WADC TECHNICAL REPORT 55-72

A COMPILATION OF DATA FROM EVALUATIONS OF THE FUNGUS RESISTANCE PROPERTIES OF AIR FORCE MATERIALS

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FOREWORD

This report was prepared by the Protective Processes Branch and was initiated under Project No. 7312 "Finishes and Materials Preservation", Task No. 73124 "Preservative Chemicals", formerly RDO No. 611-15 "Preservative Chemicals", and was administered under the direction of the Materials Laboratory, Directorate of Research, Wright Air Development Center with Earlana L. Hamilton acting as project engineer.

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ABSTRACT

The main object of this work is to provide the designer with a guide for selection of fungus resistant materials in the design and maintenance of Air Force materiel which will require some degree of protection against micro-biological degradation.

The materials discussed fall into three general classes: (1) those employing a fungicidal treatment, (2) those without treatment, but which show a natural resistance to fungi because of their chemical composition which does not readily provide fungi with a source of nutrient, and (3) the chemicals or formulations that are toxic to micro-organisms.

Fungicidal treatments which have proven unsatisfactory in the particular formulation tested are also listed. However, those found unsatisfactory may well prove satisfactory when used or tested under other conditions.

Many materials, if selected properly on the basis of future use in combination with other materials in the finished item, may provide a satisfactory fungus resistant material without the necessity of a chemical add-on treatment.

PUBLICATION REVIEW

The publication of this report does not constitute approval by the Air Force of the findings contained therein. It is published only as an aid or guide in establishing standards of performance of Air Force materials.

FOR THE COMMANDER:

M. R. WHITMORE
Technical Director
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INTRODUCTION

Inquiries are made at this Center regarding fungus resistant materials for use in advanced design aircraft and ground support equipment as well as for the proper maintenance of presently used Air Force materiel. It was considered desirable to compile data obtained from test evaluations of fungicidal chemicals, fungicidally treated materials, and non-treated materials exhibiting inherent resistance to fungi. This compilation would assist members of industry directed by the Armed Services in the selection of fungus resistant materials when initiating standards of performance.

The purpose of this compilation is to evaluate the performance of a number of products for specific applications. Many of the materials evaluated were not developed or intended by the manufacturer for the conditions to which they have been subjected. Any failure or poor performance of a material without a treatment therefore is not necessarily indicative of the utility of the material under less stringent conditions or for other applications.

The compilation lists the chemicals, the treatments, or the materials as either satisfactory or unsatisfactory. This refers to the fungus resistance of the treatment of material from theevaluations reviewed, and does not indicate disapproval of any future improvement in the formulations which are now considered to lack fungus resistance properties on the basis of present formulations. The data reviewed has been selected from evaluations performed only at this Center because a greater uniformity of test procedures were used which permitted a better comparison of results. No attempt has been made to include all fungicidal chemicals, treated materials or formulations but only those that have been investigated or evaluated for a particular Air Force use.

This compilation is not intended as a final or infallible guide to fungus resistant materials. The final decision in the choice of a material willlin great part be determined by the end use and by those components with which the item will have to function as an unit. By the use of the data presented in this compilation it will be possible to more efficiently assay the need for future development and evaluations of protective treatments for particular classes of materials which have not received prior attention in this respect by the Air Force.

DISCUSSION OF DATA

In making effective use of the information in this report, any evaluation result of the test method used on a specific material will require keeping the following factors in mind: (1) the type of test method used, (2) the composition of the exposed material, (3) the end use of the material. To properly interpret the results of the fungus resistance factor, the rating of satisfactory or unsatisfactory, it is necessary to know how the decision was reached by the personnel performing the fungus resistance evaluations. Depending on the information available, as many as possible of the following factors were considered:

Visual Observation

Macroscopic examination during the exposure period gave an indication of the development of the test organisms. A microscopic examination at the completion of the exposure period was considered a prerequisite to the second factor.

Identification of Fungi

Any fungi growing on a natural fiber material must be identified and classified as being either cellulolytic or non-cellulolytic. Cellulolytic fungi cause degradation, whereas non-cellulolytic or surface growth type of fungi may cause indirect damage. Surface growth, however, which is incapable of breaking down any substrate material by production of metabolic products rarely results in malfunction of the material unless the growth is allowed to remain so that other deleterious effects occur. An example of this would be the corrosion of associated metal parts by accumulated moisture. Surface growth of fungi usually causes an adverse psychological reaction among personnel required to use or handle the contaminated item. Due consideration of this point should enter into any rejection or acceptance of material or item.

Result of Laboratory Performance Tests

The performance record of material or item after exposure to fungi under laboratory conditions, serves as the basis for most decisions regarding fungus resistance of textiles and other materials. The breaking strength results obtained from exposed textile test samples are used as an indication of breakdown. The breaking strength must be correlated with the type of fungus growth and the length of exposure time. The breaking strength results, when available, were used as the principal guide in determining the fungus resistance of a material. However, the acceptibility of a material for use is dependent upon meeting all the standard requirements. The fungus resistance requirement is only one of many to be considered before a material is acceptable for use. Wherever the composition of the item prevented the use of breaking strength or operational type of tests, the decision to accept or reject was based solely on the presence or absence of the test organisms on the material or item while exposed to fungi in the laboratory.

Record of Field Use

The performance record of the material or item in field use is of prime importance and of great value. Wherever such reliable reports existed, the information was utilized and given preference over other factors considered since field use is more realistic than any artificial test conditions simulating field use.

Any item listed as fungus resistant was judged on the basis of tests performed, and must be considered individually on these test results only. It would not be accurate or reliable to compare a material tested by one test method against a like material tested by a different method, i.e. agar plate compared with soil burial.

While a decision to reject or accept a test material must be based on a standard acceptable minimum, there are occasions when a fungus resistant material may not meet the minimum requirements of the presently used standard in physical properties, and yet be more effective in resistance to microbiological degradation than the standard.

In the comments section of this report are listed some of the limiting factors as well as some exceptions to the rule in the use of the listed materials. However, prime consideration is given to the fungus resistance property of the evaluated sample, with other properties given secondary consideration. Wherever reliable information regarding other performance tests was available, it was included in the report and cross referenced by the assigned C letter and code number.

One of the rules of evaluation requiring improvement is the prevailing practice of using a common standard to test new materials. This practice often results in an arbitrary type of rejection or acceptance of an item. More extensive evaluations and standardization of the comparative tests would help to make the selection of the standard more reliable since more variables would have been investigated. Rejection of a new material should not occur until comparison with a realistic standard has shown the material to be unsatisfactory for the present requirements.

The various sections of this report have been arranged under headings A through F. The A Section includes the basic concepts utilized by personnel in determining the acceptance or rejection of a sample for use as a fungus resistant material. Section B, Index to Tables, lists all materials or items by the same number as shown in the Tables in Section F. A key to the symbols used in the Tables in Section F is given at the end of the Index to Tables, page 5. The C Section lists any additional information concerning the enumerated items in Section F since the tabular format of the latter Section would not accomodate a detailed discussion. Section C must be used in conjunction with Section F to insure efficient use of the compiled data which makes up the body of this report. Section D consists of a cross reference list of the fungicides by trade name and chemical name referred to in the Tables in Section F. Section E gives a detailed description of the test methods cited in the Tables in Section F. Tables listing more than 200 items comprise Section F. The data are presented in tabular form under the following headings:

a) materials are cited by an Item Number for convenient reference
b) the amount and type of treatment used as a preservative
c) the test method used to evaluate the efficiency of the preservative or material
d) the manufacturer of the test item
e) the source of active chemical or preservative formulation used
f) the evaluation results of the fungicidal efficiency of the treatment or material
g) a column for reference to the comments section wherever additional pertinent information is required

B. Index to Tables

C. Comments Section

D. Index to Fungicides by Tradename

E. Descriptions of Test Methods Referenced in Tables

I) agar plate test, general materials
II) agar plate, screening technique
III) agar plate, leather samples
IV) agar plate, varnish samples
V) non-agar plate, general materials
VI) non-agar, sand spore inoculum, leather
VII) soil burial, general materials
VIII) weathering resistance, natural method
IX) crocking test

F. Compilation Tables

Key to Symbols used in Tables

Symbol	Meaning
S	Item or material shows satisfactory fungus resistance
Un	Item or material does not show satisfactory fungus resistance.
S/R	Item or material shows satisfactory fungus resistance, but use with reservation as indicated in the accompanying comment referenced by a number under the Comments heading in the tables making up this report.
C1--	Refers to section in report labelled Comments. Information such as toxicity of the fungicide, type application, any restrictions on use of item, etc. will be given in the Comments section of the report, page 6. Do not use any item or material without checking the comment number if such a number is listed.
L	Samples were leached prior to exposure; refer to Appendix 1, Section E, page 13, for detailed description of leaching process.

