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RDT&E PROJECT NO. _____

USATECOM PROJECT NO. 7-5-0621-01

INTEGRATED ENGINEERING/SERVICE TEST OF SYNTHETIC CHAMOIS

FINAL REPORT

BY

RICHARD H. SMITH
Captain, TC

BRENDA L. SALYERS
1st Lieutenant, WAC

MAY 1966

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RDT&E PROJECT NO._____

USATECOM PROJECT NO. 7-5-0621-01

INTEGRATED ENGINEERING/SERVICE TEST OF SYNTHETIC CHAMOIS

TEST REPORT

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MAY 1966

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U.S. ARMY
GENERAL EQUIPMENT TEST ACTIVITY
FORT LEE, VIRGINIA

DEPARTMENT OF THE ARMY
HEADQUARTERS, U.S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND 21005

AMSTE-GE (7-5-0621) 21 JUN 1966

SUBJECT: Approved Final Report of Integrated Engineering/Service Test of Synthetic Chamois. USATECOM Project No. 7-5-0621-01.

TO: Commanding General
U. S. Army Materiel Command
ATTN: AMCRD-D
Washington, D. C. 20315

1. Reference subject report.

2. Conclusions reflected in subject report are as follows:

a. Of the synthetic chamois, only the code "S" chamois is considered a feasible substitute for the standard general purpose chamois.

b. Each of the synthetic chamois could be satisfactorily substituted for the standard chamois for removal of static electricity.

c. In comparison with the standard chamois, the code "S" synthetic chamois was most acceptable to the user.

d. Only the code "S" synthetic chamois met all the chemical, quality, and physical requirements as well as the capability of being adequately cleaned for reuse.

e. On the basis of cost analysis only, synthetic chamois codes "S," "T," or "K" should be used instead of the standard ("P") chamois.

f. Any of the synthetic chamois could be substituted for the standard chamois without constituting a safety hazard.

3. Recommendation reflected in subject report is as follows:

It is recommended that the code "S" synthetic chamois be considered suitable for use by the U. S. Army.

AMSTE-GE (7-5-0621) 21 JUN 1966
SUBJECT: Approved Final Report of Integrated Engineering/Service Test of Synthetic Chamois. USATECOM Project No. 7-5-0621-01.

4. The cost data utilized in this evaluation was provided by U. S. Army Natick Laboratories and may be subject to change in the final analysis as a result of market changes, size and source of procurements, transportation costs etc.

5. This headquarters concurs in the above conclusions and recommendations. However, conclusion 2f requires some amplification. The only safety hazard indicated by engineering test results was that the synthetic chamois are primarily cellulose base fibers; therefore, if oily or improperly stored, they could be subject to spontaneous combustion.

6. Conclusions:

a. The code "S" type chamois is a feasible substitute for the Army standard general purpose chamois.

b. On the basis of cost, data utilized in this evaluation, the code "S" type chamois is a better buy than the current standard general purpose chamois.

7. Recommendation:

Recommend the code "S" type synthetic chamois be considered suitable for use by U. S. Army.

FOR THE COMMANDER:

1 Incl
as (8 cys)

JAMES O. DAULTON
Colonel GS
Director, General Equipment
Testing Directorate

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U.S. ARMY GENERAL EQUIPMENT TEST ACTIVITY
FORT LEE, VIRGINIA

USATECOM 7-5-0621-01

Final Report of Integrated Engineering/Service Test of Synthetic Chamois

Conducted at Fort Lee and Fort Monroe, Virginia, and Fort Rucker, Alabama

May 1966

Abstract

An integrated engineering/service test of four synthetic chamois was conducted by U.S. Army General Equipment Test Activity to determine the technical performance of synthetic chamois and to determine their suitability for use by the Army. Testr were conducted during the period 13 July 1965 to 11 January 1966.

The engineering portion of the test compared the four synthetic chamois with the standard general purpose chamois and its Federal Specifications. The service test portion determined to what degree from the user's viewpoint the synthetic chamois performed the basic functions which the present standard general purpose chamois is now performing.

It was concluded that the code "S" chamois was the only one of the four synthetic chamois that compared satisfactorily to the criteria and to the standard general purpose chamois and that it was considered suitable for Army use. It was recommended that the code "S" synthetic chamois be considered suitable for use by the U.S. Army.

FOREWORD

The U.S. Army General Equipment Test Activity was responsible for preparing the test plan, test execution, and preparing the test report. The test was authorized by Letter, AMSTE-GE, Headquarters, USATECOM, dated 7 June 1965, subject: "Test Directive, USATECOM Project No. 7-5-0621-01, Integrated Engineering/Service Test of Synthetic Chamois."

TABLE OF CONTENTS

SECTION 1. INTRODUCTION

1.1 BACKGROUND

a. The Defense Clothing and Textile Supply Center requested the U.S. Army Natick Laboratories to investigate the feasibility of developing a substitute for the standard general purpose chamois because of the recent sharp increase in its price. Natick Laboratories evaluated several available types of synthetic chamois for use as a substitute for the standard general purpose chamois and selected four types for engineering/service test.

b. Federal specifications for the standard general purpose chamois state that its intended use is for washing and polishing as well as for use in the construction of orthopedic and prosthetic appliances. A telephonic survey of users showed many varied uses, all except two of which were in the washing, drying, and polishing category. The principal uses were drying and polishing vehicles and aircraft. The two exceptions were the removal of a static electrical charge from aircraft and very infrequent use in the construction of orthopedic and prosthetic appliances.

1.2 DESCRIPTION OF MATERIEL

1.2.1 Synthetic Chamois

a. The test items were the following four different synthetic chamois presently on the commercial market:

(1) Code "K" synthetic chamois, 19 by 29 inches and cost approximately 16 cents each.

(2) Code "N" synthetic chamois, 24 by 24 inches and cost approximately 20 cents each.

(3) Code "T" synthetic chamois, 19 by 29 inches and cost approximately 50 cents each.

(4) Code "S" synthetic chamois, 19 by 29 inches and cost approximately 1 dollar each.

b. The synthetic chamois were manufactured from natural and manmade fibers, cellulose base (cotton), nontoxic and nonallergic in

nature. Stated characteristics of the materials, as available prior to beginning the tests, included the following:

(1) Thickness range - 0.010 to 0.031 inch.

(2) Weight range - 51 to 141 pounds per bundle of 500, 2-by 3-foot sheets.

(3) Range of breaking strength - 29 to 45 pounds (dry), 10 to 33 pounds (wet).

(4) Water absorption ratio - 297 to 423 (gm H_2O/gm chamois).

(5) Water expulsion ratio - 93 to 302 (gm H_2O/gm chamois).

(6) Wetting time - 2 to 5 seconds (gm H_2O/gm chamois).

For description of physical and technical characteristics of the materials determined during tests, see Appendix I-A. Identification views are shown in Figure 1.

1.2.2 Standard General Purpose Chamois

The standard general purpose chamois (Code "P") was used as the standard of comparison for the four synthetic chamois listed previously. The standard general purpose chamois (FSN 8330-823-7547) is oil-tanned in natural color to produce a soft absorbent material and is suede-finished on both sides. It is natural skin-shaped with minimum areas ranging from 450 to 675 square inches. Cost to the U.S. Government ranges from $1.90 to $2.48 each.

1.3 TEST OBJECTIVES

a. To determine the technical performance of the synthetic chamois and to determine their suitability for use by the Army.

b. To determine the following specific objectives:

(1) Feasibility of using any one of the four synthetic chamois under test as a substitute for the standard-general purpose chamois.

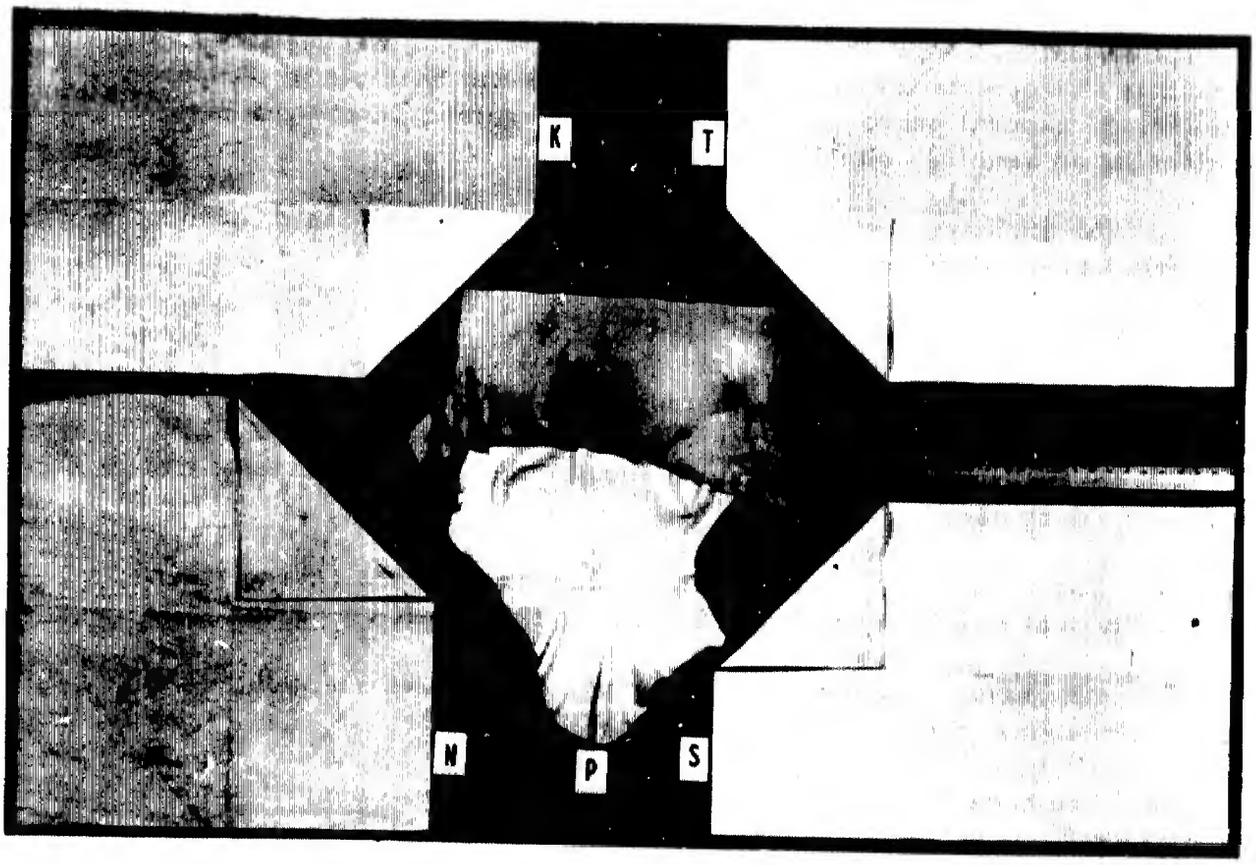

Figure 1. Examples of chamois evaluated.

