U.S. Naval Air Development Center

Johnsville, Pennsylvania

NADC-MR-6619 30 September 1966

CAMOUFLAGE PRINTING OF NOMEX SUMMER FLYING COVERALLS

• Naval Air Systems Command
Weptask RAE 20J 010/2021/F012 10 02
Problem Assignments J44 AE22-7 and 010-AE22-13

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DEPARTMENT OF THE NAVY
U. S. NAVAL AIR DEVELOPMENT CENTER
JOHNSVILLE
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From: Commanding Officer, U.S. Naval Air Development Center, Johnsville, Warminster, Pennsylvania 18974
To: Chief, Naval Air Systems Command

Subject: NADC-MR-6619: Weptask RAE 20J 010/2021/F012 10 02, Problem Assignment J44 AE22-7, 010-AE22-13, Camouflage Printing of Nomex Summer Flying Coveralls; letter report concerning

Ref: (a) BuWeps ltr RAAE-2211/258:RCB 15 March 1965
(b) MCLFDC Project #51-64-02, Flight Clothing and Survival Equipment. Third Interim Report

Encl: (1) Table I: Comparative Temperature Rise

1. The purpose of the present study was to determine the effectiveness of camouflage print coveralls as compared to the standard plain olive green garment. Reference (a) stated that the Navy will deliver to the Marine Corps Landing Force Development Center (MCLFDC) 40 staple Nomex summer flying coveralls printed with the ERDL 1948 pattern and colors and as a control 40 of the standard suits. Therefore, under the authority of the subject problem assignments, this laboratory undertook the procurement and delivery of these items. In addition, seven camouflage and two olive green coveralls were delivered for combat evaluation to Helicopter Squadron-261 in Viet Nam.

2. The coveralls were manufactured according to specifications supplied by the Air Crew Equipment Branch of the Naval Air Engineering Center incorporating part #NAEC Spl-100, a prototype of the present suit (MIL-C-81126B). Three oz/yd^2 staple, herringbone weave fabric was used for both the plain and the camouflage coveralls. The camouflage pattern was roller printed with the four-color U.S. Army camouflage pattern in a resin-bonded pigment system. This pattern, developed jointly by the U.S. Army Laboratory, Natick, Mass. and the Army Corps of Engineers, Fort Belvoir, Va. and formerly known as the ERDL 1948 pattern, consists of black, brown, dark green and light green areas completely covering the original material. Because the camouflaged fabric was produced on a "best effort" basis by the Cranston Print Works, no opportunity was available for controlling fabric characteristics such as shrinkage, color fastness, hand, etc.

3. Flammability and heat transfer studies were conducted on the camouflage fabric and compared with those on the plain fabric to determine the effect of print dyes on the thermal properties of Nomex. From the results (enclosure (1)) it is seen that, although the heat transfer is slightly greater after application of the camouflage, this increase is not significant in terms of degradation of the flame resistant characteristics of the fabric or of the thermal protection that the material provides.

4. The overall opinion expressed by the nine pilots in Viet Nam, (a Navy Medical Unit) was very favorable; the suit was comfortable temperature-wise, easily laundered and quite acceptable, however it was felt that much improvement could be realized from a few minor design changes. It was noted that: (a) the wrist sleeves were too tight to roll back and therefore were often altered, (b) the flaps on the zippers were tacked down; the pilots preferred that the zipper flaps be open on three sides, (c) the lower left leg pocket flap caught on the helicopter collective, an occurrence considered dangerous. The camouflage pattern was considered good though somewhat too bright. Finally, all the pilots considered the texture of the camouflage cloth rough but "to a minimal degree". No dermatological problems were encountered.

5. The MCLFDC report, reference (b), discusses the test procedures followed in evaluating the coveralls, the features considered, and the results. The camouflage suits were examined to determine comfort, durability, compatibility with various aircraft, escape/evasion qualities and suitability for Marine Corps aviation use. The coveralls were considered excellent insofar as comfort, construction, durability, color-fastness and retention of flame resistance after repeated washings. However, shrinkage on washing was considered to be excessive, and the design of the coverall was found deficient in several aspects: (a) sleeve cuffs too tight, (b) zipper flap-covers made pockets inaccessible, (c) legs and crotch too long and bulky, (d) absence of knife pocket. The report stated that "correction of these deficiencies is essential" to make the suit acceptable and further recommends that if the suit is finally accepted, two should be issued to each person.

6. The concealment capability of the camouflage in direct comparison with the control suits was assessed visually in the field. In a green leafy environment the camouflage item provided slightly more concealment than the olive green control, while in an environment predominantly brown, both suits contrasted sharply with the background. The latter finding is not surprising since there is no light brown whatever in the camouflage pattern and dark green, a strongly contrasting color, is the basic one in both suits. Indeed, it is extremely doubtful that any pattern could be universally highly effective, for that pattern which blends well in one environment must stand out in an environment predominated by a contrasting color.

7. It is concluded from the laboratory tests on the camouflage fabric and from the field reports that (a) Camouflage printing of staple Nomex in a resin-bonded pigment system does not significantly alter the flame-resistant characteristics of Nomex, (b) The camouflage system considered here offers very little advantage over the ordinary olive-green Nomex suits in concealment in green leafy areas and neither suit contributes to concealment in predominantly brown surroundings.

8. In light of the recommendations made in the MCLFDC report and the results of the laboratory studies it is recommended that: (a) Cognizant authority carefully weigh the small advantages gained in the camouflage versus the control suit against the extra expense of manufacturing the suit and the logistics involved in issuing yet another piece of gear. (b) The design of the coverall be studied, keeping in mind the changes suggested in the MCLFDC report (reference (b)). (c) This phase of the Problem Assignments be considered completed and terminated with this report.

This report was prepared by Maria A. Chianta, reviewed by Alice M. Stoll, and approved by Carl F. Schmidt, Research Director, Aerospace Medical Research Department.

E. M. WURZEL
By Direction

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TABLE I

COMPARATIVE TEMPERATURE RISE

Sample (Staple Nomex)	Thickness (mm)	Temp. Rise (°C/H)
Control		
Olive Green	0.315*	17.74
Camouflage		
Dark Green	0.319	19.36
Light Green	0.317	18.17
Brown	0.312	18.18
Black	0.310	19.47

H = Thermal flux in $cal/cm^2/sec.$

* = Average of 5 readings

Enclosure (1)

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY

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An investigation was carried out to determine the effectiveness of Nomex summer flying coveralls printed with a camouflage pattern as compared with the standard plain olive green coveralls. Laboratory tests indicated that camouflage printing of staple Nomex in a resin-bonded pigment system does not significantly alter the flame-resistant characteristics of Nomex. Field tests with Marine units showed that the camouflage system considered here offered very little advantage over the ordinary olive-green Nomex suits in concealment in green leafy areas and neither suit contributes to concealment in predominantly brown surroundings.

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14. KEY WORDS	LINK A		LINK B		LINK C	
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