ≥ 4) for the following criteria: cold weather, cool weather, warm weather, hot weather, rain, and dust. Refer to Table 10.

Table 10: Environmental Suitability Exit Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
Environmental Suitability	
Cold Weather	60%
Cool Weather	60%
Warm Weather	75%
Hot Weather	50%
Snow	80%
Rain	71%
Wind	89%
Dust	75%

5.2.7 Care

More than 80% of the participants rated the care of the R/x inserts acceptable (i.e. ≥ 4) for storage and cleaning. Less than 80% of the participants rated the care of the R/x inserts for lens scratches and repairs as acceptable (i.e. ≥ 4). Refer to Table 11.

Table 11: Care Results

Criteria	User Acceptance Rating ≥ 4
Care	
Lens Scratches	56%
Repairs	57%
Storage	100%
Cleaning	89%

5.2.8 Protection

More than 80% of the participants rated the R/x inserts protection acceptable (i.e. ≥ 4) for side protection and carrying case. Less than 80% of the participants found the protection of the lens size to be acceptable (i.e. ≥ 4). Refer to Table 12.

Table 12: Protection Exit Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
Protection	
Lens Size	78%
Side Protection	89%
Carrying Case	100%

5.2.9 Adjustment

More than 80% of the participants rated the ease of R/x inserts adjustment to be acceptable (i.e. ≥ 4) for the following criteria: initial assembly, put on, adjust fit, take off, range of adjustments, and adjustment retention. Less than 80% of the participants found the ease of changing lenses to be acceptable (i.e. ≥ 4). Refer to Table 113.

Table 13: Adjustment Exit Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
Adjustment	
Initial Assembly	100%
Put On	100%
Adjust Fit	100%
Take Off	89%
Range of Adjustments	100%
Changing Lenses	67%
Adjustment Retention	89%

5.2.10 Visual Characteristics

More than 80% of the participants rated the visual characteristics of the R/x inserts acceptable (i.e. ≥ 4) for degree of tint and degree of coverage. Less than 80% of the participants rated the visual characteristics of the R/x inserts acceptable (i.e. ≥ 4) for the following criteria: haze, fog due to environment, fog due to workload, and depth perception. Refer to Table 14.

Table 14: Visual Characteristics Exit Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
Visual Characteristics	
Haze	75%
Fog due to Environment	44%
Fog due to Workload	33%

Degree of Tint	88%
Degree of Coverage	89%
Depth Perception	78%

5.2.11 Visual Acuity

More than 80% of the participants rated the visual characteristics of the R/x inserts acceptable (i.e. ≥ 4) for the following criteria: near distance (0-2'), mid distance (10'-25'), far distance (50' to horizon), large objects, small objects, low contrast, low light, well lit, and colour perception. Less than 80% of the participants rated the high glare of the R/x inserts to the acceptable. Refer to Table 115.

Table 15: Visual Acuity Exit Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
Visual Acuity	
Near distance (0-2')	100%
Mid distance (10'-25')	100%
Far distance (50' to horizon)	100%
Large Objects	100%
Small Objects	100%
Low Contrast	100%
Low Light	100%
Well Lit	100%
High Glare	78%
Colour perception	89%

5.2.12 Field of View

More than 80% of the participants rated the R/x inserts field of view to be acceptable (i.e. ≥ 4) for blind spots, looking up/down, and looking side to side. Less than 80% of the participants found the visual distortion of the R/x inserts to be acceptable (i.e. ≥ 4). Refer to Table 16.

Table 16: Field of View Exit Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
Field of View	
Visual Distortion	78%
Blind Spots	89%
Looking up/down	89%
Looking side to side	89%

5.2.13 Comfort

More than 80% of the participants rated the comfort of the R/x inserts acceptable (i.e. ≥ 4) for the following criteria: skin irritation, hot spots, eyelash contact, weight, and frame movement. Less than 80% of the participants rated the R/x inserts comfort to be acceptable (i.e. ≥ 4) for pressure points and headaches. Refer to Table 17.

Table 17: Comfort Exit Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
Comfort	
Skin Irritation	100%
Hot Spots	100%
Eyelash Contact	89%
Pressure Points	67%
Headaches	78%
Weight	100%
Frame Movement	89%

5.2.14 Other Criteria

Mote than 80% of the participants rated the R/x inserts to be acceptable (i.e. ≥ 4) for the following criteria: appearance, lens shape, and stability. Refer to Table 18.