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(2) Capability of synthetic chamois to remove static electricity from aircraft in comparison with the standard general purpose chamois.

(3) Acceptability to the user of each of the synthetic chamois in comparison with the standard general purpose chamois.

(4) Chemical and quality characteristics and the following physical properties as evaluated by the user and in the laboratory: water absorption and expulsion characteristics, wet abrasion, wetting time, durability characteristics,and safety of the synthetic chamois in comparison with the general purpose chamois, as well as the comparative ease of cleaning or washing chamois after use.

(5) Relative cost, on a comparable performance basis, of the synthetic and standard general purpose chamois.

1.4 SUMMARY OF RESULTS

a. The code "S" synthetic chamois was the only chamois to meet all the inspection quality requirements of Federal Specification KK-C-300b except the marking and packaging requirements which were not met by any of the synthetic chamois.

b. The code "S" synthetic chamois was the only chamois to meet all the physical requirements of Federal Specification KK-C-300b.

c. All chamois except code "N" synthetic chamois met the chemical requirements of Federal Specification KK-C-300b.

d. The code "S" synthetic chamois had the highest overall rating on additional engineering studies. The standard code "P" chamois and the code "T" synthetic chamois were rated equally but below the code "S" chamois.

e. The synthetic chamois were composed primarily of cellulose, and they supported combustion. However, the flammability characteristics did not indicate a safety hazard for normal storage and use.

f. The code "S" chamois and the standard chamois were equally acceptable for drying and polishing light commercial vehicles. The other chamois were less acceptable and their descending order of acceptability was "T," "N," and "K."

g. The code "S" chamois was slightly better than the standard chamois for washing, drying, and polishing military aircraft. The other chamois were less acceptable, and their descending order of acceptability was "T," "N," and "K."

h. The codes "S" and "T" chamois were as acceptable as the standard chamois in their capacity to be cleaned adequately for reuse. Code "N" followed very closely as the next lower rating chamois, and "K" rated lowest.

i. All chamois satisfactorily removed static electricity from a charged surface, and there was no difference between the synthetic chamois themselves or between the standard chamois and the synthetic chamois in this capability.

j. There was no evidence of irritations or unsafe conditions attributable to the use of, or exposure to, any of the chamois.

k. Cost analysis of the chamois on a comparable performance basis indicated that codes "S," "T," and "K" chamois were acceptable and approximately equal, while codes "N" and "P" (standard) chamois were of lesser value.

1.5 CONCLUSIONS

a. The code "S" chamois was the only synthetic chamois tested that met all of the criteria to a satisfactory degree and that was considered suitable for Army use.

b. Specific conclusions based on test criteria and test conditions are as follows:

(1) Of the synthetic chamois, only the code "S" chamois is considered a feasible substitute for the standard general purpose chamois.

(2) Each of the synthetic chamois could be satisfactorily substituted for the standard chamois for removal of static electricity.

(3) In comparison with the standard chamois, the code "S" synthetic chamois was most acceptable to the user.

(4) Only the code "S" synthetic chamois met all the chemical, quality, and physical requirements as well as the capability of being adequately cleaned for reuse.

(5) On the basis of cost analysis only, synthetic chamois codes "S," "T," or "K" should be used instead of the standard ("P") chamois.

(6) Any of the synthetic chamois could be substituted for the standard chamois without constituting a safety hazard.

1.6 RECOMMENDATIONS

It is recommended that the code "S" synthetic chamois be considered suitable for use by the U.S. Army.

SECTION 2. DETAILS OF TEST

2.1 INTRODUCTION

a. The integrated engineering/service test was conducted to determine the technical and service performance as well as a cost comparison of four commercial synthetic brands of chamois in comparison with each other and with the standard general purpose chamois which is currently in the military supply system and which was used as the control item. The test was designed to provide a basis for making a determination as to the feasibility of substituting one of the synthetic chamois into the military supply system in place of the present standard general purpose chamois.

b. The engineering portion of this test compared the standard general purpose chamois and the four synthetic chamois. Test conditions and criteria were obtained from applicable federal specifications, the test directive, practical considerations, and end uses.

c. The service test portion of the test determined to what degree the synthetic chamois performed the basic functions, from the user's viewpoint, which the present standard general purpose chamois is now performing. Data were obtained by test team observer/recorder observations and inspections as well as questionnaires completed by users. Users were given a preselected pair of chamois, issued in balanced incomplete block design pattern, with which they made their comparison. The pairs of chamois were balanced so that each type of chamois was used an approximately equal number of times and was compared with other types of chamois. No user rated more than two pairs of chamois and he never rated the same chamois more than once. The degree of preference for each characteristic was rated as "Very Much," "Moderately," "Slightly," or "Practically No Difference."

d. The data were collected by the military test team at the Transportation and Military Police Motor Pools at Fort Monroe, Virginia, where personnel drying and polishing light commercial vehicles used the synthetic and standard general purpose chamois and rated them according to preference and individual acceptability, both when new and used. The test team then gathered data at the helicopter ports and airfields at Fort Rucker, Alabama, where personnel used the synthetic and the standard general purpose chamois for cleaning, drying, and polishing as well as removing static electricity from aircraft. These personnel also rated the chamois according to preference and individual acceptability both when new and used.

e. Evaluation of the subjective data was accomplished using Analysis of Variance and Duncan's Multiple Range Test as the method to separate the means at the 0.05 level of probability.

2.2. INSPECTION (ET)

2.2.1 Objective

To determine the extent to which the synthetic chamois conform to the quality requirements prescribed in Federal Specifications KK-C-300b.

2.2.2 Method

According to MIL-STD-105D from a lot of 20 chamois received, five were inspected. If no defective ones were found, the lot was considered acceptable; if one or more defective ones were found, the lot was rejected. Quality criteria were stated in paragraph 4.2.1, Federal Specification KK-C-300b.

2.2.3 Results

The inspected chamois did not have any observable defects. The results of dimensional examinations (area and thickness) are listed under physical tests in Appendix I-A. None of the synthetic chamois were individually marked or packaged for military Class 2.

2.2.4 Analysis

All chamois satisfactorily met visual examination requirements. Only the codes "K," "N," and the standard general purpose chamois (code "P") did not meet area requirement for medium size; however, they were within 0.13, 0.01, and 0.03 square feet respectively, of the specified area of 3.99 square feet. Therefore, they were considered satisfactory for use in service testing. In thickness, only code "S" and the standard general purpose chamois met the specified minimum of 0.0234 of an inch. Code "T" averaged 0.0190 of an inch thick, but codes "N" and "K" were less than half the specified thickness. The effects of these thickness differences on suitability for service test use could not be predicted. With the exception of marking and packaging, code "S" alone met all the inspection quality requirements in Federal Specification KK-C-300b. [1]

[1] It should be noted that this Federal Specification sets standards for leather products. For lack of another standard in the military system, the synthetic chamois, which were not composed of leather, were compared against this specification during engineering tests.

2.3 PHYSICAL REQUIREMENTS (ET)

2.3.1 Objective

To determine if the synthetic chamois met the physical requirements of thickness, breaking strength, water absorption, water removed by wringing, and time of wetting as specified in paragraph 3.7.2 of Federal Specification KK-C-300b.

2.3.2 Method

The following tests were performed under standard atmospheric conditions as specified in paragraphs 1.1 and 1.2 of Federal Specification KK-L-311a and as explained below:

a. Thickness (ASTM Designation, D 1814)

The thickness of ten chamois of each type was measured at not less than five approximate equally spaced places each with a micrometer graduated in 0.001 of an inch.

b. Breaking Strength (KK-L-311a, 2031)

Four 4- by 6-inch samples of each type of chamois, were stressed to break when clamped between jaws which moved in opposite directions at 12 inches per minute. The pounds of force required to break the chamois were recorded.

c. Water Absorption (KK-C-300b, Par. 4.3.1)

Five conditioned 5- by 7-inch specimens were weighed, submerged in water, removed, hung to drain, and reweighed.

d. Water Removed by Wringing (KK-C-300b, Par. 4.3.2)

The five specimens used in the water absorption test were immediately passed through a wringer and then reweighed.

e. Time of Wetting (KK-C-300b, Par. 4.3.3)

The time for the five 5- by 7-inch specimens to sink in water was determined.

2.3.3 Results

The results of physical tests are summarized in Appendix I-A.

2.3.4 Analysis

Only the code "S" synthetic chamois met all the requirements of paragraph 3.7.2, Federal Specification KK-C-300b, as indicated in Table I. The results of these tests are further analyzed in paragraph 2.5.4.

TABLE I

COMPARISON OF PHYSICAL TEST RESULTS WITH SPECIFICATION MINIMUMS*

Property	Comparison with Specification by Code				
	"S"	"T"	"N"	"K"	"P"
Thickness	Yes	No	No	No	Yes
Breaking Strength	Yes	Yes	No	Yes	Yes
Water Absorption	Yes	No	Yes	Yes	No
Water Removed by Wringing	Yes	No	No	No	No
Time of Wetting	Yes	Yes	Yes	Yes	Yes

*See physical tests, Appendix I-A

NOTE: Yes - Met minimum specified value
No - Did not meet minimum specified value

2.4 CHEMICAL REQUIREMENTS (ET)

2.4.1 Objective

To determine the extent to which the synthetic chamois conformed to chemical requirements of total ash, iron and aluminum, chromium, free formaldehyde, and acidity as specified in Table III of KK-C-300b.