C. Comments Section

Code No.	
1	Very poor fungus resistance
2	Later formulations of this fungicide provided satisfactory fungus resistance, see item 25, page 26
3	Copper content reduced considerably by leaching process
4	Tacky appearance developed after material exposed
5	Tacky appearance developed after material exposed
6	Tacky appearance developed after material exposed
7	Material was not tacky in appearance after exposure
8	Copper content insufficient to provide adequate fungus resistance
9	Copper content insufficient to provide adequate fungus resistance
10	This material should be judged by a standard based on same type material. Evaluations at this Center are in progress to provide a comparable standard for chemically altered cotton fabrics.
11	Met only very minimal requirements for fungus resistance
12	This material should be judged by a standard based on same type material. Evaluations at this Center are in progress to provide a comparable standard for chemically altered cotton fabrics.
13	Treatment leaches out easily and color of material fades upon exposure
14	No fungus resistance exhibited
15	Solvent treatment
16	Emulsion treatment
17	Failed wet crocking test
18	Failed wet crocking test
19	Treatment leaches out
20	Soft thread treated with Cunilate 2174 will not sew well
21	The dytex method of application of copper 8-quinolinolate is unsatisfactory
22	Submitted samples lost 38.0% of original breaking strength in soil burial, but passed specification requirements when evaluated by petri plate exposure
23	Use with reservation; item is not fungicidal, but is satisfactory for use where complete fungus resistance is not required
24	Utilize for limited fungus resistance
25	No fungicidal properties evident as result of tests
26	800C temperature is required to melt crystals; treat by soaking for 15 minutes
27	Satisfactory after 2 years exposure in tropical chamber at this Center
28	The toxicity evaluations with lower concentrations of this fungicide produced definite sensitivity

Code No.	
29	Toxic to personnel
30	Solution consisted of Stoddard's solvent and slightly chlorinated vegetable oil
31	Toxic to personnel
32	Solution consisted of Stoddard's solvent and slightly chlorinated vegetable oil
33	Fungus resistance obtained for at least 30 days despite contact with susceptible material. Use with caution; dielectric constant and arc resistance tests failed by this lubricant
34	Failed dielectric constant, but maintained fungus resistance for 30 days
35	Fungus resistance not maintained after 14 days when fungicide incorporated in DC5 base grease
36	Fungus resistance not maintained after 14 days when fungicide incorporated in DC5 base grease
37	The silicone XE112A finishing oil for parachute nylon is less susceptible to surface fungus growth than any presently used vegetable oil
38	Incorporate fungicide in bonding latex only
39	Copper leached out when sample sterilized by steam as required by testing specification
40	Minimum of 6.0% copper 8-quinolinolate required to provide satisfactory fungus resistance
41	Fungicide fugitive when steam sterilization used
42	Fungicide fugitive when steam sterilization used
43	Recommended use of 1.25-1.5% DAAP fungicide based on weight of combined adhesive and paper and applied to flat outer surfaces as well as corrugated area. An effective adhesive is necessary. This is an experimental procedure and is not indicative of Air Force acceptance of the item unless it proves to be fungus resistant when evaluated by this Center
44	Ineffective adhesive caused loss of fungicide which might otherwise have provided protection
45	Consisted of rosin sized kraft paper liner bonded to distended Douglas fir veneer core with a soya adhesive; no fungicide included.
46	Consisted of same composition as described under C45, but with the inclusion of a fungicide as indicated in the table.
47	Fungus growth occurred and samples became delaminated while exposed to fungus resistance evaluation.
48	Same construction as described under C45, with the exception of the soya adhesive being replaced by an extended urea adhesive.
49	Same construction as described under C48, with the addition of Woodtox Sealer.
50	DAAP fungicide content was based on the dry weight of adhesive (Lauxien 10-B) applied to rosin sized kraft paper. Fungus growth covered specimens by end of seven days exposure on agar medium. Test discontinued at 7 days.

Code No.	
51	Fungicide content based on weight of paint, and applied in the paint to the plywood surface.
52	Treatment is satisfactory for fungus resistance when applied to either of the following bases: (a) 16 point high wet strength kraft paper laminated to a 3/16" pini infected Douglas fir veneer core distended 8.0 -- 10.0%. (b) 16 point ordinary kraft paper (rosin sized) laminated to 3/16" pini infected Douglas fir veneer core.
53	Treatment applied to bases (a) and (b) as described under C52.
54	Amount of fungicide based on dry weight of soya protein in adhesive applied to bases (a) and (b) as described under C52.
55	VPI evaluation consisted of 5.0, 10.0, and 20.0% solution of dicyclohexyl ammonium nitrite chemical used as the active constituent of vapor phase inhibitors for paper items.
56	Fungus growth occurred on case liner material
57	Sample switch case was equipped with cellulose filled melamine plunger which supported fungus growth. This type of cellulosic material must be avoided. The glass filled alkyd resin material was satisfactory as represented by the sample submitted.
58	Item designed for use in thermo-switch detectors for aircraft temperature control systems.
59	Fungus growth occurred on 1 out of 3 pieces of exposed. glass tubing dipped into Geon 101 powder.
60	Vinylite VYNW#5 supported slight amount of fungus growth when applied to pieces of glass tubing and exposed.
61	Slight fungus growth occurred on the pieces of glass tubing dipped into the Marvinol VR-10 or VR-20 powder.
62	Fungus growth was slight in amount on test glass tubing dipped into Opalon 300 powder (polyvinyl chloride ingredient).
63	PVC-100 base resin supported slight fungus growth on 2 of 3 pieces of glass tubing dipped into test powder.
64	This base resin shows low lead content
65	Plumbo-Sil-C base resin shows marked susceptibility to fungi.
66	Lorothidal fungicide supported a slight amount of fungus growth on the glass tubes dipped into the powder and exposed to fungi.
67	Fungus growth occurred on 1 of 3 pieces of test tubing dipped in the fungicide.

Code No.	
68	1 fluoro, 3 bromo, 4,6 dinitrobenzene chemical is toxic to personnel in a concentration of 0.61% in fabric used to accomplish skin patch testing. Caution should be exercised in the use of this fungicide.
69	Refer to Comment No. 68
70	This formulation of copper 8-quinolinolate in the tubing caused corrosion of aluminum; discolored copper; imparted an undesirable color to the tubing; failed dielectric test.
71	Tubing containing 2.0% DAAP supported only very slight amount of fungus growth when evaluated in accordance with Specification MIL-I-7444.
72	Fungicide imparts an undesirable color to vinyl tubing at high concentrations.
73	1,3 difluoro 4,6 dinitrobenzene chemical is extremely toxic to personnel at a concentration of 0.68% in fabric used to accomplish skin patch testing. Caution should be exercised in the use of this fungicide.
74.	Present formulations using Thiolutin antibiotic as a fungicide in vinyl tubing causes "surface bloom" on the tubing. Proper formulation could eliminate this objectionable characteristic, providing the presence of a dark yellow color, imparted by the fungicide, is not objectionable.
75	1 fluoro 3 chloro-4,6 dinitrobenzene is toxic to personnel in a concentration of 0.66% when incorporated in fabric used to accomplish skin patch testing. Caution should be excerised in the use of this fungicide.
76	Cost of pure fungicide should be considered before use.
77	The fungicide in varnish was applied to a stator unit. The stator unit did show corrosion of the metal portion following exposure to fungi.
78	No fungus growth occurred for 63 days while exposed in tropical chamber at this Center.
79	Enamel coating supported extensive fungus growth.
80	GRS and natural rubber combinations when properly compounded show very slight susceptibility to fungus growth. Use of an item composed of this material would depend on whether the end use item would require extensive protection, as with the use of a fungicide.
81	Polyethylene rope, yellow #1104, had 1000.0% ∕ elongation value prior to exposure. For this reason the test was discontinued.
82	Very corrosive to steel, brass, copper; is toxic to personnel; use with extreme caution; not recommended by this Center.
83	Parachute tapes treated with 9.2% Nuodex 100SS fungicide, non-leached, passed soil burial test, but leached treated sample failed this test.

Code No.	
84	Dip green wood for preserving into treatment no less than 24 hrs. after the log has been cut.
85	This fungicide was not corrosive to metals.
86	The treatment must be applied to tapes prior to time zinc portions of zipper are added in order to comply with the corrosion requirements of presently used Specification QQ-Z-325. Cronak, a corrosion preventative coating, when applied to zinc surface prevents corrosion of metal by treatment.
87	Insufficient copper content after leaching.
88	Insufficient copper content after leaching.
89	Fungicidal treatment applied to tapes prior to placement of scoops onto tape. Black oxide coated brass showed **no corrosion** as a result of soil burial. Copper content of fungicide insufficient to provide fungus resistance.
90	Zinc components treated with a corrosion inhibitor, brass and nickel-plated brass components without corrosion inhibitor showed corrosion of metals after soil burial. Fungus growth also appeared on the treated cotton warp threads in the tapes.

