

UNIVERSAL CAMOUFLAGE FOR THE FUTURE WARRIOR

A. Dugas*, K. J. Zupkofska, A. DiChiara and F. M. Kramer
U.S. Army Research, Development and Engineering Command, Natick Soldier Center
Natick, MA 01760

ABSTRACT

Due to increased deployments with varied missions and new technologies/advanced threats against U.S. Soldiers, a clear need arose for developing camouflage pattern(s) to enhance the Warfighter's survivability on the modern battlefield. Based on these technology enhancements and program doctrine, a family of improved camouflage pattern(s) with enhanced visual and near-infrared properties to support the Future Force Warrior Advanced Technology Demonstration (FFW ATD) effort was developed.

1. INTRODUCTION

A total of 12 improved camouflage pattern(s) with enhanced visual and near-infrared (NIR) properties was developed. The future Warfighter can expect to be deployed anywhere in the world within 96 hours. Therefore, the Soldier needs to be Responsive, Deployable, Versatile, Lethal, and Survivable. This summary will discuss the approach in the development of an improved "universal" camouflage pattern for the FFW.

1.1 PATTERN DEVELOPMENT

Through the use of textile designers, six designs were developed and reviewed for camouflage effectiveness as an initial step. The first set of designs developed included a geometric track-like design (Track) and a design resembling brush strokes (Shadow Line). The second set included four additional designs, including a pattern that had random brush strokes all over (All Over Brush). Three of the six designs were eliminated due to their limited camouflage effectiveness, leaving three designs to move forward. All the patterns were reviewed in the Camouflage Evaluation Facility, Natick Soldier Center (NSC), and finalized into full design repeat, 28" x 40". Within three months, three different novel designs were developed in four color combinations, representing each terrain: Woodland, Urban, Desert and Desert/Urban.

1.2 COLOR SELECTION

Based on historical and spectral terrain data and visual imagery collected, color chips from Pantone® Textile Color Specifier, ©Pantone, Inc. were selected to match the collected imagery for Woodland, Urban and Desert

terrain. Four-color combinations in three designs were developed for a total of 12 experimental camouflage patterns and sample yardages were ink-jet printed on 50/50 Nylon/Cotton material in four-color combinations: Woodland, Desert, Urban and Desert/Urban. During the color development process, a new requirement surfaced to develop a common color in all 12 experimental patterns to make Clothing and Individual Equipment (CIE) interchangeable if multiple camouflage patterns were going to remain in the system. Slight color modifications to the new designs were made to accommodate this new requirement. The final colors are outlined in Table 1.

Table 1. Colors Chosen For The Various Terrain Types

Terrain	Colors
Woodland	Tan*, Brown, Green, Black
Desert	Tan*, Brown, Khaki, Dark Tan
Urban	Tan*, Light Gray, Medium Gray, Black
Desert/Urban	Tan*, Brown, Light Gray, Dark Tan

*Common color

All 12 designs were approved and fabricated into a Battle Dress Uniform (BDU) configuration with matching helmet cover for upcoming field evaluations.

1.3 FIELD EVALUATIONS

Through coordination with Training and Doctrine Command (TRADOC) System Manager-Soldier (TSM), Fort Benning, GA, and the Product Optimization and Evaluation Team, NSC, four distinct phases of field evaluations were executed to assess the "blending" effectiveness of the 12 experimental camouflage patterns against multiple terrains. The first three phases focused on new camouflage designs/color schemes in BDU configurations that offered the most promise as effective across the three environments: Urban, Woodland, and Desert. Phase IV evaluated the down-selected patterns, across all environments, configured in full FFW systems, which consist of helmet, armor chassis, armored load belt, knee and elbow pads, and Modular Lightweight Load Bearing Equipment (MOLLE).

All the patterns evaluated were viewed in all environments during day and night conditions. The objective of the evaluations was to assess each camouflage design's level of blending (the degree to

Report Documentation Page

*Form Approved
OMB No. 0704-0188*

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE 00 DEC 2004	2. REPORT TYPE N/A	3. DATES COVERED -	
4. TITLE AND SUBTITLE Universal Camouflage For The Future Warrior		5a. CONTRACT NUMBER	
		5b. GRANT NUMBER	
		5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)		5d. PROJECT NUMBER	
		5e. TASK NUMBER	
		5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Research, Development and Engineering Command, Natick Soldier Center Natick, MA 01760		8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)	
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited			
13. SUPPLEMENTARY NOTES See also ADM001736, Proceedings for the Army Science Conference (24th) Held on 29 November - 2 December 2005 in Orlando, Florida.			
14. ABSTRACT			
15. SUBJECT TERMS			
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified	UU
			18. NUMBER OF PAGES 2
			19a. NAME OF RESPONSIBLE PERSON

which the camouflage visually matches its environment in terms of color, pattern, brightness, contrast, and reflectance (at night) in a manner which reduces the amount of perceivable separation from the background) and to determine which design blends best and most consistently across multiple terrains. Trained- military Soldiers made ratings of the camouflage designs subjectively.