2.4.2 Method

The following tests were performed as specified below:

a. Total Ash (KK-L-311a, 6421)

Two 5-gram specimens from a composite sample of each type chamois were placed in porcelain crucibles, burned to ash in a muffle furnace, and the percentage of weight as total ash determined.

b. Iron and Aluminum (KK-L-311a, 6531)

Two 5-gram composite samples of each type chamois were ashed in platinum crucibles and the amounts of iron and aluminum determined by quantitative chemical analysis.

c. Chromium (KK-L-311a, 6521)

One 5-gram composite sample of each type chamois was ashed in a platinum crucible and the amount of chromic oxide was determined by the colorimetric method.

d. Free Formaldehyde (KK-L-311a, 6111)

One 5-gram specimen from the composite sample was tested for the presence or absence of formaldehyde. If results were positive, the amount of free formaldehyde was determined by quantitative chemical analysis.

e. Acidity (KK-L-311a, 6621)

The acidity of the decanted liquid from one 3-gram specimen from the composite sample of each type chamois was determined with a pH meter.

2.4.3 Results

The results of laboratory tests are summarized in Appendix I-A.

2.4.4 Analysis

All chamois met the chemical requirements stated in Federal Specification KK-C-300b except code "N" which had an acidity below the specified minimum.

2.5 ADDITIONAL STUDIES (ET)

2.5.1 Objective

To determine the comparative abrasion resistance, tearing strength, bursting strength, air permeability, stiffness, resistance to mildew, materials identification, propensity to scratch windshields, and capability of the chamois to remove a static charge from aircraft windshields.

2.5.2 Method

The following tests, except materials identification, were performed under standard atmospheric conditions as specified in Section 7 of Federal Specification KK-L-311a and described below:

a. Abrasion Resistance, Wet and Dry (KK-L-311a, 4311)

Three specimens of each type chamois were tested wet and dry on a standard abrasion tester until a 1/4-inch hole developed. The number of cycles were recorded.

b. Tearing Strength (CCC-T-191b, 5134)

Five 3- by 8-inch samples of each type chamois were tested with two specimens taken from each sample. Tears of the two specimens were made perpendicular to each other in a standard strength tester with 1- by 2-inch jaws moving 12 inches per minute. The average of the five highest loads necessary to tear each specimen was recorded.

c. Bursting Strength (ASTM Designation D 2207)

The pounds required to force a spherical 1-inch diameter steel plunger through each of five specimens of each type chamois were recorded.

d. Air Permeability (ASTM Designation D 737)

The sample was mounted between the clamp and the circular orifice of the air permeability testing instrument. Conditioned air was drawn through the sample and through the calibrated flow meter. The pressure drop was adjusted across the sample to 0.5 of an inch of water,

and the cubic feet of air per minute per square foot of fabric passing through the sample was calculated. Five samples of each type chamois were tested.

e. Stiffness (KK-L-311a, 4211)

Five samples of each type chamois, with two specimens taken from each sample, were tested on a standard stiffness tester, and the force in pounds required to bend the specimen was recorded.

f. Mildew Resistance (KK-L-311a, 5011)

Three 2- by 2-inch squares of each type chamois were inoculated with a mixture of fungi spores and sand and incubated for 30 days. The amount of fungus growth was determined by visual examination.

g. Materials Identification (ASTM Designation D 276)

Materials were subjected to standard identification tests (microscopic examination and chemical solubility).

h. Propensity to Scratch Windshields (ASTM D 1003-61)

Three aircraft windshield samples were rubbed with each type of chamois, and a pivotal sphere hazemeter was used to determine if and how much each type chamois scratched the windshield surface.

i. Measurement of Static Charge

An approved static meter was used which provided a field of ionized air through which the material passed while the meter spontaneously selected a charge of the kind and quality to neutralize itself.

2.5.3 Results

Materials identification tests showed that each type of synthetic chamois contained cellulose-base fibers. The results of other tests are included in Appendix I-A.

2.5.4 Analysis

a. Appendix I-B presents a statistical separation of means, and Appendix I-C indicates comparative evaluations of the means

obtained in those tests indicative of the expected durability of the chamois. Appendix I-C places each test item in selected subtests into a rank order of durability based on an arbitrarily weighted scale. Included are some results from Physical Studies (Par. 2.3) and abrasion resistance, tearing strength, and bursting strength results obtained in Additional Studies. Overall ratings in Appendix I-C indicate the following descending order of durability: Codes "S," "P" (standard), "T," "K," and "N."

b. Comparative evaluations of air permeability, stiffness, mildew resistance, propensity to scratch windshields, and measurements of static charges are also presented in a rank order of desirability (based on an arbitrarily weighted scale) in Appendix I-D along with evaluations of other tested properties (except durability) from Physical Studies (Par. 2.3) and Inspection (Par. 2.2). Overall ratings in Appendix I-D indicate the following descending order of desirability: Codes "S," "P" (standard), "T," "K," and "N."

c. Combining the durability and desirability ratings for the 19 tested properties (App. I-C and I-D) produces the following descending rank order:

Code "S"

Code "P" (standard)

Code "T"

Code "K"

Code "N"

2.6 SAFETY (ET)

2.6.1 Objective

To determine if the synthetic chamois were safe for issue for service test.

2.6.2 Method

During initial testing, laboratory results were evaluated and safety observations were made in order to determine adherence to pertinent safety considerations.

2.6.3 Results

Flammability of test items is summarized in Table II.

TABLE II

FLAMMABILITY

Chamois Code	"S"	"T"	"N"	"K"	"P"
Time of Burning	21.7 sec	22.5 sec	24.6 sec	8.0 sec	Did Not Burn

Materials identification test showed that all the synthetic chamois contained cellulosic fibers (Par. 2.5.3).

2.6.4 Analysis

a. Since each of the four synthetic chamois had a flame spread of more than 7.0 seconds, they are regarded as having no more than normal flammability. However, none of the synthetic chamois were equal to the standard general purpose chamois which did not burn.

b. The only safety hazard indicated by engineering test results was that the four synthetic chamois are primarily cellulose base fibers; therefore, if oily or improperly stored, they could be subject to spontaneous combustion.

2.7 ACCEPTABILITY FOR DRYING AND POLISHING LIGHT COMMERCIAL VEHICLES (ST)

2.7.1 Objective

To determine the degree with which each of the four synthetic test chamois compares with the standard general purpose chamois when used for normal drying and polishing purposes in a post motor pool as well as user acceptability, both when new and after use, in respect to:

a. Cleaning and drying a smooth surface without streaking or leaving a residue.

b. Polishing a smooth surface until it is clean and shining.

c. Resisting tearing, rolling off, or other material failures.

d. Marring or abrading painted and plated surfaces.

e. Reusing.

f. Depositing fibers on cleaned surfaces, including glass and plastic.

2.7.2 Method

a. Test NCO was stationed at the vehicle wash racks of the Transportation and Military Police Motor Pools at Fort Monroe. As light commercial vehicle operators from various activities came to the wash rack to clean their vehicles they were introduced to the test and asked for their assistance in the conduct of the test.

b. The operators first washed their vehicles, after which the test NCO gave the test participants detailed instructions for carrying out their phase of the test and issued to each a pair of chamois, a pencil, and a questionnaire designed to solicit opinions of preferential rating of one type of chamois over the other in respect to various performance criteria. At this time, the test NCO insured that each test participant rated the chamois as to his initial preference in regard to state of cleanliness and acceptability for use.

c. After this initial rating, the test participant dried and polished his vehicle, using each chamois for one-half of the vehicle (Fig. 2). When finished with both chamois, the test participant washed them clean in soapy water and squeezed them dry (Fig. 3). He then completed the questionnaire and returned it with the chamois to the test NCO.

d. The test NCO, in observing each test participant, also executed an evaluation form giving his appraisal of the performance of each pair of chamois, using the same performance criteria and preferential rating used on the questionnaire. This evaluation served as an independent check on opinions rendered by the test participants.

e. This procedure was followed when the chamois were new (Cycle I) and after one usage (Cycle II).

Figure 2. Vehicle is cleaned and dried using a different chamois on each side.

Figure 3. Both chamois are cleaned in soapy water and rinsed in clear water for future use.

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2.7.3 Results

a. A total of 85 paired comparisons was made of the synthetic and general purpose chamois. The results of these comparisons are shown in Figure 4 and Appendix I-E. These data show the acceptability of new (Cycle I) and used (Cycle II) chamois for the test criteria sampled. The data are based on mean values computed from the following arbitrarily weighted scale:

0 - Zero rating assigned to the chamois of a pair which was not preferred for the criteria tested.

1 - Practically no difference.

2 - The choice item is slightly preferred.

3 - The choice item is moderately preferred.

4 - The choice item is very much preferred.

b. Appendix I-F shows the results of applying a multiple range test to the five ranked means under the two use conditions (Cycle I and Cycle II) for each criterion measured. The means within each of these Cycles were considered to be significantly different if the computed range exceeded the studentized range at the 0.05 level of probability. Those means which were not found to be significantly different are underlined.

c. Damage to the chamois during service testing ranged from small holes to large tears. Such damage did not necessarily result in complete chamois degradation. Most chamois were usable after being damaged; but percent degradation of each chamois was not rated. However, damage to some code "N" chamois was judged to be so extensive after one usage (Cycle I) that service testing of all chamois was limited to two uses (Cycle II) in order that comparative data could be obtained throughout all tests.

d. A summary of the number of chamois damaged during both cycles of automotive and aircraft (Par. 2.8) use is provided in Table III.