D. Fungicidal Treatments Listed in Tables

List of Trade Names and Corresponding Chemical Name

Trade Name	Active Chemicals
1. BBN	bi-b-naphthol
2. Copper 8 Dispersion #8008	copper 8-quinolinolate
3. Coppertreat	copper naphthenate with water repellant
4. CQ-A	copper 8-quinolinolate
5. CQ-3A	copper 8-quinolinolate
6. Cunilate 2174	solvent formulation of copper 8-quinolinolate
7. Cunilate 2419A	water dispersion formulation of copper 8-quinolinolate
8. Cunilate 25HS	emulsion formulation of copper 8-quinolinolate
9. Cunimene D	dehydroabietyl ammonium pentachlorophenoxide
10. Dowicide 31	4,6 chloro-2-phenylphenol
11. Dri Seal	copper 8-quinolinolate
12. Ferro 221	copper 8-quinolinolate
13. G-4	dihydroxy dichloro-diphenyl methane
14. Lorothidol	bis-(2 hydroxy-3,5 dichloro-phenyl) sulfide
15. Milban	zinc dimethyl dithio-carbamate
16. Milmer I	copper 8-quinolinolate
17. Nox Rust Vapor	sodium benzoate, urea, ammonium nitrite
18. Nuodex 100WD	water dispersion of dodecyl-dimethyl benzyl ammonium cyclopentane, carboxylate salt

19.	Nuodex 765	dodecyl dimethyl benzyl ammonium cyclopentane, carboxylate salt
20.	Ottocept	parachlorometaxylenol
21.	Ottocide	parchorometaxylenol, paranitro-phenol, and tetrachlorophenol
22.	Permatox OS	pentachlorophenol
23.	Prevent	paraformaldehyde, pentachloro-phenol paradichlorobenzene, and metacresyl acetate.
24.	Pyrazol	3-5 dimethyl-4-nitroso-1 (p-tolyl)
25.	Rosin amine D acetate	dehydroabietyl ammonium acetate (DAAA)
26.	Rosin amine D pentachlorophenate	dehydroabietyl ammonium pentachloro-phenoxide (DAAP)
27.	Santicizer 141	an alkyl aryl phosphate
28.	Santobrite-Dowicide G	sodium pentachlorophenol
29.	Vancide 89	(N-trichloro methyl thiotetra-hydrophthalimide)
30.	Vitasan 33	orthophenylphenol
31.	Volatile Corrosion Inhibitor	dicyclohexyl ammonium nitrite
32.	Zinc 2-dispersion 8007	zinc dimethyl dithio-carbamate and 2 mercaptobenzo thiazole
33.	Vancide 51	sodium dimethyl dithio-carbamate and 2 mercaptobenzothiazole

E. Description of Test Methods Referenced in Tables

I. Agar Plate Test

Consists of placing an appropriate amount of sterile mineral salts agar described below in a sterile covered pyrex container such as a 4 or 6 inch petri plate. The test sample or samples were placed on the surface of the hardened agar medium in the covered dish.

Unless otherwise indicated spores of the following organisms were used to prepare a spore suspension for use as an inoculum:

a) Chaetomium globosum USDA 1042.4
b) Myrothecium verrucaria USDA 1334.2
c) Aspergillus terreus PQMD82j

The inoculuted sample material or piece of equipment placed in the container holding the hardened agar medium was incubated at 30 ± 2.0°C for the indicated exposure period, which might range from 7 to 30 days duration.

The exposed test samples may or may not have been sterilized with steam in a covered container for 1 hour, at 121°C. Hair and wool felt tested in accordance with USAF Specification MIL-F-8261 have been sterilized. Other samples of test material would probably not be sterilized prior to exposure since few items will withstand steam sterilization without serious damage or complete breakdown of the item.

Culture medium consists of:

NH_4NO_3	3.0g
K_2HPO_4	1.0g
$MgSO_4.7H_2O$	0.25g
KCl	0.25g
Agar	15-20.0g
Distilled water	1000.0ml

The samples may have been leached, indicated by a capital L in the tables. Samples requiring leaching are placed in an apparatus of the following description:

A water container or tank shall be provided, of such a shape and size that the specimen can be submerged therein with all surfaces of the specimen having free access to the water. The ratio of the specimen to water shall be not less than 1 to 100 by weight. Means shall also be provided for maintaining the following conditions: (1) a continuous flow of water to the bottom of the container, at a rate of about five changes per hour; (2) disposal of the overflow; (3) suspension of the specimens in such a manner that they do not contact the container or each other during leaching; (4) complete submersion of each specimen during leaching; (5) different treatments in separate leaching containers.

The sample remains in the leaching apparatus for a period of 24 hours. At the end of the leaching period the sample is removed from the water and air-dried prior to exposure to fungi.

The leaching of test samples is performed to test the effectiveness of applied fungicides with or without accompanying water repellants, since a fungicide is effective only to the extent that it is retained on the item or material exposed to weathering.

Textile samples exposed on agar plate for 7-14 days give a more reliable test result in regard to fungus resistance than the other type of tests since many of the test conditions existing in the agar plate are within experimental control. This test method when properly carried out, is sufficiently controlled to exclude most contaminants, particularly bacteria, and to maintain adequate moisture content for the possible germination of fungus spores. By microscopic examination it is usually possible to identify the fungi growing on the exposed sample, and to determine that breakdown was essentially a result of microbiological degradation by cellulolytic fungi.

In the case of nearly all test items listed under textiles which were given an agar plate type of exposure, physical test results were taken and were utilized to ascertain the degree of degradation due to fungi. Bulk materials listed under the textiles grouping in the charts were tested by preparing and exposing ravelled strips of the material which contained a standard amount of unbroken threads between ravelled edges. A sample of this type assures reliable breaking strength results of individual specimens within a sample lot since the unit of measure of strength retention will be the same for all samples. The physical test results combined with observational data are more accurate than a test procedure based on visual observation only.

Thread samples were treated the same as bulk textiles except that the specimens consisted of twenty samples, each 18 inches in length for exposure. Breaking strength tests were made.

Wherever breaking strength tests were made, control non-exposed samples were broken also for comparative data. In this way, the strength retention percent indicated the extent of fungicidal effectiveness when a treated material had been exposed to fungi.

II. Agar Plate, Screening Technique test referenced under section XI, Plastics.

The preparation of the mineral salts medium and the steps up to the placement of the test sample on the solidified surface of the medium in this test procedure are the same as for agar plate test, given on page 13 . Since this technique was used exclusively for the screening of fungicides to be included in vinyl tubing, the same technique was followed for ingredients tested prior to formulation and inclusion in vinyl tubing. The test ingredients, usually being a powder form, resisted incorporation into the aqueous agar medium which would have resulted in a dispersion of the test compound. This reason and the need for a rapid preliminary screening test resulted in the following technique:

Three inch lengths of glass tubing were washed in water containing trisodiumphosphate and rinsed prior to dipping in dilute acetic acid and rinsing 3 times with distilled water. The chemically clean tubes were placed in flowing steam for at least 30 minutes. Just prior to the exposure on agar plate, the tubes were placed in a covered container and sterilized for 1 hour in a dry heat oven at 400°F.

Sterile technique was followed as closely as possible in inserting the sterile glass tubes in the test ingredient, and then placing each tube on a hardened agar surface. Where necessary the ingredient was crushed or melted to facilitate ample pickup of the fungicide. This procedure was set up in triplicate. Each piece of tubing was pushed slightly into the medium to prevent sliding. Two inch lengths of sterile cotton twine were placed no closer than one inch to the glass tubing. This twine, when inoculated, served to check the viability of the inoculating organisms which were as follows:

Trichoderma USDA T-1
Aspergillus niger USDA 215-4247
Aspergillus flavus WADC 26

The plates were then incubated at 30 ± 2.0°C for 14 days duration. Microscopic examination of plates was made, and a test ingredient considered to be fungus resistant if all 3 tubes were free of fungus growth.

It is important to remember that a 100.0% concentration of the test ingredient or fungicide was evaluated (percent impurities unknown) when considering the test results in relation to later tests when the fungicides were reduced in concentration for incorporation into a vinyl tubing.

III. Agar Plate Test Leather

Three specimens of treated leather 2 inches square were leached as follows: The specimens were shaken or drummed for approximately 3 hours in 20 times their weight of distilled water at 25° plus or minus 5°C. The specimens were then drained before starting the test. A control sample consisting of a non-treated leather sample was leached separately from the treated samples. The agar medium was prepared in the following proportions and poured into sterile four inch petri plates:

NH_4NO_3	3.0 g
K_2HPO_4	1.0 g
$MgSO_4.7H_2O$	0.25 g
KCl	0.25 g
Sucrose or glucose	20.00 g
Agar	15 - 20.00 g
Distilled water	1000.0 ml

The inoculum used to seed the agar plates consisted of spores from Aspergillus niger, USDA 215-4247. The seeded plates are incubated at 30.0 ± 2.0°C temperature until a white mycelial mat has formed. The leached leather squares are placed on the white mycelial mat in the seeded agar plates prior to the production of spores. The incubation period is 7 days from the time the leather samples are placed on the mycelial mat. Fungus growth could be expected to occur on the surface and the cut ends of the treated leather square, but any growth occurring over an area greater than 2.0% of the upper side of the leather is cause for rejection.

IV. Agar Plate Test Varnish Test

Four 3 - 5 cm. circular sheets of Whatman No. 2 filter paper shall be treated with varnish, and the film allowed to air-dry for 48 hours. The viscosity of the varnish shall be adjusted, if necessary, or the sheet shall be re-treated to give an increase in dry weight of 80 to 120 percent to the filter paper. The dried sheet shall then be conditioned by immersing in slowly running tap water or in distilled water, using a separate container for each varnish under test, for 18 hours at room temperature, then allowed to dry, and heated in a drying oven at 85°C for 2 hours.