Table 18: Other Criteria Exit Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
Other Criteria	
Appearance	100%
Lens Shape	100%
Stability	89%

5.2.15 Overall Ratings

More than 80% of the participants' overall ratings of the R/x inserts were acceptable (i.e. ≥ 4) for the following criteria: functionality, activities, care, compatibility, protection, physical comfort, fit, environmental suitability, adjustment, and thermal comfort. Less than 80% of the participants' overall ratings of the R/x inserts were acceptable (i.e. ≥ 4) for visual characteristics and durability. Refer to Table 79.

Table 79: Overall Ratings Exit Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
Overall Ratings	
Functionality	100%
Activities	100%
Care	89%
Visual Characteristics	78%
Durability	75%
Compatibility	100%
Protection	100%
Physical Comfort	100%
Fit	100%
Environmental Suitability	100%
Adjustment	100%
Thermal Comfort	100%

5.2.16 System Acceptance

The R/x inserts system was accepted overall by 89% of the participants. Refer to Table 20.

Table 20: System Acceptance Exit Questionnaire Results

Criteria	User Acceptance Rating ≥ 4
System Acceptance	
Overall	89%

5.3 Durability Issues

Five of the soldiers' R/x inserts broke during this study. The inserts all broke at the nose bridge (Figure 4). The fractures started on the inside of the nose bridge (Figure 5). The inserts broke while changing the BEW lens.

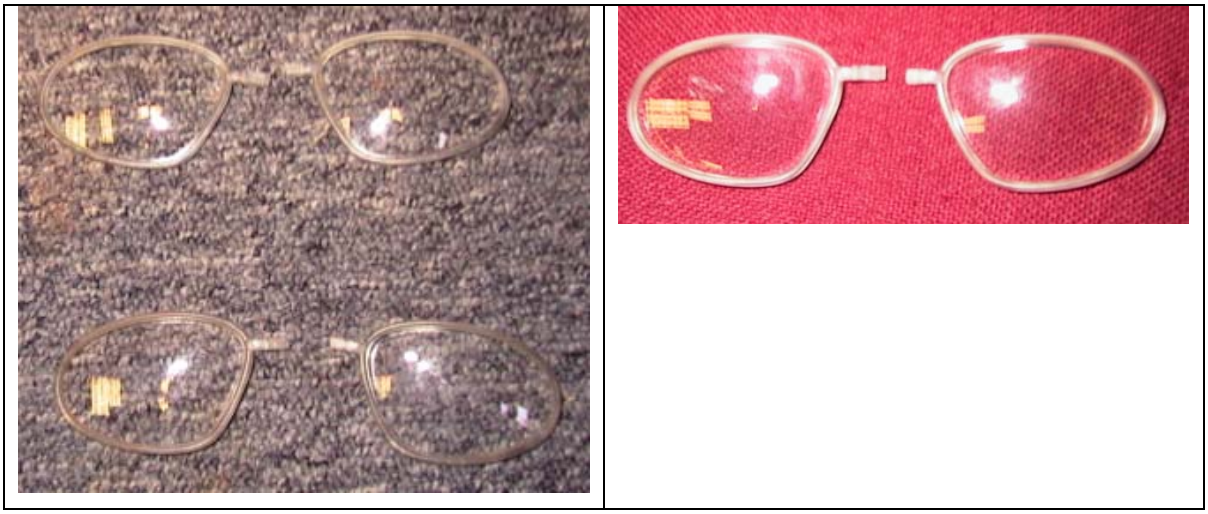


Figure 4: Broken R/x inserts

Figure 5: Initial Fracture of R/x inserts Focus Group Discussion

All participants at the end of the trial participated in a focus group discussion regarding the R/x inserts. A summary of the comments made by the Fort Benning and NDHQ participants is presented below.