Figure 4

AVERAGE USER ACCEPTABILITY RATING
FOR INDIVIDUAL PERFORMANCE CRITERIA
(Automotive Application)

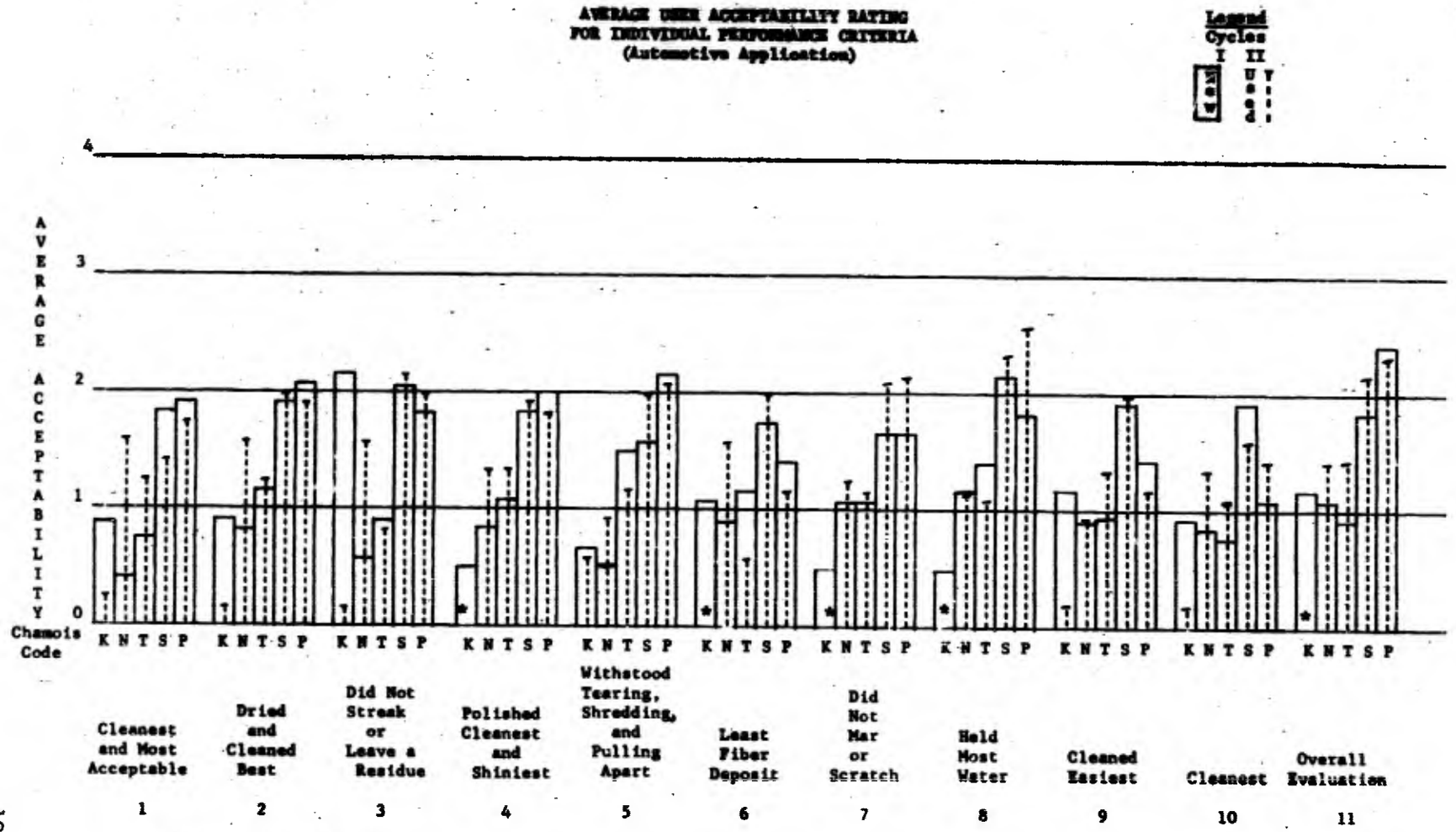

TABLE III

AUTOMOTIVE AND AIRCRAFT CHAMOIS DAMAGE

Chamois Code	Total Uses	Number of Chamois Damaged		
		Total	Number by Damage Type	
			Tear	Hole (Abrasion)
"P"	90	10	9	1
"S"	91	5	4	1
"T"	88	12	12	0
"N"	87	38	21	0
"K"	87	22	38	0

2.7.4 Analysis

a. Code "K" chamois is rated lower than "P" under all performance criteria of both cycles as shown in Figure 4. Appendix I-F indicates that the lower rating of "K" is significantly different from "P" in 6 of the 11 performance criteria for Cycle I conditions and in all criteria for Cycle II conditions.

b. Code "N" chamois is rated lower than "P" (Fig. 4) under all performance criteria of Cycle I and under all except one of the criteria (6) for Cycle II. The lower rating of "N" is significantly different from "P" (App. I-F) in 6 of the 11 criteria for Cycle I and in 3 of the criteria for Cycle II.

c. Code "S" chamois is approximately equal to "P." Considering Cycle I and II conditions simultaneously (Fig. 4 or App. I-E) for each rating, "P" exceeds "S" in five criteria (1, 2, 5, 7, and 11); "S" exceeds "P" in four criteria (3, 6, 9, and 10); and the "S" and "P" ratings are interchanged in two criteria (4 and 8). This apparent equality is substantiated by the fact that there is no significant difference between the mean values of "P" and "S" under any of the performance criteria in either cycle (App. I-F).

d. Code "T" chamois is rated lower than "P" under all performance criteria in Cycle I and under all except one of the criteria (9) of Cycle II in Figure 4. The lower rating of "T" is significant

in three criteria (1, 4, and 11) of Cycle I and in two criteria (7 and 8) of Cycle II as shown in Appendix I-F; "T" is not significantly higher than "P" under any criterion.

e. When "S" and "T" chamois are compared, "T" is rated lower than "S" under all criteria in both cycles; and "T" is significantly lower than "S" under one criterion of Cycle I and under three criteria of Cycle II.

f. From the above analysis, it is evident that "K," "N," and "T" chamois are inferior to both standard ("P") and code "S" chamois, and code "S" chamois is considered equal to the standard chamois for drying and polishing light commercial vehicles.

2.8 ACCEPTABILITY FOR WASHING, DRYING, AND POLISHING AIRCRAFT (ST)

2.8.1 Objective

To determine the degree to which each of the four synthetic test chamois compare with the standard general purpose chamois during washing, drying, and polishing use as found when used at a military airfield as well as user acceptability, both when new and used, in respect to:

a. Washing, drying, and polishing an aircraft surface without streaking or leaving a residue.

b. Removing any objectionable film of dirt from transparent plastic aircraft windows.

c. Marring or scratching the surface of transparent plastic aircraft windows.

d. Cleaning surfaces without depositing fibers.

2.8.2 Method

The test was conducted on the flight line and wash rack areas of two Army helicopter ports and one Army airfield at Fort Rucker, Alabama. The chamois were used by civilian contracted maintenance personnel on various types of fixed and rotary wing Army aircraft. A pair of chamois and a questionnaire were issued to each of the individuals washing aircraft on the wash racks and cleaning aircraft windows

on the flight lines. Questioning, rating, and evaluation procedures were similar to those used for automotive application. The test participants immediately rated the chamois as to their initial preference. They then washed, dried, and polished the aircraft and the windows using both chamois equally (Fig. 5 and 6). When the test participants were finished with the chamois, they washed them clean and squeezed them dry. The questionnaires were then completed and returned along with the chamois to the test NCO. This procedure was followed when the chamois were new and after one usage.

2.8.3 Results

a. In the aircraft application portion of the service test, 134 paired comparisons were made of the synthetic and general purpose chamois. The results of these comparisons are shown in Figure 7 or Appendix I-E. These data show the average acceptability of new (Cycle I) and used (Cycle II) chamois for the test criteria sampled. The graphic results (Fig. 7) are based on the same 4-point scale used for the automotive evaluation (Par. 2.7.3a).

b. The results shown in Appendix I-G were arrived at by using the same statistical procedure discussed in paragraph 2.7.3b.

2.8.4 Analysis

a. The data exhibited in Figure 7 and Appendix I-G indicate that acceptability ratings for codes "K" and "N" chamois consistently fall below the standard (code "P") chamois.

b. The overall evaluation performance criterion (11) results shown in Appendix I-G indicate that chamois "T" and "S" were not found to be significantly different under both Cycles I and II. However, code "S" was found to be significantly different from and it exceeded the standard ("P") chamois under both Cycle I and Cycle II of the use conditions experienced by the participants. Also, the mean values for "T" exceed "S" on only one of the criteria (10) measured, and this is true for only the first cycle usage. In the remaining performance criteria "S" is rated higher than "T." Thus, the code "S" chamois can be considered superior to the code "T" chamois.

c. The data indicate that participants considered the code "S" chamois slightly better than the standard ("P") chamois for washing, drying, and cleaning aircraft.

Figure 5. Transparent plastic windshield of a UH-13 aircraft is cleaned with one of the chamois.

Figure 6. Chamois are used for cleaning a a UH-1 aircraft.

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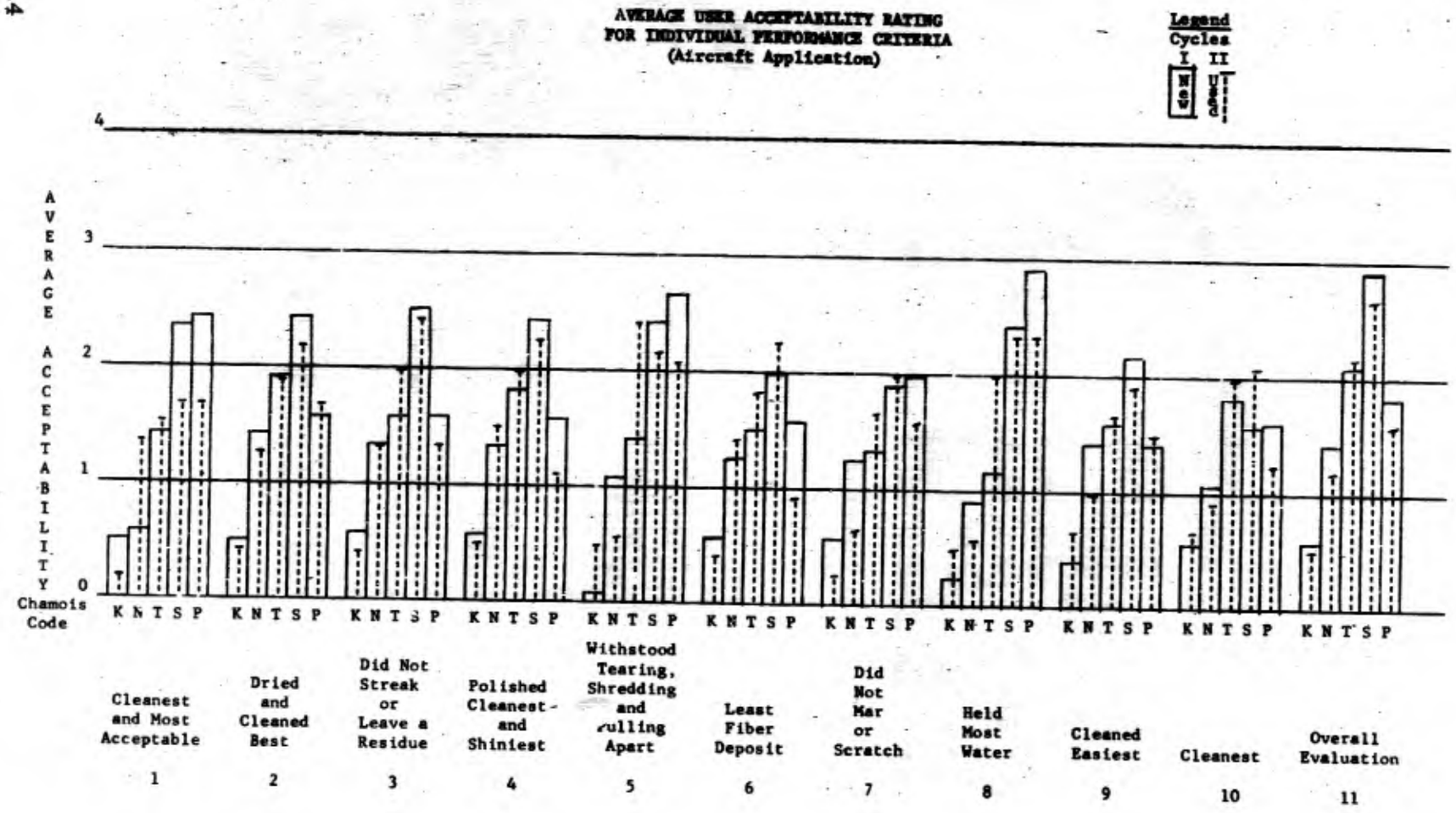
NEGATIVE 31EE, 33EE

