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# EVALUATION OF MATERIALS PROPOSED FOR USE IN SPACE FLIGHT



FINAL REPORT

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PRELIMINARY REPORT

# TESTING OF FLAME-RESISTANT TREATED COTTON FABRIC AND SHIRTS

1.0 PURPOSE OF STUDY: To evaluate the cutaneous primary irritancy and allergenicity potential of cotton shirts/fabrics treated with flame retardants in order to establish their suitability for spacecraft crew use.

2.0 METHODS: This study consisted of three phases of evaluation:

2.1 PATCH TESTS IN HUMANS: Twenty-five volunteer human subjects were patch tested on the back utilizing standard methodology, with both treated and untreated cotton fabric. The fabric was treated with tetrakis (hydroxymethyl) phosphonium hydroxide and subsequently cured with gaseous ammonia ($THPOH/NH_3$). The final treatment comprised adding on Dicyandiamine/Phosphoric acid.

2.1.1. INDUCTION: 2 x 2 inches square patches of each fabric were wetted with 10% sodium lauryl sulfate and applied under occlusion for two days. Sodium lauryl sulfate is a known primary irritant and all subjects developed slight or moderate erythema which faded in 24 hours at the test sites. The degree of irritation at the two sites was equal.

2.1.2. CHALLENGE: Three weeks after removal of the induction patches, identical fabric patches, one treated and one untreated, were wetted with tap water and applied to the upper back. They were left in place for 48 hours and the sites were examined by a board certified dermatologist for evidence of inflammation.

Identical challenge tests were performed following usage tests.

2.2 USAGE TESTS BY HUMAN VOLUNTEERS: Following the negative patch tests, 12 individuals were selected from the 25 member test panel for usage tests of shirts fabricated by NASA from the treated cotton material. The subjects were selected from the panel (members of the Department of Dermatology) so as to give as wide a range of usage testing as possible. Thus the shirts were worn in air-conditioned offices as well as on the athletic field and for yard work, etc. The shirts were worn against bare skin at all times and were not worn during sleep more than 50% of the time.

Each subject was issued one shirt. The shirts were initially worn for at least 12 hours prior to dry cleaning. Thereafter, the shirts were dry cleaned as necessary (approximately after each 12-15 hours of wear). The shirts were worn intermittantly for 50 hours. A three week "rest period" was then imposed during which the shirt was not worn. The shirt was then worn for an additional 10-12 hours.

Follow-up patch tests (2.1.2.) after the period of usage-testing, were performed in 10 of 12 subjects who participated in this phase of the study.

2.3 SHIRT CLEANING: All shirts were dry cleaned at the previously stated intervals at a single dry cleaning establishment.

Perchlorethylene (Harkrider Distributing Company) was used for dry cleaning.

3.0 RESULTS:

3.1 PATCH TESTS: None of the individuals experienced primary irritant or allergic reactions attributable to the fabric during induction or challenge patch testing. Likewise, there were no reactions to treated or untreated fabric patches placed on 10 subjects of the usage panel at the conclusion of the study.

3.2 USAGE TESTS: The shirts were well made (the best of many the primary investigator has examined in previous studies) and colorfast. They were well tolerated by all panel members during extremes of usage (two panel members wore their shirts continuously for one week on a camping trip to Big Bend National Park). It should be noted, however, that the shirts were considered uncomfortably warm and "stiff" prior to the initial dry cleaning by 5 panel members. Thereafter, the shirts were considered comfortable by the same individuals. No other discomfort or skin irritation was encountered during the course of the study.

4.0 CONCLUSION: The flame resistant treated cotton shirts provided by NASA do not appear to have any primary irritant qualities nor potential for producing allergic contact dermatitis in humans. Dry cleaning, prior to actual wearing of garments fabricated of this treated material, would appear to be advisable, however.