- Five participants found that their R/x insert frame broke while changing the BEW lens. The attachment mechanism on the nosepiece for the R/x insert needs to be made more durable.
- The eyewear fogged easily and sweat poured down between the Rx insert lens and the shield during physical activity.
- A number of the participants found the lens to be too close to the eyes. Unlike their normal prescription, which has some standoff, the insert seemed to cause a fishbowl effect. Similarly, some of the participants reported annoying eyelash contact. In order to compensate for eyelash contact soldiers tried to adjust the arms so that the glasses fit lower on the nose, which then made the glasses fit too low. For some users it was difficult to find a comfortable position for wearing the BEW with the R/x insert.
- The slight increase in magnification of the R/x inserts gave a couple of the soldiers headaches. Three soldiers In the Fort Benning trial and one soldier in the NDHQ trial thought they had received the wrong prescription (believed the prescription was too

strong). Given the number of soldiers who believed they had received the wrong prescription the correction factor for the protective lens should be re-examined.

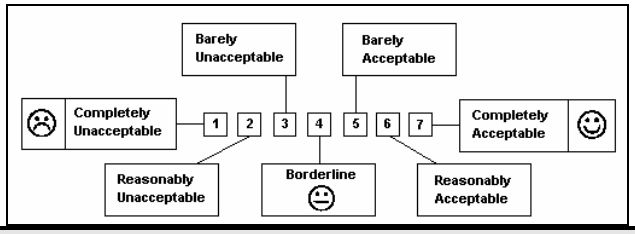
- Making the frame of the insert rubberized and pressing against the BEW lens may reduce the number of particles collecting between the lenses.
- The soldiers would like the eyewear to have an anti-scratch and an anti-glare coating. A number of soldiers commented that depending on the light there was a glare problem between the insert and the outer shield. They reported that glare was most noticeable after initial issue and the majority of soldiers overcame the annoyance within two days.
- All of the soldiers in the Fort Benning trial would prefer to have the BEW lenses with built-in prescription so that the insert would not be needed.
- All of the soldiers believed that the insert system would be acceptable if the durability concerns were addressed.

6 Discussion

Overall the soldiers found the R/x inserts solution to be acceptable for all criteria. The main concern of the participants' was the durability of the R/x inserts. During this trial 36% of the inserts broke at the attachment mechanism to the BEW at the nose bridge. The soldiers stated that they found the R/x solution to be acceptable except for this durability issue. It is recommended that this attachment mechanism is made more durable to withstand frequent interchanging of the BEW lenses.

Annex A – Task Questionnaire

Excellence in Applied Ergonomics



PERSONAL DATA **Clearly indicate your Name, Subject Number and Eyewear Type.**

Subject #_____ **Date:** _____

Eyewear Type: R/x ☐

Task: **Obstacle Course** ☐ **Section Attack** ☐ **Day Patrolling** ☐

FIBUA ☐ **Night Patrolling** ☐ **Live Fire Range** ☐

Other: _____

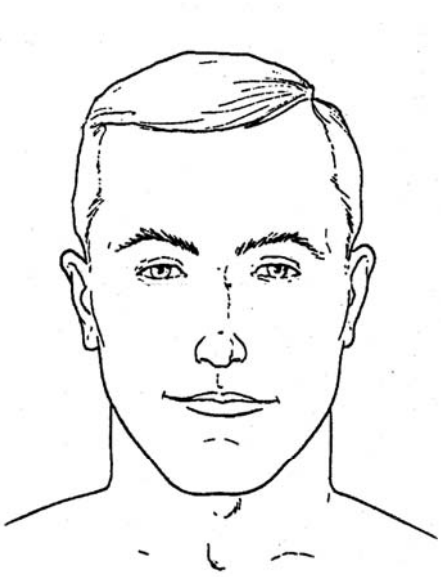
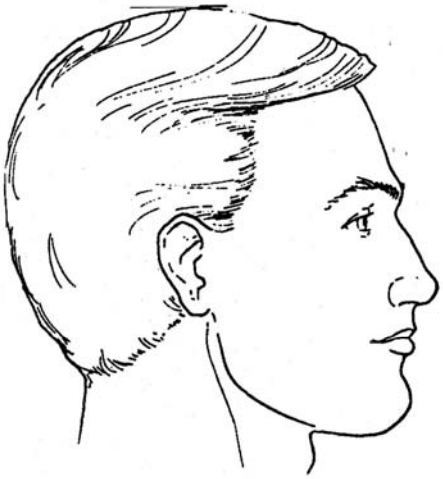
Rate the following Features	User Acceptance Rating ☹ 1 2 3 😐 4 5 6 ☺ 7	Comments (use backside if required)
Task Performance	◯ ◯ ◯ ◯ ◯ ◯ ◯	
Eyewear Stability	◯ ◯ ◯ ◯ ◯ ◯ ◯	
Adjustment Retention	◯ ◯ ◯ ◯ ◯ ◯ ◯	
Eyewear Compatibility	◯ ◯ ◯ ◯ ◯ ◯ ◯	
Thermal Comfort	◯ ◯ ◯ ◯ ◯ ◯ ◯	
Physical Comfort	◯ ◯ ◯ ◯ ◯ ◯ ◯	
Weight	◯ ◯ ◯ ◯ ◯ ◯ ◯	
Fit	◯ ◯ ◯ ◯ ◯ ◯ ◯	
Adjustability	◯ ◯ ◯ ◯ ◯ ◯ ◯	