Figure 7

AVERAGE USER ACCEPTABILITY RATING
FOR INDIVIDUAL PERFORMANCE CRITERIA
(Aircraft Application)



2.9 CLEANABILITY OF SYNTHETIC CHAMOIS (ST)

2.9.1 Objective

To determine the ability of each of the synthetic chamois to be cleaned and returned to future service after use, in comparison to the standard general purpose chamois. This includes the capability of the chamois to withstand soaps, squeezing, and wringing in the normal process of cleaning.

2.9.2 Method

a. Performance criteria 1, 9, and 10 of Appendices I-F and I-G were used as the basis of evaluation. With one exception, data obtained from both cycles of chamois usage at both test sites were evaluated in the manner described in subtests 2.7 and 2.8. The exception was that performance criterion 1 of Cycle I was inappropriate.

b. Each chamois was washed clean after each use by the test participant. They were washed in a mild soap solution, squeezed or wrung out by hand, and hung up to dry (Fig. 3).

c. The cleanability of both chamois issued to the test participant was compared and evaluated by him after washing. In addition, the next test participant using the same chamois evaluated its cleaned condition prior to putting it back into use.

d. Observations were made as to the effects upon the various synthetic chamois from the cleaning process, including shrinkage, cracking, stiffening, or other action which detracted from its intended use.

2.9.3 Results

a. Observations made throughout the test did not indicate that the cleaning process had an adverse effect on any of the synthetic chamois. However, the users would occasionally tear the synthetic chamois when wringing them dry with excessive force. Those tears occurred frequently in the codes "N" and "K" chamois and occasionally in the code "T" chamois. Replies to performance criterion 5 of Appendices I-F and I-G support that finding, even though the criterion covered a more general situation.

b. With regard to cleanability, Appendices I-F and I-G show the following: The codes "S" and "T" chamois were not significantly different from the standard chamois; code "N" chamois was significantly different from the standard chamois in one case in which it was less acceptable; and code "K" chamois was consistently different and less acceptable than the standard chamois.

2.9.4 Analysis

With regard to the ability of the chamois to be cleaned and returned to use, codes "S" and "T" chamois were as acceptable as the standard (code "P") chamois, code "N" chamois was slightly less acceptable than the standard, and code "K" chamois was least acceptable.

2.10 REMOVAL OF STATIC ELECTRICITY (ST)

2.10.1 Objective

To determine the capability of each type synthetic chamois to remove the static electrical charge from the surface of aircraft.

2.10.2 Method

This subtest was conducted on various flight lines at Fort Rucker, Alabama. Maintenance personnel removed static electrical charges (Fig. 8) from the transparent plastic windows of various types of aircraft utilizing each of the synthetic and standard chamois. A static electrical charge was generated by rubbing a wool cloth across the window surface. A test team member then read and recorded this charge using a static electricity meter (Fig. 9). The test participant then wiped the surface to remove the electrical charge and took another reading with the static meter. The difference between those two readings was the amount of static electricity that was removed by the chamois. This procedure was followed once for each type of chamois, using similar wiping motions, on the same surface area. Various fixed and rotary wing aircraft were utilized with a total of 123 readings recorded.

2.10.3 Results

All four of the synthetic chamois and the standard general purpose chamois were effective in removing a static electrical charge from the transparent plastic windows of the various types of aircraft utilized. Initial charge readings ranged between +18 volts and -1.4 volts. The amount of static electricity removed ranged from a maximum of 18 volts

Figure 8. Test participant removed static electrical charge by wiping damp chamois over electrified windshield.

Figure 9. Remaining static electrical charge is read and recorded by members of test team.

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NEGATIVE 3EE, 4EE

to a minimum of .22 volts. Observations indicated that variables such as moisture content of the chamois and the area and length of time it was in contact with the surface had a dominant influence on the amount of static electricity removed from a surface. As a chamois dried (some types dried faster than others), it appeared to lose its capability of removing static electricity. Also, it was observed that the longer a surface was wiped and the greater the area covered, the greater was the amount of static electricity removed from that surface.

2.10.4 Analysis

Analysis of the data observed during this test revealed that although the readings between the various chamois varied, there was no statistically significant difference in the effectiveness of the chamois. All chamois satisfactorily performed the function of removing a static electrical charge from an aircraft surface.

Although no controlled experiment was conducted in this subtest, observations indicated that the moisture content of the chamois and the length of time and area of contact with a surface were more deciding factors in the amount of static electricity dissipated from the surface than the use of any one particular type of chamois considered in the test.

2.11 SAFETY CONFIRMATION (ST)

2.11.1 Objective

To provide information regarding safety factors relative to the use of the test items.

2.11.2 Method

Each test participant was interviewed regarding safety with respect to whether the items created any dermatitis, skin irritation, or other adverse effects. Frequent observations were made by the observer/recorder to detect any irritations or unsafe conditions caused by the use of the chamois. In addition, each person using the test items was asked on the questionnaire if any skin irritations were noticed while using the chamois.

2.11.3 Results

No test participant interviewed at Fort Monroe or Fort Rucker complained of any dermatitis, skin irritation, or other adverse effects

caused by the test items. The frequent observations made by the observer/recorders also did not detect any irritations or unsafe conditions caused by the use of any of the chamois. With three exceptions, the question on the 221 questionnaires (App. I-H) asking the test participant if any chamois was observed to be the direct cause of any noticeable skin irritating factors was answered in the negative. The three exceptions to this answer on the questionnaire were one on the standard general purpose chamois (the control item) and two on code "N" snythetic chamois. In addition to the data obtained during the service test, the developer provided letters (App. I-I) from the manufacturers of the synthetic chamois stating that their products are being sold commercially and they have on no occasion received a complaint or experienced any safety hazard in the use of these synthetic chamois.

2.11.4 Analysis

The performance of all the chamois to remove static electricity from aircraft windshields (Par. 2.10) shows that chamois reduce the hazards involved in the refueling of aircraft. There were only three indications, made on the questionnaires, of any adverse effects or unsafe conditions caused by any of the test items throughout the entire service test. It is possible that the question on the three out of 221 questionnaires was answered in the affirmative by test participants who failed to read or fully understand the question. For instance, one of the three answered that the standard general purpose chamois had been the direct cause of a noticeable skin irritation. This is highly unlikely since it consists of natural skin and has been a standard item in the military supply system for many years. Other factors such as the soap used could also be considered in this answer. Even though code "N" chamois was mentioned in the other two instances, it appears quite probable that all three answers occurred by chance. The data collected plus the manufacturers' statements (App. I-I) lead to the conclusion that all the synthetic chamois are safe for their intended use.

2.12 VALUE ANALYSIS (ST)

2.12.1 Objective

To determine the relative cost on a comparable performance basis of the synthetic and standard general purpose chamois.

2.12.2 Method

Performance data generated in the tests for breaking strength, tearing strength, and abrasion resistance of wet chamois were used to determine chamois value. Chamois cost was divided by pounds of strength and by cycles of abrasion to give comparative cost data.

2.12.3 Results

Strength and abrasion resistance data from Appendix I-A were used in conjunction with the cost of each chamois type to provide the cost data presented in Table IV.

TABLE IV

PERFORMANCE COST

Chamois Code	Chamois Cost ($/Chamois)	Cost Based on Strength (Cents/Lb)				Cost Based on Abrasion Resistance (Cents/100 Cycles), Wet Chamois Not Wrung Out
		Breaking Strength Wet Chamois Wrung with Wringer Wt:		Tearing Strength Wet Chamois Wrung with Wringer Wt:		
		30 lb	5 lb	30 lb	5 lb	
"S"	1.00	3.12	3.03	7.35	7.46	4.53
"T"	0.50	1.53	1.50	4.98	4.67	3.13
"N"	0.20	1.73	1.65	14.90	13.30	5.51
"K"	0.16	0.60	0.63	4.74	4.57	8.00
"P"	2.19*	3.98	6,25	33.30	40.00	3.66

*The standard code "P" chamois cost ranges from $1.90 to $2.48 per chamois. The midpoint cost of $2.19 is used for the purpose of this table.

2.12.4 Analysis

The variation in cost per pound of breaking strength was less than five cents, and the variation in cost per 100 cycles of abrasion was also less than five cents. However, cost per pound of tearing strength varied seven times that much. Since 80 to 100 percent of the damage incurred by all chamois types during service testing was attributable to tearing (Table III), the cost analysis is based on the tearing strength data shown in Table IV. Those data indicate that codes "S," "T," and "K" chamois were the best value, with a variation between them of less than three cents per pound of tearing strength; code "N" chamois was the next best value; and the standard (code "P") chamois was the poorest value. Consequently, codes "S," "T," and "K" chamois are considered to be acceptable and approximately equal from the cost-performance standpoint.