Culture medium.- The culture medium shall be composed of the following ingredients:

Distilled water	1000 ml
Dextrose	40 g
Peptone	10 g
Agar	20 g

The inoculum was composed of spores of the following fungi:

Aspergillus niger USDA 215-4247
Aspergillus flavus WADC 26
Penicillium luteum USDA 1336.1
Trichoderma T-1 USDA T-1

Glassware.- One covered container, such as a 10 cm. petri dish, shall be used for each specimen to be inoculated with fungi. Use approximately 25 ml. of the culture medium in each container.

Inoculation.- Each test specimen shall be deposited on the center of the surface of the set agar in a petri dish. The surface, including the surface of the test specimen, shall then be inoculated with the composite spore suspension, either by spraying the suspension from an atomizer in such manner that the entire surface is moistened with the spore suspension, or by distributing 0.5 to 1.0 ml. of the spore suspension from a pipette and tilting the dish to moisten the entire surface with the suspension. In each daily group of tests, four dishes of set agar without test specimens shall be inoculated with the spore suspension to serve as controls.

Evaluation of results.- For the varnish to be considered fungus-resistant, the following are required:

Quantitative and qualitative

Fungus growth in control dishes.- There shall be copious growth in all four of the control dishes. (Absence of such growth requires repetition of the test and is not to be considered as indicating failure.)

Contaminating growth in test dishes.- Growth of bacteria, or of fungi obviously other than the test fungi, shall not occur within 1 cm. of more than one test specimen, nor occupy more than one-fourth of the area in more than one test dish. (Presence of such contaminating growth in more than one of the four test dishes requires repetition of the test and is not to be considered an indication of failure. When such contaminating growth occurs in one dish only, that dish shall be discarded and the evaluation shall be based upon the remaining three test dishes).

Fungus growth in test dishes.- Growth of the test fungi, as observed with the naked eye, shall not extend more than 2 ml. over the edge and toward the center of any test specimen. (Fungus growth may touch the specimen and grow to the designated distance over its periphery. If growth extends to a greater distance over one of the specimens, the test may be repeated. Upon such repetition, the varnish shall be considered fungus-resistant provided all test specimens pass.)

V. Non-agar plate

Items tested in this manner were placed on a non-metallic support or platform in an appropriate sized container for exposure. The support or platform was necessary to keep the item from contact with the distilled water placed in the bottom of the outer container. The water insured adequate moisture content for germination of fungus spores.

The inoculum was composed of the spores from one fungus of each of the following five groups:

Group I	*Chaetomium globosum* USDA 104.2 or *Myrothecium verrucaria* USDA 1334.2
Group II	*Rhizopus nigricans* S.N. 32 or *Aspergillus niger* USDA 215-4247
Group III	*Aspergillus flavus* WADC 26 or *Aspergillus terreus* PQMD 82j
Group IV	*Penicillium luteum* USDA 1336.1 *Penicillium sp.* USDA 1336.2, or *Penicillium citrinum* ATCC 9849
Group V	*Memnoniella echinata* WADC 37 or *Fusarium moniliforme* USDA 1004.1

The item, including applicable external components, was sprayed with a suspension of mixed spores as listed above. The covered glass container holding the test item was placed in an incubator or mold chamber having a temperature of 30°C. In most cases the exposure period was for 14-28 days. The visual observations were usually the only means of judging this type of fungus test. Wherever the item was a complete unit capable of operational tests, such tests were recommended. Without operational tests, the sole rule of judgement was on the presence or lack of fungus growth.

The non-agar type test more nearly simulates the conditions found in actual use or storage. In this type of tests, the extent of growth is often more difficult to judge accurately, especially when performed by untrained personnel. Most materials will receive both an agar plate and a non-agar test prior to the time of acceptance and use as a stock item. When the material, either the various ingredients separately or combined in a raw state, are in an experimental step, an agar plate test is usually given. Later, when the same type of raw material has been processed and used in the construction of an operational item or unit, the non-agar type of test is given. While the agar plate test is considered severe in some respects, yet the non-agar type test is a more critical evaluation since the finished item may contain a combination of many materials in close contact lacking compatibility with one or more materials. Wherever an item is listed and tested by non-agar test method, the report of the fungus resistance will indicate which materials are of great susceptibility to the growth. It is the elimination of these materials which will help to reduce loss of equipment due to microbiological degradation. Those materials which show marked incompatibility with adjacent components or chemical treatments usually require replacement or a more satisfactory protective treatment substituted.

VI. Non-agar plate test, sand spore inoculum
Leather

Test specimens.- Four test specimens, each one inch square, and cut from a sample of treated leather shall be inoculated and exposed.

Control specimens.- Two control specimens, each one inch square, and cut from a sample of untreated leather, shall be inoculated and exposed. One of these specimens shall be exposed with one of the test specimens, and the other control specimen shall be exposed alone.

Processing.- The control specimens and one-half the number of test specimens shall be moistened by immersion for 5 - 10 minutes in distilled water at 25° plus or minus 5°C. The excess water shall then be removed by blotting. The remaining test specimens shall be leached as specified under agar test for leather and the excess water removed by blotting.

Glassware.- One stoppered container shall be used for each specimen to be inoculated and exposed.

Inoculation.- (Aseptic technique is not necessary in the inoculation procedure for this method).- The specimens shall be inoculated heavily as follows, care being taken that all surfaces are covered: The fungus spore mixture shall be dusted on the moist specimens, or the moist specimens shall be sprayed, by means of an atomizer, with a spore suspension of the mixture.

Microorganisms.- The following test organisms are contained in the A.L.C.A. Spore Mixture:

Aspergillus repens
Paecilomyces varioti
Rhizopus arrhizus
Penicillium namyslowskii
Aspergillus niger
Aspergillus fumigatus
Penicillium spinulosum
Aspergillus terreus
Penicillium oxalicum
Penicillium luteum
Penicillium pinophilum
Myrothecium verrucaria
Aspergillus flavus
Gliocladium fimbriatum

The American Leather Chemists Association Spore Mixture may be obtained, upon request, from The Tanners' Council Laboratory, University of Cincinnati, Cincinnati, Ohio.

Samples for exposure shall be suspended in separate containers and incubated for a period of 30 days. To maintain proper moisture content for spore germination, a quantity of distilled water shall be placed in each container in such a manner that it is not in direct contact with the exposed sample.

VII. Soil Burial

Soil mixture.- The soil mixture to be used for test purposes shall be composted according to usual greenhouse practice using good top soil or leaf mold, well rotted, finely shredded manure and a clean and rather coarse sand or a mixture of sandy loam field soil and well decayed manure. Soil used in this test shall be rich in the forms of microbial life which decomposes cellulose. It shall be sufficiently porous in texture to permit ready pentration of air and moisture, and shall not become sticky or tend to pack too closely when damp. The soil shall have a pH value of 7.0 plus or minus 1.5. The mixture shall be put through a number 4 mesh screen.

Preparation of soil beds.- The burial procedure shall be as follows: In a greenhouse or other suitable room, a bed shall be prepared of the composted, screened soil in suitable trays, shallow boxes, or beds made from wood, glass, porcelain, earthenware, etc, to a depth of at least five inches. If the test is conducted indoors the beds shall be placed in a cabinet or room where they are not exposed to light.

Procedure.- The specimens shall be submerged in the immersion tank containing water, and allowed to remain immersed for a period of 24 hours. At the end of the leaching period the specimens shall be removed from the water and air-dried.

Manner of burial.- The specimens for burial shall be buried horizontally and covered with 1/2 to 1 inch of composted soil. Buried specimens of thread shall be well separated in the soil so that no strands are intertwined. Immediately after burial of specimens, the soil shall be well sprinkled with a water spray fine enough to prevent washing and deformation of the surface. The moisture content of the soil shall be maintained at a uniform level; approximately 25 to 30 percent moisture on an oven-dry basis is considered to be satisfactory. Moisture content shall be checked regularly during the test period with replacement of water lost by evaporation. Such addition shall be made in a fine spray to avoid washing or deformation of the bed. The soil condition may be determined by the following empirical test: a handful of the soil shall be lightly squeezed in the hand; it shall feel moist to the touch, but when dropped to the bed from an elevation of approximately 2 feet, it shall crumble. The temperature of the soil at a depth of one inch below the surface shall be between 75° and 88°F during the period of burial.

The period of exposure is usually 14 days, but in the case of some synthetic fabrics, such as Orlon or Dacron, the exposure period may be increased. After removal from the soil beds, the specimens are rinsed in tap water to remove the debris and soil particles. The specimens are then allowed to dry at room temperature prior to conditioning for breaking strength tests.

It must be kept in mind that when a fabric shows a loss in breaking strength after soil burial, there is more than the one factor of fungus growth to be

considered as the causal agent of deterioration. The extent that bacterial growth occurred and caused breakdown can not be measured separately from the damage caused by fungi in the soil. The extent of continued leaching is another problem faced with soil burial. There is less control over the test conditions in soil burial than in the agar plate type of exposure, but soil burial is adequate preliminary test to evaluate the stability of a chemical treatment or the effectiveness of a water repellant. This is considered one of the most severe tests used to evaluate a fungicidal application. Items such as rope, webbing, paulins, tent material etc. which may have rough use over a prolonged period are required to pass the soil burial test. Samples retaining 90.0% of the original or control breaking strength after 14 days soil burial are considered to show satisfactory fungus resistance by the presently used standards.