Protection Afforded	○ ○ ○ ○ ○ ○ ○	
Durability	○ ○ ○ ○ ○ ○ ○	

Rate the following Features	User Acceptance Rating ☹ 😐 ☺ 1 2 3 4 5 6 7	Comments (use backside if required)
Visual Acuity		
Near distance (0-2')	○ ○ ○ ○ ○ ○ ○	
Mid distance (10'-25')	○ ○ ○ ○ ○ ○ ○	
Far distance (50' to horizon)	○ ○ ○ ○ ○ ○ ○	
Large objects	○ ○ ○ ○ ○ ○ ○	
Small objects	○ ○ ○ ○ ○ ○ ○	
Low contrast	○ ○ ○ ○ ○ ○ ○	
Low light	○ ○ ○ ○ ○ ○ ○	
Well lit	○ ○ ○ ○ ○ ○ ○	
High glare	○ ○ ○ ○ ○ ○ ○	
Colour perception	○ ○ ○ ○ ○ ○ ○	
Depth perception	○ ○ ○ ○ ○ ○ ○	
Field of View		
Visual distortion	○ ○ ○ ○ ○ ○ ○	
Blind spots	○ ○ ○ ○ ○ ○ ○	
Looking up / down	○ ○ ○ ○ ○ ○ ○	
Looking side to side	○ ○ ○ ○ ○ ○ ○	
Overall Vision	○ ○ ○ ○ ○ ○ ○	

Overall Rating for this Task	○ ○ ○ ○ ○ ○ ○	

Physical Discomfort

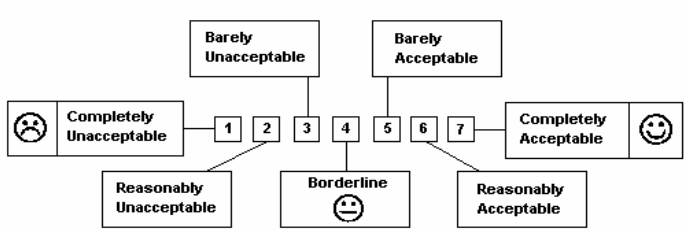
Using the different views of the head below, draw in the areas where you felt discomfort. Indicate how much discomfort by assigning a number from the scale to the right.	**Neutral** **1**	**Slight Discomfort** **2**	**Noticeable Discomfort** **3**	**Pain** **4**	**Extreme Pain** **5**
					
COMMENTS:					