SECTION 3. APPENDICES

APPENDIX I - TEST DATA

- A Summary of Results (ET)
- B Chamois Performance - Expected Durability (ET)
- C Durability Evaluation (ET)
- D Desirable Factors Evaluation (ET)
- E Summary of Average User Ratings on Chamois Evaluations by Performance Criteria (ST)
- F Chamois Performance - Automotive Application (ST)
- G Chamois Performance - Aircraft Application (ST)
- H Questionnaire Data on Skin Irritations (ST)
- I Letter From Natick Laboratories With Inclosures

APPENDIX II - FINDINGS

APPENDIX III - DEFICIENCIES AND SHORTCOMINGS

APPENDIX IV - REFERENCES

APPENDIX V - DISTRIBUTION LIST

APPENDIX I. TEST DATA

APPENDIX I-A

SUMMARY OF RESULTS (ENGINEERING TEST)

Name of Test	Test Method	Description of Samples	No. of Tests Per Chamois Type	Average Results Experimental Code "S"	Code "T"	Code "W"	Code "K"	STD Code "P"	Test Criteria
PHYSICAL TESTS									
Area per Unit (sq ft)	1111 of KK-L-311a	New, Conditioned	5	4.22	4.17	3.98	3.86	3.96	3.99 minimum (medium size)
Thickness (inches)	ASTM D 1814	New, Conditioned	10	.0261	.0190	.0117	.0101	.025	.0234 minimum (grade B)
Breaking Strength (lbs)	KK-L-311a, 2031	New, Dry	9 and 10	47.63	47.23	29.68	75.86	63.42*	30 lb minimum (grade B)
Breaking Strength (lbs)	KK-L-311a, 2031	New, Wet (30 lb wringer)	5 and 10	32.10	32.68	11.53	26.70	55.5 *	Comparison
Water Absorption (gm/100 gm)	KK-C-300b	New, Conditioned	5	409	227	400	384	345	375 minimum (grade B)
Water Removed by Wringing (gm 100 gm)	KK-C-300b	New, Wet	5	280	141	193	88	161	200 minimum (grade B)
Time of Wetting (sec)	KK-C-300b	New, Conditioned	5	3.3	22.5	4.7	1.2	6.9	30 maximum (grade B)
CHEMICAL TESTS									
Total Ash (percent)	KK-L-311a, 6421	New, Composite	2	5.0	2.1	5.2	0.5	10.0	12 maximum (grade B)
Iron and Aluminum (percent)	KK-L-311a, 6531	New, Composite	2	0.5	0.0	1.2	0.1	0.1	1.5 maximum (grade B)
Chromium (percent)	KK-L-311a, 6521	New, Composite	1	<0.3	<0.3	<0.3	<0.3	<0.3	0.3 maximum (grade B)
Free Formaldehyde (percent)	KK-L-311a, 6111	New, Composite	1	0	0	<.025	0	0	0.05 maximum (grade B)
Acidity (pH)	KK-L-311a, 6621	New, Composite	1	8.40	8.18	5.38	6.71	10.36	6.5 minimum (grade B)
ADDITIONAL TESTS									
Abrasion Resistance (cycles)	KK-L-311a, 4311	New, Dry	3	1020	640	320	600	2723	Comparison
Abrasion Resistance (cycles)	KK-L-311a, 4311	New, Wet	3 and 8	2207	1597	363	200	5988*	Comparison
Tearing Strength (lbs)	CCC-T-191b, 5134	New, Dry	10	14.63	7.75	2.45	2.75	5.78	Comparison
Tearing Strength (lbs)	CCC-T-191b, 5134	New, Wet (30 lb wringer)	5 and 10	13.61	10.05	1.33	3.37	6.70*	Comparison
Bursting Strength (lbs)	ASTM D 2207	New, Dry, Conditioned	5	81.6	79.4	37.6	111.2	87.2	Comparison
Air Permeability (CFM/Ft^2)	ASTM D 737	New, Conditioned	5	44.8	6.8	124.4	28.0	8.4	Comparison
Stiffness (gm-cm)	KK-L-311a, 4211	New, Conditioned	5	2.0	2.1	1.1	24	1.1	Comparison
Milden Resistance (days)	KK-L-311a, 5011	New, Wet (incubated)	1	30	30	30	30	5	Comparison
Propensity to Scratch (percent)	ASTM D 1003	New, Dry (2,000 cycles)	3	+17	+28	+30	+46	-5	Comparison
Static Charge (volts/1000c)	Improvised	New, Dry (5,000 cycles)	3	100-	85-	100+	25-	75+	Comparison
Breaking Strength (lbs)	KK-L-311a, 2031	New, Wet (5 lb wringer)	4,8,9, and 10	33.0	33.3	12.1	25.2	35.1*	Comparison
Tearing Strength (lbs)	CCC-T-191b, 5134	New, Wet (5 lb wringer)	5, 8, and 10	13.4	10.7	1.5	3.5	5.5*	Comparison

* A larger number of samples were taken on Code "P" because of the wide variance in thickness.

APPENDIX I-B

CHAMOIS PERFORMANCE - EXPECTED DURABILITY

Engineering Test

Performance Criteria	Chamois Rating Low _____ High
Breaking Strength (dry)	N T S P K
Breaking Strength (30 lb wringer, wet)	N K S T P
Breaking Strength (5 lb wringer, wet)	N K S T P
Bursting Strength (dry)	N T S P K
Abrasion (dry)	N K T S P
Abrasion (wet)	K N T S P
Tearing Strength (dry)	N K P T S
Tearing Strength (30 lb wringer, wet)	N K P T S
Tearing Strength (5 lb wringer, wet)	N K P T S

NOTE: Underlining shows those items whose numerical performance ratings from Appendix I-A show no significant difference at the 0.05 level.

APPENDIX I-C

DURABILITY EVALUATION

Engineering Test

Name of Subtest	Evaluation by Code				
	"K"	"N"	"T"	"S"	"P" (Std.)
Breaking Strength, Dry	Excellent	Poor	Fair	Fair	Good
Point Value	5	2	3	3	4
Breaking Strength, Wet	Poor	Very Poor	Fair	Fair	Fair
Point Value	2	1	3	3	3
Bursting Strength, Dry	Excellent	Poor	Good	Good	Good
Point Value	5	2	4	4	4
Abrasion Resistance, Dry	Fair	Poor	Fair	Good	Good
Point Value	3	2	3	4	4
Abrasion Resistance, Wet	Poor	Poor	Good	Good	Good
Point Value	2	2	4	4	4
Tearing Strength, Dry	Poor	Poor	Good	Excellent	Fair
Point Value	2	2	4	5	3
Tearing Strength, Wet	Poor	Very Poor	Good	Excellent	Fair
Point Value	2	1	4	5	3
Total Point Value	21	12	25	28	25
Average Point Value	3.0	1.7	3.6	4	3.6
Overall Evaluation	Fair	Very Poor	Fair	Good	Fair
Rank Order	4	5	2-3	1	2-3

APPENDIX I-D

DESIRABLE FACTORS EVALUATION

Engineering Test

Property	Evaluation by Code				
	Code "S"	Code "T"	Code "N"	Code "K"	Code "P"
Area	Very Good	Very Good	Good	Good	Good
Point Value	5	5	4	4	4
Thickness	Good	Fair	Poor	Poor	Good
Point Value	4	3	2	2	4
Breaking Strength, Dry	Fair	Fair	Very Poor	Very Poor	Good
Point Value	3	3	1	1	4
Breaking Strength, Wet	Fair	Fair	Very Poor	Poor	Good
Point Value	3	3	1	2	4
Water Absorption	Very Good	Very Poor	Very Good	Good	Good
Point Value	5	1	5	4	4
Water Expelled	Very Good	Good	Good	Very Poor	Good
Point Value	5	4	4	1	4
Time of Wetting	Good	Very Good	Good	Very Good	Good
Point Value	4	5	4	5	4
Stiffness	Fair	Fair	Good	Very Poor	Good
Point Value	3	3	4	1	4
Mildew Resistance	Very Good	Very Good	Very Good	Very Good	Poor
Point Value	5	5	5	5	2
Propensity to Scratch	Fair	Poor	Poor	Very Poor	Good
Point Value	3	2	2	1	4
Static Removal	Very Good	Good	Very Good	Poor	Good
Point Value	5	4	5	2	4
Air Permeability	Poor	Good	Very Poor	Fair	Good
Point Value	2	4	1	3	4
Total Points	47	42	38	31	46
Average Point Score	3.9	3.5	3.2	2.6	3.83
Average Rating	Fair	Fair	Fair	Poor	Fair
Rank Order	1	3	4	5	2