VIII. Weathering Resistance Test; Natural Method

This method is used to determine the deterioration of materials when subjected to prolonged outdoor exposure. A specimen rack or frame, usually composed of wood, is provided with noncorrosive fasteners for use in anchoring the exposed material. The rack is placed to allow free access of air to the exposed sample as well as sunlight since the specimen is positioned at a 45° angle from the horizontal and facing geographic south. A pyrheliometer is used for measuring the radiant energy of the sun at the exposure site and the radiation recorded is converted by calculation to gm. cal./cm.^{2}. The duration of the exposure period may vary from one to twelve months. It is suggested that the gram calorie per square centimeter or Langley might be a more consistent unit of measure for weathering than that based on length of exposure.

After exposure the materials are conditioned and broken. The samples are judged on the following basis:

Satisfactory: When the change in characteristic, percent, of the exposed test sample is equal to or less than the change in characteristic, percent, of the standard.

Unsatisfactory: When the change in characteristic, percent, of the exposed test sample is greater than the change in characteristic, percent, of the standard.

When no standard sample has been established, change in breaking strength or other characteristic shall be reported to the nearest 1.0 percent.

IX. Crocking Test

This method is intended for determining the resistance of colored cloth to crocking. Crocking in this case refers to the transfer of coloring matter from one cloth to another cloth with which it may come in contact. This method is applicable to fabrics of all fibers whether dyed, printed, impregnated, or otherwise colored. This method is particularly applicable to fabrics of solid color, although variegated fabrics may be tested where the colored area is of sufficient size. Wet and dry crocking may be determined by this method.

The test specimen consisted of a rectangle of cloth at least 8 inches by 4 inches with the long dimension in the direction to be rubbed. In the case of narrow tapes and laces, the specimen was held in the test position by any suitable means; for example, laces were attached firmly to a piece of white cotton cloth.

A crockmeter consisting of a wooden base upon which a sliding arm operated by a crank was fixed in such a manner as to slide back and forth in a straight line with a stroke of 4 inches. The arm had a flat-ended cylindrical finger, 5/8 inch in diameter, which exerted a force of 32 ounces upon the cloth clamped to the base.

Crock cloth consisted of bleached, unstarched, 80 by 80 or finer texture, white cotton cloth, print or lawn type, cut 2 inches square.

The specimen was rubbed parallel to the warp direction. When a standard sample was established, a specimen from the standard sample was tested under the same conditions as the specimen undergoing test.

Dry crocking.- The specimen and the "dry" crock cloth were brought to standard conditions. The specimen was placed on the base of the crockmeter so that the finger contacts the specimen about 1 inch from the 8-inch edge of the specimen. The specimen was placed under sufficient tension to maintain a smooth surface throughout the test. The white cloth square was placed and firmly held over the flat end of the cylindrical finger. The finger with cloth attached was placed on the surface of the specimen and moved back and forth on the specimen at the approximate rate of 1 cycle per second. Ten cycles (20 strokes) constituted a test.

Wet crocking.- The test was repeated on an area adjacent to the previous test area using a new white cloth moistened with distilled water. For moistening, the white cloth was wet throughout, squeezed, placed between two sheets of absorbent filter paper and passed through a wringer.

Evaluation.- Staining of the dry and wet crock cloth was considered in rating the resistance to crocking. When no standard had been established resistance to crocking was rated as:

Good: No appreciable staining of the white cloth.
Fair: Appreciable but not objectionable staining.
Poor: Objectionable staining.

When a standard sample had been established, the crock cloth of the test specimen was compared with that of the standard sample and rated as follows:

Satisfactory: Equal or superior to standard in resistance to crocking.
Unsatisfactory: Inferior to the standard in resistance to crocking.

Three specimens were tested from each Unit-of-Product. The crocking resistance of the Unit-of-Product was the lowest (poorest resistance) dry and wet values respectively obtained on the specimens tested. When a standard sample had been established, resistance to crocking was reported as satisfactory or unsatisfactory. When no standard sample had been established, resistance to crocking was reported as "good, fair, or poor."

F. Tables

Table I, Cotton, bulk material, duck

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
1.	3.6 oz. cotton duck	cyanoethylation, 3.64% nitrogen content	agar plate L 14 days soil L 14 days	Monsanto Chemical Co.	None utilized	S	
2.	4.0 oz. cotton duck	aluminum sulphate / lead	soil 14 days	unknown	Lt. Col. A.M. de Luxembourg	Un	C1
3.	4-5.0 oz. cotton duck	2.0-3.5 DAAP	soil L 14 days agar plate L 14 days	Flightex Fabric	Hercules Powder Co.	Un	C2
4.	7-8 oz. cotton duck	10.0% emulsion of Cunilate 25 HS	soil L 14 days crocking test	Goodrich Co.	Scientific Oil Compounding Co.	Un	C3
5.	7-8 oz. cotton duck	20.0% emulsion of Cunilate 25HS	soil L 14 days crocking test	Goodrich Co.	Scientific Oil Compounding Co.	Un	C4
6.	7-8 oz. cotton duck	Cu-8-Quinolinolate	soil L 14 days crocking test	Flightex Fabric	Scientific Oil Compounding Co.	S/R	C5
7.	7-8 oz. cotton duck	Cu-8-Quinolinolate / water repellant	soil L 14 days crocking test	Flightex Fabric	Scientific Oil Compounding Co.	S/R	C6
8.	7-8 oz. cotton duck	Cu-8-Quinolinolate	soil L 14 days crocking test	Flightex Fabric	Scientific Oil Compounding Co.	S	C7
9.	7-8 oz. cotton duck	4.0% Cu-3-phenyl-salicylate / Zelan water repellant	agar plate L 14 days	unknown	Dow Chemical	Un	C8
10.	7-8 oz. cotton duck	4.0% Cu-3-phenyl-salicylate / Uformite	agar plate 1 14 days	unknown	Dow Chemical	Un	C9

Table I, Cotton, bulk material **duck (Cont.)**

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
11.	8 oz. cotton duck	12.6 ∠ 0.4% acetylation of cotton	soil L 30 days agar plate L 30 days	Wm. Hooper and Sons Co.	none utilized	S	C10
12.	8 oz. cotton duck	cyanoethylation 3.4-3.7% nitrogen content	agar plate 14 days	Institute of Textile Technology	none utilized	S	
13.	8.5 oz. cotton duck (treated with a water repellant and a flame retardant)	7.0% Permel, 30.0% Pyroset DO, 6.0% Aerotex Resin M-3 1.1% sodium acetate, 10.0% of 85.0% phosphoric acid solution	6 mos. weathering at WPAFB, New Mexico soil L 14 days agar plate L 14 days	American Cyanamid Co.	none utilized	Un	
14.	8.5 oz. cotton duck (treated with repellant)	15.0% Permel Resin, 1.0% Aerotex Accelerator AS, 1.5% Aerotex Buffer 190A, 0.25% ammonium hydroxide	6 mos. weathering at WPAFB, New Mexico soil L 14 days agar plate L 14 days	American Cyanamid Co.	none utilized	Un	
15.	8.89 oz. cotton duck	0.24, 0.54, 0.79, 1.07 and 1.35% Cu-8-Q with one of following water repellants: 75.0% Zelan, or Aridye 9913 and 9914	soil L 14 days crocking test	unknown	Interchemical Corp.	S/R	C11
16.	10.0 oz. cotton duck	12.6 ∠ 0.4% acetylation	soil L 30 days agar plate L 30 days	Wm. Hooper and Sons Co.	none utilized	Un	C12

Table I, Cotton, bulk material, duck. (Cont.)

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
17.	10.0 oz. cotton duck	*CQ-A	agar plate 14 days soil 14 days	unknown	Ferro Chemical	S	
18.	10.0 oz. cotton duck	*CQ-3A 0.6% Cu-8-Q	agar plate 14 days soil 14 days	unknown	Ferro Chemical	S	
19.	10.0 oz. cotton duck	* BBN	soil 14 days	unknown	J. I. Holcomb Co.	Un	
20.	10 oz. cotton duck	*CSDA	soil 14 days	unknown	J. I. Holcomb Co.	Un	
21.	10.38 oz. cotton duck	1.0 or 2.0% Ottacide	soil L 14 days	unknown	Ottawa Chemical Co.	Un	
22.	10.38 oz. cotton duck	1.0 or 2.0% Ottacept	soil L 14 days	unknown	Ottawa Chemical Co.	Un	
23.	10.38 oz. cotton duck	3.0% salicylanilide	soil L 14 days	unknown	Dow Chemical Co.	Un	C13
24.	12.0 oz. cotton duck	12.6% ± 0.4% acetylation	soil L 30 days agar plate L 30 days	Wm. Hopper and Sons Co.	none utilized	Un	C14
25.	13 oz. cotton duck	1.45% DAAP	agar plate 14 days	unknown	Scientific Oil Compounding Co.	S	C15
26.	13 oz. cotton duck	1.8% DAAP	agar plate 14 days	unknown	Scientific Oil Compounding Co.	S	C16

* Refer to Index to Fungicides, page 11.

Table I, Cotton, bulk material, duck (Cont.)