Annex B – Exit Questionnaire

Ballistic Eyewear R/x – Exit Questionnaire

DATE: _____

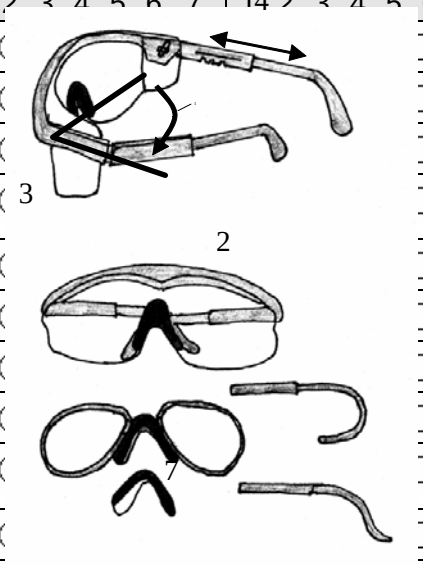
PARTICIPANT NUMBER: _____



Lens: R/x $

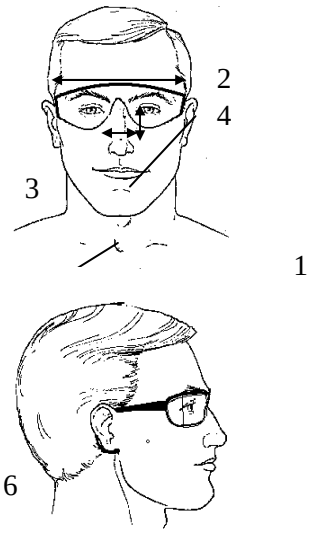
Section A: Specific Features

	Function (works well) ☹ 1 2 3 4 5 6 7 ☺	Durability (wears well) ☹ 1 2 3 4 5 6 7 ☺
1. Frame	○ ○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○ ○
2. Temple Arm	○ ○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○ ○
3. Temple Arm Hinge	○ ○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○ ○
4. Adjustable Arm Length	○ ○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○ ○
5. Temple Arm Ends	○ ○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○ ○
6. Nose Bridge	○ ○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○ ○
7. R/x Lens	○ ○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○ ○
8. R/x Lens Insert	○ ○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○ ○
9. R/x Lens Retention System	○ ○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○ ○
10. Carrying Case	○ ○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○ ○

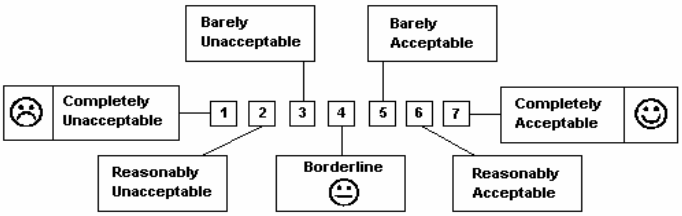


Section B: Fit

	☹ 1	2	3	☺ 4	5	6	7
1. Temple Arm Length	○	○	○	○	○	○	○
2. Frame Width	○	○	○	○	○	○	○
3. Nose Bridge Width	○	○	○	○	○	○	○
4. Nose Bridge Height	○	○	○	○	○	○	○
5. Clearance from Cheeks	○	○	○	○	○	○	○
6. Over Ears	○	○	○	○	○	○	○
7. Proximity to the Eyes	○	○	○	○	○	○	○



