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UNIVERSAL CAMOUFLAGE FOR THE FUTURE WARRIOR

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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

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).

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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.