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
27.	15.2 oz. cotton duck	Cu-8-dispersion 8002	agar plate 14 days soil 14 days crocking test	unknown	Interchemical Corp.	S	C17
28.	15.2 oz. cotton duck	Cu-8-dispersion 8002 / Impregnole water repellant	agar plate 14 days soil 14 days crocking test	unknown	Interchemical Corp.	S	C18
29.	15.2 oz. cotton duck	1.5% DAAP	soil 14 days	unknown	Hercules Powder Co.	S	
30.	15.2 oz. cotton duck	1.5% DAAA	soil 14 days	unknown	Hercules Powder Co.	Un	

Table I, Cotton, bulk material, thread.

31.	40/3 size thread, OD	0.03-0.04% metallic copper deposit	agar plate L 14 days	Premier Thread Co.	unknown	Un	
32.	28/4 size thread, glazed	0.34% Preventol GD	agar plate L 14 days	Philadelphia Textile Institute	Elmore Corp.	Un	C19
33.	16/4 size thread, glazed and soft, natural and OD color	Cunilate 2174	agar plate 14 days	Dean and Sherk Co.	Scientific Oil Compounding Co.	S	C20
34.	12/4 thread, soft finish	Cunilate 2419A	petri 14 days soil 14 days	Dean and Sherk Co.	Scientific Oil Compounding Co.	Un	C21

Table I, Cotton, bulk material, thread.

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
35.	12/4 size thread, OD color	0.14% copper	agar plate L 14 days	Premier Thread Co.	Scientific Oil Compounding Co.	S	
36.	thread, size unknown	Nuodex 765	agar plate 14 days	unknown	Nuodex Products	S/R	C22

Table I, Cotton, bulk material, webbing yarn.

37.	cotton webbing yarn	2.1% DAAA	soil L 14 days	Southern Wearing Co.	Hercules Powder Co.	Un	
38.	cotton webbing	0.16% metallic copper in solubilized Cu-8-Q	soil L 14 days	Du Pont	Scientific Oil Compounding Co.	Un	
39.	cotton webbing (parachute)	2.5, 3.0, and 3.5% DAAA	soil L 14 days	unknown	Hercules Powder Co.	Un	

Table I, Cotton, bulk material, sateen.

40.	cotton sateen	0.66% metallic copper as contained in Cu-8-Q	soil L 14 days	Philadelphia Textile Institute	Scientific Oil Compounding Co.	Un	
41.	3.8 oz. cotton sateen	3.8 parts Cu-8-Q dispersion 8008 / 5.0% zelan A.P. paste / 7.7 parts of Interchemical clear binder 9917	soil L 14 days	Du Pont Corp.	Interchemical Corp..	S	
42.	3.8 oz. cotton sateen	3.8 parts Cu-8-Q dispersion 8008 / 7.7 parts of clear binder 9917	soil L 14 days	Catan Corp.	Interchemical Corp.	Un	

Table II, Fabric, Cotton-Incorporated as Finished Item-Burlap Bag

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
43.	burlap bag	Cu Naphthenate	soil 14 days	Mente and Co.	unknown	S	
44.	burlap bag	partial acetylation	soil 50 weeks	S.R.R.L.	none utilized	S	
45.	cord	1.0-2.99% DAAA	agar plate 14 days	Goodrich Co.	Scientific Oil Compounding Co.	Un	

Table III. Cushioning Materials*

46.	saran-latex	none	non- agar plate 28 days	TA-PAT-Co.	none utilized	S	C23
47.	molded paratex, natural latex	1.5% DAAP by weight of bonded latex	agar plate 14 days	Blocksom & Co.	Hercules Powder Co.	S/R	C24

Table IV, Deodorizing and Fungicidal Solution

48.	Hypotomic solution	unknown	1. agar and non-agar plate, inoculated 2. vapor inhibitive test	H. E. Peabody	Hypotomic Corp.	Un	C25

* Look under Padding, p 35.

Non-metallic materials other than Textiles

Table V, Leather, synthetic - without fungicide.

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
49.	Biltrite Nuron	none	agar plate 7 days	John R. Evans Co.	none utilized	Un	

Table V, Leather - without fungicide.

50.	leather, 1/16" chrome tanned cattle	soak treat in cedarwood oil #LO-4 and cedarwood oil crystals #LO-4c	agar plate 14 days mixed spore inoculum	South West Cedar Oil Co. of San Antonio, Texas	none utilized	Un	C26

Table V, Leather - with fungicide.

51.	vegetable tanned 1. case leather 2. finished sheepskin	0.5% Bis 2 hydroxy 5 chlorophenol methane	non-agar plate, sand spore culture, 30 days	Textile By-Product	Sindar Corp.	Un	
52.	chrome tanned sheepskin	orthophenyl-phenol Vitasan 33 or Vilasan 33-40	agar plate 7 days non-agar plate, sand spore culture, 30 days	United Finish Co.	Dow Chemical Co.	S	C27
53.	vegetable tanned sheepskin	1.0, 1.5, and 2.0% solutions of trichloro-phenyl-acetate	agar 7 days non-agar plate, sand spore culture, 30 days	unknown	Sindar Corp.	Un	

Table V, Leather, with fungicide (Cont.)

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
54.	leather	0.5% Sterozol QT	non-agar plate sand spore culture 30 days	Smith-Kirk-patrick and Co.	Smith, Kirkpatrick and Co.	Un	
55.	leather	0.5% Sterozol TBN	non-agar plate sand spore culture 30 days	Smith, Kirk-patrick and Co.	Smith, Kirkpatrick and Co.	Un	
56.	bark tanned strap leather	0.125% solution of paranitro-phenol in Stoddard's solvent, silicone resin base formulation	non-agar plate sand spore inoculum, 30 days	United Finish	United Finish	S	C28
57.	vegetable tanned sheep-skin and cowhide	0.05% 1-Fluoro-3-Bromo-4,6 Dinitro-benzene in Stodd-ards solvent and silicone resin finish concentra-tion 0.50% in treating solution.	non-agar plate sand spore inoculum, 30 days	none (leather experimentally treated at WPAFB)		S	C29
58.	vegetable tanned sheep-skin and veg-etable chrome tanned cowhide	0.14% 1-Fluoro-3-chloro-4,6 dinitro-benzene, 0.50% concentrated in treating solution	non-agar plate sand spore inoculum, 30 days	none (leather experimentally treated at WPAFB)		S	C30

Table V, Leather, with fungicide (Cont.)

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
59.	leather, vegetable tanned sheepskin	0.5 emulsion of 2,2' dihydroxy -5.5'-dichloro diphenyl methane	agar plate 14 days non-agar plate sand spore culture 30 days	none (leather experimentally treated at WPAFB)		Un	
60.	leather, vegetable tanned sheepskin	0.5% 2-4 dinitrofluoro benzene in Stoddard's solvent and chlorinated vegetable oil	non-agar plate sand spore culture 30 days	none (leather experimentally treated at WPAFB)		S	C31
61.	leather, vegetable tanned sheepskin	0.19% 1-3 difluoro 4,6 dinitro benzene	non-agar plate sand spore culture, 30 days	none (leather experimentally treated at WPAFB)		S	C32

Table VI, Lubricant, AN connectors.

62.	silicone grease	2,0% by weight, orthophenylphenol in DC5 grease	non-agar plate 30 days with and without contact between grease and susceptible material	Dow Corning	Dow Chemical	S/R	C33
63.	silicone grease	2.0% by weight 4 tertiary butyl 2-phenyl phenol in DC5 grease	non-agar plate 30 days; agar plate 14 days with and without contact between grease and susceptible material	Dow Corning	Dow Chemical	S	C34

Table VI, Lubricants, AN Connectors (Cont.)

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
64.	silicone grease	0.5, 1.0, and 2.0% by weight dialkyl dimethyl ammonium bromide in DC4 or DC5 silicone grease	non-agar plate, 30 days; agar plate 14 days with and without contact between grease and susceptible material	Dow Corning	Dow Chemical	Un	C35
65.	silicone grease	0.5, 1.0, 2.0% by weight dehydroabietyl ammonium pentachlorophenoxide in DC4 and DC5 silicone grease	non-agar plate, 30 days; agar plate with and without contact between grease and susceptible material	Dow Corning	Hercules Powder Co.	Un	C36

Table VI, Lubricants, Nylon parachute cloth

66.	XE111 and XE112 silicone oils	none	agar plate 7 days	Dow Corning	none utilized	Un	
67.	XE112A	none	agar plate 7 days	Dow Corning	none utilized	S/R	C37
68.	nylon	liquid cosmol 10.0% pick-up	non-agar plate 28 days	Du Pont	none utilized	Un	
69.	nylon	alkaterage C 9.3% pickup	non-agar plate 28 days	Du Pont	none utilized	Un	

Table VI, Lubricants for, nylon suspension lines .(Cont.)

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
70.	nylon	glaurin 90.0% pickup	non-agar plate 28 days	Du Pont	none utilized	Un	
71.	nylon	monoglycerides 5-00 10.0% pickup	non-agar plate 28 days	Du Pont	none utilized	Un	
72.	nylon	ceresine-white-Ozokerite 8.7% pickup	non-agar plate 28 days	Du Pont	none utilized	Un	
73.	nylon	monoglycerides 9-40 9.5% pickup	non-agar plate 28 days	Du Pont	none utilized	Un	
74.	nylon	spermacete 9.0% pickup	non-agar plate 28 days	Du Pont	none utilized	Un	
75.	nylon	spermafol 45 9.2% pickup	non-agar plate 28 days	Du Pont	none utilized	Un	
76.	nylon	Methacrol 9.3% pickup	non-agar plate 28 days	Du Pont	none utilized	Un	

Table VII, Neoprene, with fungicides.