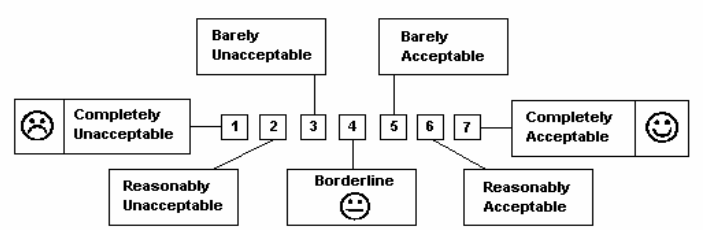
Section C: Whole Item



Activities	☹ 1 2 3 4 5 6 7 ☺	Environmental Suitability	☹ 1 2 3 4 5 6 7 ☺
Crawling	○○○○○○○	Cold Weather	○○○○○○○
Looking Down	○○○○○○○	Cool Weather	○○○○○○○
Obstacles	○○○○○○○	Warm Weather	○○○○○○○
Marching Flat	○○○○○○○	Hot Weather	○○○○○○○
Marching Rough Terrain	○○○○○○○	Snow	○○○○○○○
Running	○○○○○○○	Rain	○○○○○○○
Fine Movements	○○○○○○○	Wind	○○○○○○○
C7 Firing	○○○○○○○	Dust	○○○○○○○
C7 Handling	○○○○○○○	**Care**	☹ ☺
Run Down Drills	○○○○○○○	Lens Scratches	○○○○○○○
Sighting While Standing	○○○○○○○	Repairs	○○○○○○○
Sighting While Kneeling	○○○○○○○	Storage	○○○○○○○
Sighting While Prone	○○○○○○○	Cleaning	○○○○○○○
Vehicle Movement	○○○○○○○	**Protection**	☹ ☺
Rolling	○○○○○○○	Lens Size	○○○○○○○
Fire and Movement	○○○○○○○	Side Protection	○○○○○○○
		Carrying Case	○○○○○○○
Compatibility	☹ ☺	**Adjustment**	☹ ☺
Weapon Sights	○○○○○○○	Initial Assembly	○○○○○○○
Binoculars	○○○○○○○	Put On	○○○○○○○
Helmets	○○○○○○○	Adjust Fit	○○○○○○○
Masks	○○○○○○○	Take Off	○○○○○○○
Section Radio	○○○○○○○	Range of Adjustments	○○○○○○○
Weapons	○○○○○○○	Changing Lenses	○○○○○○○
Vehicle Entry and Exit	○○○○○○○	Adjustment Retention	○○○○○○○

Ballistic Eyewear R/x – Exit Questionnaire

Section C: Whole Item (continued)



Visual Characteristics	☹ 1 2 3	😐 4	☺ 5 6 7
Haze	○	○	○
Fog due to Environment	○	○	○
Fog due to Workload	○	○	○
Degree of Tint	○	○	○
Degree of Coverage	○	○	○
Degree of Tint	○	○	○
Degree of Coverage	○	○	○
Depth Perception	○	○	○
Visual Acuity	☹	😐	☺
Near distance (0-2')	○	○	○
Mid distance (10'-25')	○	○	○
Far distance (50' to horizon)	○	○	○
Large Objects	○	○	○
Small Objects	○	○	○
Low Contrast	○	○	○
Low Light	○	○	○
Well Lit	○	○	○
High Glare	○	○	○
Colour perception	○	○	○

Field of View	☹ 1 2 3	😐 4	☺ 5 6 7
Visual Distortion	○	○	○
Blind Spots	○	○	○
Looking up/down	○	○	○
Looking side to side	○	○	○
Comfort	☹	😐	☺
Skin Irritation	○	○	○
Hot Spots	○	○	○
Eyelash Contact	○	○	○
Pressure Points	○	○	○
Headaches	○	○	○
Weight	○	○	○
Frame Movement	○	○	○
Other	☹	😐	☺
Appearance	○	○	○
Lens Shape	○	○	○
Stability	○	○	○

Section D: Overall Ratings

	☹ 😐 ☺		☹ 😐 ☺		☹ 😐 ☺
Functionality	○○○○○○○	**Durability**	○○○○○○○	**Fit**	○○○○○○○
Activities	○○○○○○○	**Compatibility**	○○○○○○○	**Environmental Suitability**	○○○○○○○
Care	○○○○○○○	**Protection**	○○○○○○○	**Adjustment**	○○○○○○○
Visual Characteristics	○○○○○○○	**Physical Comfort**	○○○○○○○	**Thermal Comfort**	○○○○○○○

System Acceptance	☹ 😐 ☺ 1 2 3 4 5 6 7
Overall	○○○○○○○

Section E: Comments

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Human factors technical memorandum: User trial for ballistic eyewear R/x solution (U)
L'humain factorise le mémorandum technique : le procès d'utilisateur pour la solution de R/X de lunettes balistique

4. AUTHORS (First name, middle initial and last name. If military, show rank, e.g. Maj. John E. Doe.)

Harry A. Angel; Lisa J. Massel

5. DATE OF PUBLICATION (Month and year of publication of document.)

September 2005

6a NO. OF PAGES (Total containing information, including Annexes, Appendices, etc.)

37

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W7711-3-7879/01-TOR

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14. KEYWORDS, DESCRIPTORS or IDENTIFIERS (Technically meaningful terms or short phrases that characterize a document and could be helpful in cataloguing the document. They should be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location may also be included. If possible keywords should be selected from a published thesaurus, e.g. Thesaurus of Engineering and Scientific Terms (TEST) and that thesaurus identified. If it is not possible to select indexing terms which are Unclassified, the classification of each should be indicated as with the title.) (U) ballistic eyewear; prescription lens; visual acuity; field of view; prescription inserts; ballistic protection