APPENDIX I-E

SUMMARY OF AVERAGE USER RATINGS ON
CHAMOIS EVALUATIONS BY PERFORMANCE CRITERIA
Service Test

Application	Cycle I (Item New)										Cycle II (Item Used)									
	Automotive					Aircraft					Automotive					Aircraft				
Performance Criteria \ Item Code	K	N	T	S	P	K	N	T	S	P	K	N	T	S	P	K	N	T	S	P
1. Cleanest and Most Acceptable	0.85	0.47	0.76	1.90	1.95	0.50	0.59	1.30	2.35	2.44	0.23	1.50	1.20	1.28	1.71	0.10	1.27	1.38	1.63	1.63
2. Dried and Cleaned Best	0.90	0.84	1.19	1.95	2.09	0.50	1.41	1.81	2.46	1.52	0.15	1.64	1.20	2.0	1.93	0.36	1.23	1.80	2.14	1.70
3. Did Not Streak or Leave a Residue	1.15	0.52	0.90	2.04	1.81	0.69	1.33	1.65	2.50	1.67	0.15	1.57	0.87	2.07	1.93	0.39	1.26	1.92	2.36	1.29
4. Polished Cleanest and Shiniest	0.60	0.84	1.09	1.81	2.00	0.65	1.29	1.80	2.39	1.59	0.0	1.35	1.26	1.89	1.79	0.56	1.42	1.92	2.25	1.07
5. Withstood Tearing, Shredding, and Pulling Apart	0.75	0.64	1.45	1.57	2.18	0.03	1.07	1.38	2.39	2.59	0.69	0.93	1.20	2.00	2.07	0.50	0.62	2.30	2.18	2.07
6. Least Fiber Deposit	1.10	0.84	1.19	1.77	1.45	0.62	1.26	1.54	2.00	1.56	0.0	1.57	0.67	2.00	1.14	0.46	1.38	1.88	2.25	0.93
7. Did Not Mar or Scratch	0.50	1.05	1.04	1.73	1.73	0.54	1.26	1.30	1.85	2.00	0.0	1.14	1.13	2.07	2.21	0.25	0.69	1.73	2.00	1.56
8. Held Most Water	0.50	1.21	1.38	2.14	1.82	0.26	0.96	1.23	2.43	2.85	0.0	1.14	1.06	2.28	2.57	0.54	0.59	2.00	2.30	2.37
9. Cleaned Easiest	1.20	0.84	0.95	1.91	1.45	0.46	1.40	1.65	2.18	1.40	0.15	0.88	1.33	1.93	1.21	0.68	0.96	1.71	1.89	1.42
10. Cleanest	0.95	0.94	0.80	1.95	1.13	0.57	1.04	1.80	1.50	1.55	0.15	1.35	1.13	1.64	1.35	0.63	0.81	1.92	2.03	1.23
11. Overall Evaluation	1.20	1.10	0.90	1.95	2.32	0.54	1.40	2.07	2.93	1.77	0.0	1.43	1.46	2.14	2.28	0.46	1.15	2.15	2.70	1.52

The chamois received a preference rating of 1 to 4.

Preference Scale:

0 - Not Preferred
1 - Practically No Difference
2 - Slight Preference
3 - Moderate Preference
4 - Very Much Preferred

APPENDIX I-F

CHAMOIS PERFORMANCE - AUTOMOTIVE APPLICATION

Service Test

Performance Criteria	1st Cycle (New Chamois) Chamois Rating Low ——— High	2nd Cycle (Used Chamois) Chamois Rating Low ——— High
1. Cleanest and Most Acceptable	N T K S P	K T S N P
2. Dried and Cleaned Best	N K T S P	K T N P S
3. Did Not Streak or Leave a Residue	N T K P S	K T N P S
4. Polished Cleanest and Shiniest	K N T S P	K T N P S
5. Withstood Tearing, Shredding, and Pulling Apart	N K T S P	K N T S P
6. Least Fiber Deposit	N K T P S	K T P N S
7. Did Not Mar or Scratch	K T N S P	K T N S P
8. Held Most Water	K N T P S	K T N S P
9. Cleaned Easiest	N T K P S	K N P T S
10. Cleanest	T N K P S	K T N P S
11. Overall Evaluation	T N K S P	K N T S P

NOTE: Underlining shows those items whose numerical preference ratings (App. I-E) showed no significant difference at the 0.05 level.

APPENDIX I-G

CHAMOIS PERFORMANCE - AIRCRAFT APPLICATION

Service Test

Performance Criteria	1st Cycle (New Chamois) Chamois Rating Low ——— High	2nd Cycle (Used Chamois) Chamois Rating Low ——— High
1. Cleanest and Most Acceptable	K N T S P	K N T S P
2. Dried and Cleaned Best	K N P T S	K N P T S
3. Did Not Streak or Leave a Residue	K N T P S	K N P T S
4. Polished Cleanest and Shiniest	K N P T S	K P N T S
5. Withstood Tearing, Shredding, and Pulling Apart	K N T S P	K N P S T
6. Least Fiber Deposit	K N T P S	K P N T S
7. Did Not Mar or Scratch	K N T S P	K N P T S
8. Held Most Water	K N T S P	K N T S P
9. Cleaned Easiest	K N P T S	K N P T S
10. Cleanest	K N S P T	K N P T S
11. Overall Evaluation	K N P T S	K N P T S

NOTE: Underlining shows those items whose numerical preference ratings (App. I-E) showed no significant difference at the 0.05 level.

APPENDIX I-H

QUESTIONNAIRE DATA ON SKIN IRRITATIONS

Service Test

Characteristic	Application	Cycles	User Evaluations	
			Yes	No
Caused Noticeable Skin Irritation	Automotive	I	2*	50
	Automotive	II	0	35
	Aircraft	I	0	67
	Aircraft	II	1**	66

*The 2 instances reported were using Code "N" chamois. Data were not sufficient to determine if reports were valid as no irritations were verified by medical authorities.

**Reported when using the control item (Code "P"), consequently is not considered valid.

APPENDIX I-I

LETTER FROM NATICK LABORATORIES WITH INCLOSURES

U.S. ARMY NATICK LABORATORIES
Natick, Massachusetts

In Reply Refer to:
AMXRE-COP

27 Sep 1965

SUBJECT: ET/ST on Synthetic Chamois, USATECOM Project No. 7-5-0621-01

TO; Commanding General
U.S. Army Test and Evaluation Command
ATTN: AMSTE-GE
Aberdeen Proving Ground
Maryland

1. Reference:

a. NLABS letter to CG, USATECOM, dated 20 May 1965, subject: "Proposed ET/ST of Synthetic Chamois."

b. Telecon Mr. Elie Weeks, USAGETA to Dr. J.A. Murray, NLABS, requesting additional information to support safety statement indicating non-hazardous characteristics of test items.

2. Letters have been obtained from Code "K"(Incl 1), Code "N" (Incl 2), and Codes "S" and "T" (Incl 3) indicating no safety hazard in their experience of merchandising the respective products which have been furnished for subject test.

FOR THE COMMANDER:

3 Incl
as

GERALD C. MacDONALD
Chief
Quality Assurance Office

Copy furnished:
CO, USAGETA, Ft. Lee, Va.

APPENDIX I-I

Code "K"

September 7, 1965

Dr. J. Alden Murray
U.S. Army Natick Laboratories
Natick, Massachusetts

Dear Dr. Murray:

This short note will serve as an acknowledgement of your request as per our phone conversation of this morning.

Our Code "K", imitation chamois, has been sold commercially for the past few years. The exact number of years would be in excess of five years. This grade has been sold for commercial use as imitation chamois.

We know of no safety hazards such as Dermititis. Our sales here have been somewhat limited to the wiping industry, however, as stated above, the sales have been made for a period in excess of five years with no problem.

We trust that this information answers your questions and, naturally, if you should require any additional information, please feel free to contact us.

Very truly yours,

Code "K"
Sales Service Manager

APPENDIX I-I

CODE "N"

September 7, 1965

Dr. J. Alden Murray
U.S. Army Natick Laboratories
Natick, Massachusetts - 01762

SUBJECT: CODE "N"

Dear Dr. Murray:

Per our telecon of today regarding subject matter, following is the information you requested.

Based on our research and development of subject material, and subsequent use experienced by a variety of consumers, there has been no adverse effect on the skin of personnel when used for the purpose intended.

I hope the above information is sufficient. If I can be of any further assistance, please don't hesitate to contact me. Your continued interest in subject material is greatly appreciated.

Sincerely yours,

Code "N"
Government Sales Manager

APPENDIX I-I

CODES "S" & "T"

September 9, 1965

Dr. J. Alden Murray, Chief
Chemical Products & Paper Engr. Branch
U.S. Army Natick Laboratories
Natick, Massachusetts 01762

Reference: AMXRE-CCP

Dear Dr. Murray

With your telephone call of September 7, you inquired as to the toxidity and possible health hazard of our synthetic chamois products.

This letter is to advise you that your synthetic chamois products and more specifically, Codes "S" & "T" are in no way toxic and do not represent a health hazard. Besides the fact that these products have been sold worldwide for over 10 years without a single report of dermatitis, may we point out that the fibers utilized in the manufacture of these products are natural and man-made fibers approved by Food and Drug and even used in surgical dressings.

The binders are the butadiene-acrylo-nitrile type and are known to be non-allergenic.

We hope that this is the information desired.

Sincerely yours,

Codes "S" and "T"
Industrial Division

APPENDIX II. FINDINGS

Characteristic (ET)	Chamois Evaluation					Reference
	"P"	"S"	"T"	"N"	"K"	
Area	B	E	E	B	B	2.2
Thickness	E	E	B	B	B	2.3
Breaking Strength - Dry	E	E	E	B	E	2.3
Breaking Strength - Wet	*	C	C	B	B	2.3
Water Absorption	B	E	B	E	E	2.3
Water Removed by Wringing	B	E	B	B	B	2.3
Wetting Time	E	E	E	E	E	2.3
Total Ash	E	E	E	E	E	2.4
Iron and Aluminum	E	E	E	E	E	2.4
Chromium	E	E	E	E	E	2.4
Free Formaldehyde	E	E	E	E	E	2.4
Acidity	E	E	E	B	E	2.4
Abrasion Resistance - Dry	*	C	B	B	B	2.5
Abrasion Resistance - Wet	*	C	C	B	B	2.5
Tearing Strength - Dry	*	E	E	B	B	2.5
Tearing Strength - Wet	*	E	E	B	B	2.5
Bursting Strength	*	C	C	B	E	2.5
Air Permeability	*	E	B	E	E	2.5
Stiffness	*	B	B	C	B	2.5
Mildew Resistance	*	E	E	E	E	2.5
Propensity to Scratch	*	B	B	B	B	2.5
Static Charge	*	E	E	E	B	2.5
Flammability	*	B	B	B	B	2.6

* - Used as Standard for Comparison
E - Exceeded Standard
C - Complied to Standard
B - Below Standard