Phase I consisted of a total of 13 (12 experimental camouflage patterns plus 1 contractor developed) different camouflage uniforms. Using data collected during Phase I, the patterns were down-selected and 11 camouflage printed uniforms were evaluated for Phase II. Data from the second phase of evaluations indicated that the Woodland and Urban Track, Desert All Over Brush, and Scorpion (contractor-developed) patterns performed the best among all the candidates. The next step was to optimize these four patterns by incorporating changes from the field evaluations and focus groups. These patterns were known as “mods” (modifications) to the original camouflage patterns. The “mods” were color changes to incorporate the new goal of developing a *universal* camouflage pattern that will be adaptable in all three terrains: Desert, Woodland and Urban. The camouflage designs were then modified and reevaluated in Phase III. The top four performing designs were down-selected and produced in full FFW system configurations for Phase IV. These systems were evaluated in two distinct woodland, urban, and desert terrains.

1.4 DATA ANALYSIS AND RESULTS

Observer ratings had a possible range from zero to one hundred. These were determined by measuring the placement of their rating marks on the 100mm line scale used in the rating logbooks. Once measured, the data was entered into computers using a Statistical Package for the Social Sciences: Data Entry (SPSSDE). The rating data was paired with target information using a pre-designed observer and target metrics. Data was then cleaned and verified. The Statistical Package for the Social Sciences (SPSS) and Microsoft Excel were used to carry out data analyses and create graphical and tabular summaries of the results during the four phases of the data collection. Analyses of variance were performed to identify any significant differences in blend ratings caused by the test variables: camouflage design, terrain, time of day, distance, posture/view, and target location. A uniform’s performance at night was not necessarily related to its performance in the day, due to the varying NIR properties of the uniforms and the nature of observing camouflage through night vision devices. The down-selection process following each test phase was based on the combined results of the day and night testing in each of the three testing environments. Woodland, urban, and desert

performance were all weighted equally, as were day and night performance. It was important that the uniforms selected to move forward showed high and consistent performance across all three terrains. The designs tested in Phase IV were among the best performers throughout all three phases of testing. They were rated higher and more consistently across each of the three types of test environments than the remaining uniforms. Nighttime results showed little range of difference in ratings between the uniforms. Overall, the best relative performer was the Desert All Over Brush design, followed by Woodland Track Mod, Scorpion Mod, and Urban Track (in ranking order).

ACKNOWLEDGEMENTS

The authors would like to acknowledge and express sincere appreciation to the following individuals for their expertise and efforts throughout this program: James G. Fairney (Material System and Integration Team-MSIT), and Veronica Panciocco (Advanced Technology Team – ATT), Jane Johnson, Allen Wright, Kathy Rock, Ruth Roth (The Product Optimization and Evaluation Team – POET), Dr. Kenneth Parham, Frederick Dupont, Thomas Theaux (Battle Lab Integration Team – BLIT), and Major Keith Smith (TRADOC Soldier Manager - TSM) for all their support in the testing, evaluation and analysis of this project (May 01 – June 04). In addition, the authors would like to extend their appreciation to all the Soldiers in the U.S. Army who participated in the camouflage field evaluations. The support and assistance of all involved have contributed to the timely and efficient execution in the development of the new Army camouflage pattern(s) for the Future Force Warrior.

REFERENCES

McManamey, James R. “Comparative Evaluation of Technologies for Camouflage Performance Assessment,” August 2003.

CONCLUSION

Pattern Desert All Over Brush was identified and recommended as the best performing camouflage design for multiple environments for the Future Force Warrior Program. Desert All Over Brush’s performance demonstrated its effectiveness in a wide range of terrains. Though none of the four down-selected camouflage designs tested performed poorly in any one environment, neither did any perform optimally, due to the fact that they were designed to “blend” universally across all terrains: Woodland, Urban, and Desert.