77.	neoprene	4.3% bis subsalicylate	agar plate 14 days	experimentally prepared at WPAFB		Un	
78.	neoprene	2.3% Cu-8-Q	agar plate 14 days	experimentally prepared at WPAFB		S	
79.	neoprene	2.0% zinc dimethyl dithio carbamate	agar plate 14 days	experimentally prepared at WPAFB		Un	

Table VII, Neoprene (Cont.)

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
80.	neoprene	2.0% tetrahydrofurfuryl salicylate	agar plate 14 days	Experimentally prepared at WPAFB		Un	
81.	neoprene	2.0% ethyl salicylate	agar plate 14 days	Experimentally prepared at WPAFB		Un	

Table VIII, Oil, hydraulic"

82.	petroleum base	none	agar plate, 14 days oil with and without contact with susceptible material	AF stock item	none utilized	Un	

Table IX, Padding, hair

83.	hair, cattle and hog hair combination	3.0% salicylanilide	agar plate 14 days	Stein, Hall & Co., Inc.	Du Pont	Un	
84.	hair, latex bond	none	agar plate 14 days	Clarence Braun	none utilized	Un	
85.	hair	minimum of 1.5% DAAP based on total weight of padding	agar plate 14 days	Clarence Braun	Hercules Powder Co.	S	C38

Table IX, Padding, hair felt .

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
86.	hair felt	3.0, 3.5, and 4.5% Cunimene D	agar plate 14 days, leached and sterilized specimens	unknown	Scientific Oil Compounding Co.	Un	C39
87.	hair felt	6.0% Cu-8-Q	agar plate 14 days leached and sterilized specimens	Textile By-Product Co.	Scientific Oil Compounding Co.	S	C40
88.	felt, jute	2.62% Cunimene D by weight of felt	agar plate 28 days leached and sterilized specimens	Textile By-Product Co.	Scientific Oil Compounding Co.	Un	C41
89.	felt, jute	2.7% Cunimene D	agar plate 28 days leached and sterilized specimens	unknown	Scientific Oil Compounding Co.	Un	C42

Table IX, Padding, felt wool .

90.	felt, wool	0.15-0.18% metallic copper content in Cu-8-Q	agar plate 14 days leached and sterilized specimens	unknown	Scientific Oil Compounding Co.	S	
91.	felt, wool	1.25% by weight Cunimene D2601	agar plate 14 days leached and sterilized specimens	American Felt Co.	Scientific Oil Compounding Co.	S	

Table X, Paper, corrugated board.

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
92.	corrugated board	0.41% wettable DAAP powder	non-agar plate 28 days	Thilmory Pulp and Paper Co.	Hercules Powder Co.	Un	C43
93.	corrugated board	1.55% DAAP powder on all areas of board	non-agar plate 28 days	Thilmory Pulp and Paper Co.	Hercules Powder Co.	Un	C44

Table X,"Paper, laminated plywood"

94.	paper laminate plywood	none	soil 14 days agar plate 28 days	Elmendorf Research Inc.	none utilized	Un	C45
95.	paper laminate plywood	1.0-2.0% Dowicide 31 in adhesive	soil 14 days agar plate 28 days	Elmendorf Research Inc.	Dow Chemical	Un	C46
96.	paper laminate plywood	1.0-2.0% Dowicide 31 in adhesive; woodtox sealer brushed on kraft paper	soil 14 days agar plate 28 days	Elmendorf Research Inc.	Dow Chemical	Un	C47
97.	paper laminate plywood	1.0-2.0% Dowicide 31 applied to high wet strength kraft	soil 14 days agar plate 28 days	Elmendorf Research Inc.	Dow Chemical	Un	
98.	paper laminate plywood	none	soil 14 days agar plate 28 days	Elmendorf Research Inc.	none utilized	Un	C48
99.	paper laminate plywood	none(refer to C49 for description)	soil 14 days agar plate 28 days	Elmendorf Research Inc.	none utilized	Un	C49

Table X, Paper, laminate plywood (Cont.)

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
100.	paper laminate plywood	2.0% DAAP with and without 1 coat of OD paint	soil 14 days agar plate 7 days	Elmendorf Research Inc.	Hercules Powder Co.	Un	C50
101.	paper laminate plywood	3.0% DAAP	soil 14 days agar plate 7 days	Elmendorf Research Inc.	Hercules Powder Co.	Un	C51
102.	paper laminate plywood	urea formaldehyde adhesive extented with 50.0% by weight of wheat flour / 1 coat woodtox sealer	soil 14 days	Elmendorf Research Co.	unknown	S	C52
103.	paper laminate plywood	phenolic adhesive	soil 14 days	Elmendorf Research Inc.	unknown	Un	C53
104.	paper laminate plywood	soya adhesive containing 2.0% Dowicide 31	soil 14 days	Elmendorf Research Inc.	Dow Chemical	Un	C54

Table X, Paper, Volalile Corrosion Inhibitor

105.	Nox Rust vapor wrapper	sodium benzoate, urea, ammonium nitrite	agar plate 14 days, sterilized specimens	Elmendorf Research Inc.	none utilized	Un
106.	waterproof asphalt laminate paper	sodium benzoate, urea, ammonium nitrite	agar plate 14 days sterilized specimens	Elmendorf Research Inc.	none utilized	Un

Table X, Paper, volalile corrosion inhibitor (Cont.)

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
107.	VPI chemical for use with paper	5.0, 1.0, and 2.0% dilutions of dicyclohexyl ammonium nitrite	agar plate 14 days	USAF stock item	none utilized	Un	C55

Table X, Paper, wadding .

108.	paper wadding	1.8% DAAP by weight	agar plate 14 days	Elmendorf Research Inc.	Hercules Powder Co.	Un	
109.	paper wadding	1.9% DAAP by weight	agar plate 14 days	Elmendorf Research Inc.	Hercules Powder Co.	Un	

Table XI, Plastics, finished product case, glasses .

110.	Royalite and Vinylite plastic	none	non-agar plate 28 days	Bausch & Lomb	none utilized	Un	
111.	vinyl leatherette	none	non-agar plate 28 days	Bausch & Lomb	none utilized	Un	
112.	vinyon	none	non-agar plate 28 days	Opticase Co.	none utilized	Un	
113.	Tolovon	none	non-agar plate 28 days	Bausch & Lomb	none utilized	Un	C56
114.	Royalite dynel lined	none	non-agar plate 28 days	Opticase Co.	none utilized	S	

Table XI, Plastics, camera cover .

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
115.	vinyl coated base fabric, wool felt inner liner and cotton outer liner	none	non-agar plate 14 days	American Optical Co.	none utilized	Un	

Table XI, Plastics, carrying case .

116.	glass fiber reinforced plastic	none	non-agar plate 28 days	Houston-Fearless Corp.	none utilized	S	

Table XI, Plastics, polyvinyl alcohol film .

117.	polyvinyl alcohol film	none	agar plate 14 days	Minn. Mining and Manufacturing	none utilized	Un	

Table XI, Plastics, plastic film tape .

118.	plastic film tape #471, pressure sensitive	none	agar plate 14 days	Minn. Mining and Manufacturing	none utilized	Un	

Table XI, Plastics, plastic switch cases.

119.	cellulose filled melamine melmac	none	non-agar plate 28 days	Micro Switch Co.	none utilized	Un	
120.	mica filled melamine	none	non-agar plate 28 days	Micro Switch Co.	none utilized	Un	

Table XI, Plastics, plastic switch cases . (Cont.)

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
121.	mica filled phenolic melmac	none	non-agar plate 28 days	Micro Switch Co.	none utilized	Un	
122.	asbestos filled phenolic	none	non-agar plate 28 days	Micro Switch Co.	none utilized	Un	
123.	general purpose phenolic	none	non-agar plate 28 days	Micro Switch Co.	none utilized	Un	
124.	glass filled alkyl resin material	none	non-agar plate 28 days	Micro Switch Co.	none utilized	S/R	C57

Table XI, Plastics, plastic thermostat bushings .

125.	GE Mycalex 2803	none	non-agar plate 28 days	General Electric Co.	none utilized	S	C58

Table XI, Structural Plastic Materials, cotton base .

126.	phenolic laminate cotton base type II, Grade C	none	agar plate 28 days	stock item	none utilized	Un	

Table XI, Structural Plastic Materials, glass fiber base .

127.	Selectron 5003 resin, glass fiber 181-136 base	none	agar plate 28 days	Pittsburg Plate Glass Co.	none utilized	Un	

Table XI, Structural Plastic Materials, glass fiber base . (Cont.)