APPENDIX II

Characteristic (ST)		Cycle	Chamois Evaluation "P"	"S"	"T"	"N"	"K"	Reference
Cleanest and Most Acceptable	Auto. Use	I	*	C	B	B	C	2.7, 2.9
		II	*	C	C	C	B	2.7, 2.9
	Aircraft Use	I	*	C	B	B	B	2.8, 2.9
		II	*	C	C	C	B	2.8, 2.9
Dried and Cleaned Best	Auto. Use	I	*	C	C	B	B	2.7
		II	*	C	C	C	B	2.7
	Aircraft Use	I	*	E	E	B	B	2.8
		II	*	C	C	B	B	2.8
Did Not Streak or Leave a Residue	Auto. Use	I	*	C	B	B	C	2.7
		II	*	C	B	C	B	2.7
	Aircraft Use	I	*	C	C	B	B	2.8
		II	*	E	E	B	B	2.8
Polished Cleanest and Shiniest	Auto. Use	I	*	C	B	B	B	2.7
		II	*	C	C	C	B	2.7
	Aircraft Use	I	*	C	C	B	B	2.8
		II	*	E	E	E	B	2.8
Withstood Tearing, Shredding, and Pulling Apart	Auto. Use	I	*	C	C	B	B	2.7
		II	*	C	C	B	B	2.7
	Aircraft Use	I	*	C	B	B	B	2.8
		II	*	C	C	B	B	2.8
Least Fiber Deposit	Auto. Use	I	*	C	C	C	C	2.7
		II	*	C	B	C	B	2.7
	Aircraft Use	I	*	C	C	C	B	2.8
		II	*	E	E	C	B	2.8
Did Not Mar or Scratch	Auto. Use	I	*	C	C	C	B	2.7
		II	*	C	B	B	B	2.7
	Aircraft Use	I	*	C	C	C	B	2.8
		II	*	C	C	B	B	2.8
Held Most Water	Auto. Use	I	*	C	C	C	B	2.7
		II	*	C	B	B	B	2.7
	Aircraft Use	I	*	C	B	B	B	2.8
		II	*	C	C	B	B	2.8
Cleaned Easiest	Auto. Use	I	*	C	C	C	C	2.7, 2.9
		II	*	C	C	C	B	2.7, 2.9
	Aircraft Use	I	*	C	C	C	B	2.8, 2.9
		II	*	C	C	C	B	2.8, 2.9
Cleanest	Auto. Use	I	*	C	C	C	C	2.7, 2.9
		II	*	C	C	C	B	2.7, 2.9
	Aircraft Use	I	*	C	C	C	B	2.8, 2.9
		II	*	C	C	B	B	2.8, 2.9
Overall Evaluation	Auto. Use	I	*	C	B	B	B	2.7
		II	*	C	C	C	B	2.7
	Aircraft Use	I	*	C	C	C	B	2.7
		II	*	E	C	C	B	2.8
Removal of Static Electricity			*	C	C	C	C	2.10
Safety Confirmation			*	C	C	C	C	2.11
Value Analysis			*	E	E	E	E	2.12

* - Used as Standard of Comparison
E - Exceeded Standard
C - Complied to Standard
B - Below Standard

APPENDIX III. DEFICIENCIES AND SHORTCOMINGS

1. DEFICIENCIES

Deficiency	Suggested Corrective Action	Remarks
1.1 None	None	None

2. SHORTCOMINGS

Shortcoming	Suggested Corrective Action	Remarks
2.1 Codes "T," "N," and "K" did not meet all physical requirements of KK-C-300b	None	See par. 2.3.4. The control item also failed to meet all these standards.
2.2 Code "N" did not meet all chemical requirements of KK-C-300b	None	See par. 2.4.4
2.3 Codes "N" and "K" experienced frequent failures by tearing during wringing out water.	None	See par. 2.9.3

APPENDIX IV. REFERENCES

References for this test are as follows:

1. Letter, AMXRE-COP, U.S. Army Natick Laboratories, Natick, Massachusetts, dated 20 May 1965, subject: "Proposed ET/ST of Synthetic Chamois," with two inclosures.

2. Federal Specification KK-C-300b, dated 13 Feb 64, Chamois, Leather, Sheepskin, Oil-Tanned, with Interim Amendment - 1, dated 7 Jul 64.

3. Federal Specification KK-L-311a, dated 19 Jan 53, Leather; Methods of Sampling and Testing, with Amendment - 4, Part 1, dated 26 Jun 56; Part 2, dated 17 Dec 58; and Part 3, dated 6 Nov 62.

4. Military Standard 105D, dated 29 Apr 63, Sampling Procedures and Tables for Inspection by Attributes, with Change 2, dated Mar 64.

5. Federal Specification CCC-T-191b, dated 15 May 51, Textile Test Methods, with amendments.

6. 1965 Book of ASTM Standards, dated Oct 65, Parts 24, 25, and 27.

AD Accession No.

Headquarters, U.S. Army General Equipment Test Activity, Fort Lee, Virginia.

FINAL REPORT OF INTEGRATED ENGINEERING/SERVICE TEST OF SYNTHETIC CHAMOIS, by Richard E. Smith, Capt., TC, and Brenda L. Salyers, 1st Lt., WAC, May 1966, 34p. -illus.-tables, 3 Appendices p31-34.
(TECOM Project No. 7-3-0621-01) (Unclassified Report)

An integrated engineering/service test of four synthetic chamois was conducted by U.S. Army General Equipment Test Activity to determine the technical performance of synthetic chamois and to determine their suitability for use by the Army. Tests were conducted during the period 13 July 1965 to 11 January 1966.

The engineering portion of the test compared the four synthetic chamois with the standard general purpose chamois and its Federal Specifications. The service test portion determined to what degree from the user's viewpoint the synthetic chamois performed the basic functions which the present standard general purpose chamois is now performing.

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1. Chamois, Synthetic
I. Smith, Richard E., Capt. TC, and Salyers, Brenda L., 1st Lt., WAC
II. Title
III. TECOM Proj. No. 7-3-0621-01

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1. Chamois, Synthetic
I. Smith, Richard E., Capt. TC, and Salyers, Brenda L., 1st Lt., WAC
II. Title
III. TECOM Proj. No. 7-3-0621-01

It was concluded that the Code "F" chamois was the only one of the four synthetic chamois that compared satisfactorily to the criteria and to the standard general purpose chamois and that it was considered suitable for Army use. It was recommended that the Code "F" synthetic chamois be considered suitable for use by the U.S. Army.

It was concluded that the Code "F" chamois was the only one of the four synthetic chamois that compared satisfactorily to the criteria and to the standard general purpose chamois and that it was considered suitable for Army use. It was recommended that the Code "F" synthetic chamois be considered suitable for use by the U.S. Army.

It was concluded that the Code "F" chamois was the only one of the four synthetic chamois that compared satisfactorily to the criteria and to the standard general purpose chamois and that it was considered suitable for Army use. It was recommended that the Code "F" synthetic chamois be considered suitable for use by the U.S. Army.

It was concluded that the Code "F" chamois was the only one of the four synthetic chamois that compared satisfactorily to the criteria and to the standard general purpose chamois and that it was considered suitable for Army use. It was recommended that the Code "F" synthetic chamois be considered suitable for use by the U.S. Army.

AD Accession No.

Headquarters, U.S. Army General Equipment Test Activity, Fort Lee, Virginia.

FINAL REPORT OF INTEGRATED ENGINEERING/SERVICE TEST OF SYNTHETIC CHAMOIS, by Richard H. Smith, Capt., TC, and Brenda L. Salyers, 1st Lt., WAC, May 1966, 54p, -illus. -tables, 5 Appendices p31-54.
(TECOM Project No. 7-5-0621-01) (Unclassified Report)

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1. Chamois, Synthetic
I. Smith, Richard H., Capt, TC, and Salyers, Brenda L., 1st Lt., WAC
II. Title
III. TECOM Proj. No. 7-5-0621-01

It was concluded that the Code "S" chamois was the only one of the four synthetic chamois that compared satisfactorily to the criteria and to the standard general purpose chamois and that it was considered suitable for Army use. It was recommended that the Code "S" synthetic chamois be considered suitable for use by the U.S. Army.

It was concluded that the Code "S" chamois was the only one of the four synthetic chamois that compared satisfactorily to the criteria and to the standard general purpose chamois and that it was considered suitable for Army use. It was recommended that the Code "S" synthetic chamois be considered suitable for use by the U.S. Army.

It was concluded that the Code "S" chamois was the only one of the four synthetic chamois that compared satisfactorily to the criteria and to the standard general purpose chamois and that it was considered suitable for Army use. It was recommended that the Code "S" synthetic chamois be considered suitable for use by the U.S. Army.

It was concluded that the Code "S" chamois was the only one of the four synthetic chamois that compared satisfactorily to the criteria and to the standard general purpose chamois and that it was considered suitable for Army use. It was recommended that the Code "S" synthetic chamois be considered suitable for use by the U.S. Army.

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DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)
Department of the Army
U.S. Army General Equipment Test Activity
Fort Lee, Virginia 23801

2a. REPORT SECURITY CLASSIFICATION
UNCLASSIFIED

2b. GROUP

3. REPORT TITLE
Integrated Engineering/Service Test of Synthetic Chamois

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Final Report

5. AUTHOR(S) (Last name, first name, initial)
Smith, Richard H., Captain, TC, and Salyers, Brenda L., 1st Lieutenant, WAC.

6. REPORT DATE
May 1966

7a. TOTAL NO. OF PAGES
54

7b. NO. OF REFS
6

8a. CONTRACT OR GRANT NO.

b. PROJECT No.
USATECOM 7-5-0621-01

c.

d.

9a. ORIGINATOR'S REPORT NUMBER(S)

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

10. AVAILABILITY/LIMITATION NOTICES
This document may be further distributed by any holder only with specific prior approval of Commanding General, U.S. Army Natick Laboratories, Natick, Mass.

11. SUPPLEMENTARY NOTES
None

12. SPONSORING MILITARY ACTIVITY
U.S. Army Natick Laboratories
Natick, Massachusetts

13. ABSTRACT

An integrated engineering/service test of four synthetic chamois was conducted by U.S. Army General Equipment Test Activity to determine the technical performance of synthetic chamois and to determine their suitability for use by the Army. Tests were conducted during the period 13 July 1965 to 11 January 1966. The engineering portion of the test compared the four synthetic chamois with the standard general purpose chamois and its Federal Specifications. The service test portion determined to what degree from the user's viewpoint the synthetic chamois performed the basic functions which the present standard general purpose chamois is now performing.

It was concluded that the code "S" chamois was the only one of the four synthetic chamois that compared satisfactorily to the criteria and to the standard general purpose chamois and that it was considered suitable for Army use. It was recommended that the code "S" synthetic chamois be considered suitable for use by the U.S. Army.

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There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Idenfiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, rules, and weights is optional.

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