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
128.	Selectron 5003 resin, glass fiber 181-114 base	none	agar plate 28 days	Pittsburg Plate Glass Co.	none utilized	Un	
129.	silicone DC-2104 resin, glass fabric 181-112	none	agar plate 28 days	Dow Corning	none utilized	Un	
130.	Selectron 5003 resin, glass fabric 181-RS49 finish	none	agar plate 28 days	Pittsburg Plate Glass Co.	none utilized	Un	
131.	30.0% Epon 1001 resin, glass fabric base 181 Volan A	none	agar plate 28 days	Shell Development Co.	none utilized	Un	
132.	42.7% Laminac 4129 resin, glass fiber base 181-136	none	agar plate 28 days	American Cyanamid Inc.	none utilized	Un	
133.	43.9% Laminac 4202 resin, glass fiber base	none	agar plate 28 days	American Cyanamid Inc.	none utilized	Un	
134.	35.5% Selectron 5003 resin, glass fiber base 181-114	none	agar plate 28 days	Pittsburg Plate Glass Co.	none utilized	Un	

Table XI, Structural Plastic Materials, paper base .(Cont.)

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
135.	phenolic laminate, paper base	none	agar plate 28 days	stock item	none utilized	Un	
136.	Styron 666, modified Polystyrene, L-P-416	none	agar plate 28 days	Dow Corning	none utilized	Un	
137.	Lustrex LH	none	agar plate 28 days	Monsanto Chemical Co.	none utilized	Un	

Table XI, Plastics, Raw Materials, plasticizers (Cont.)

138.	Hercoflex 150	none	agar plate screening technique	Experimental	none utilized	Un	
139.	orthonitrobiphenyl (liquid)	none	agar plate screening technique	Irvington Varnish and Insulator Co.	none utilized	S	
140.	dioctyl phthalate (liquid)	none	agar plate screening technique	Irvington Varnish and Insulator Co.	none utilized	Un	
141.	trioctyl phosphate (liquid)	none	agar plate screening technique	Irvington Varnish and Insulator Co.	none utilized	Un	
142.	Santicizer 141	none	agar plate screening technique	Irvington Varnish and Insulator Co.	none utilized	Un	

Table XI, Plastics, Raw Materials, base resin (Cont.)

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
143.	polyvinyl chloride (Geon 101)	none	agar plate screening technique	Irvington Varnish and Insulator Co.	none utilized	Un	C59
144.	vinylite VYNW #5 (vinyl chloride 95.0% vinyl acetate 5.0%)	none	agar plate screening technique	Irvington Varnish and Insulator Co.	none utilized	Un	C60
145.	vinylite QYNA	none	agar plate screening technique	Irvington Varnish and Insulator Co.	none utilized	Un	
146.	Marvinol VR-10 and VR-20	none	agar plate screening technique	Irvington Varnish and Insulator Co.	none utilized	Un	C61
147.	Opalon 300 (polyvinyl chloride)	none	agar plate screening technique	Irvington Varnish and Insulator Co.	none utilized	Un	C62
148.	Vinylite QYNA (polyvinyl chloride)	none	agar plate screening technique	Irvington Varnish and Insulator Co.	none utilized	Un	
149.	PVC-100 (polyvinyl chloride)	none	agar plate screening technique	Irvington Varnish and Insulator Co.	none utilized	Un	C63
150.	EXON500 (polyvinyl chloride)	none	agar plate screening technique	Irvington Varnish and Insulator Co.	none utilized	Un	C64

Table XI, Plastics, Raw Materials, stabilizers .

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
151.	Plumbo-Sil-C	none	agar plate screening technique	Irvington Varnish and Insulator Co.	none utilized	Un	C65
152.	Coprecipitated lead orthosilicate and silicate gel	none	agar plate screening technique	Irvington Varnish and Insulator Co.	none utilized	Un	

Table XI, Plastics, non-cracking agents .

153.	Ferro 221 (liquid)	none	agar plate screening technique	Irvington Varnish and Insulator Co.	none utilized	S	
154.	aryl sulfonamide formaldehyde resin (solid)	none	agar plate screening technique	Irvington Varnish and Insulator Co.	none utilized	Un	

Table XI, Plastics, fungicides (not incorporated with plastic)

155.	fungicide	Milmer I	agar plate screening technique	Irvington Varnish and Insulator Co.	Monsanto Chemical	S	
156.	fungicide	Lorothidal	agar plate screening technique	Irvington Varnish and Insulator Co.	Hilton Davis Chemical Co.	Un	C66
157.	fungicide	Vancide 89AW	agar plate screening technique	Irvington Varnish and Insulator Co.	R.T. Vanderbilt Co.	Un	C67

Table XI. Plastics, fungicides incorporated with vinyl ingredients

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
158.	fungicide	10.0% dispersion of Cu-8-Q in dioctyl sebacate	agar plate screening technique	Irvington Varnish and Insulator Co.	Scientific Oil Compounding Co.	S	
159.	fungicide	tributyl cellu-solve phosphate	agar plate screening technique	experimental		S	
160.	fungicide	Ferro 903 tri-phenyl phosphate	agar plate screening technique	experimental	Ferro Chemical Co.	S	
161.	fungicide in dioctyl sebacate	1.0% 1 fluoro, 3 bromo, 4,6 dinitrobenzene	agar plate 14 days	compounded at WPAFB	experimental	S/R	C68
162.	fungicide in dioctyl sebacate	1.0% 1 fluoro, 3 bromo, 4,6 dinitrobenzene / trichloro-phenyl acetate	agar plate 14 days	compounded at WPAFB.	experimental	S/R	C69
163.	fungicide	trimethyl ISO butyl carbinol ester of aconitic acid / 2.0% tri-chlorophenyl acetate	agar plate 14 days	compounded at WPAFB	experimental	S	

Table XI, Plastics, vinyl tubing containing fungicides

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
164.	fungicidal tubing	0.5% solubilized Cu-8-Q contained in dioctyl phthalate plasticizer	agar plate 14 days	Wm. Brand Co.	Scientific Oil Compounding Co.	Un	C70
165.	fungicidal tubing	3.0 gms of 2-tertiary butyl-4 phenylphenol	agar plate 14 days	unknown	Dow Chemical Co.	Un	
166.	fungicidal tubing	3.0 gms of 4-tertiary butyl-2 phenylphenol	agar plate 14 days	compounded at WPAFB	Dow Chemical Co.	Un	
167.	fungicidal plastic	3.0% tri-N-butyl aconitate	agar plate 14 days	experimental		Un	
168.	fungicidal plastic	1.0% Pyrazol	agar plate 14 days	experimental		Un	
169.	fungicidal plastic	2.0% trichlorophenyl acetate in 60.0% trioctyl phosphate	agar plate 14 days	experimental	Sindar Corp.	Un	
170.	fungicidal plastic	2.0% DAAP	agar plate 14 days	experimental	Hercules Powder Co.	Un	C71
171.	fungicidal plastic	7.5, 15.0, and 22.5% concentration of tri-N-butyl aconitate	agar plate 14 days	experimental		Un	

Table XI, Plastics, vinyl tubing containing fungicides .(Cont.)

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
172.	fungicidal plastic	1.5% Cu-8-Q	agar plate 14 days	Goodall Fabric Co.	Scientific Oil Compounding Co.	Un	C72
173.	fungicidal plastic	1.0% 1-3 difluoro 4,6 dinitro benzene	agar plate 14 days	experimental		S/R	C73
174.	fungicidal plastic	0.1-0.5% Thiolutin (70.0% pure)	agar plate 14 days	experimental	Charles Pfizer	S/R	C74
175.	fungicidal plastic	1.0% p-p' biphenol	agar plate 14 days	experimental		S	
176.	fungicidal plastic	1.0% of 1 fluoro-3 chloro-4,6 dinitro benzene	agar plate 14 days	experimental		S/R	C75

Table XII, Lacquer and Varnish

177.	lacquer applied to optical instruments	2.0% fenchyl thiocyanacetate	non-agar 60 days	Carbide and Carbon Chemical	unknown	S/R	C76
178.	fungicidal varnish	5.39% salicylanilide	non-agar 28 days	stock item	Du Pont	Un	
179.	fungicidal varnish	1.0-2.0% Cu-8-Q based on wieght of solids in varnish	non-agar 28 days	stock item	unknown	S	C77

Table XII, Lacquer and Varnish

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
180.	fungicidal varnish	Tuf-on 58F	agar plate 7 days	Brooklyn Varnish Co.	unknown	Un	
181.	silicone varnishes	formulae: RS-513, 220-44, 220-71, 220-120	agar plate 7 days	Midland Industrial Finishes	none utilized	Un	

Table XIII, Adhesive.

182.	cement for use in construction of glasses case	Permabond	non-agar 28 days	American Optical Co.	none utilized	S	C78

Table XIV, Metal and rubber combination

183.	carrying case, enamel coated aluminum with gum rubber gasket	none	non-agar 28 days	unknown	none utilized	Un	C79

Table XV, Rubber.

184.	GRS and Natural Rubber combination	none	agar 14 days non-agar 28 days	General Tire & Rubber Co.	none utilized	S/R	C80
185.	GRS and Natural Rubber combination	0.97% sodium orthophenyl-phenate	agar 14 days non-agar 28 days	General Tire & Rubber Co.	unknown	S	

Table XV, Rubber, (cont.)

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
186.	GRS and Natural Rubber combination	1.0% DAAP	agar 14 days non-agar 28 days	General Tire & Rubber Co.	Hercules Powder Co.	Un	

Table XVI, Rope, natural fiber.

187.	manila fiber rope	4.4-4.6% DAAP	soil L 14 days	unknown	Hercules Powder Co.	S	
188.	manila fiber rope	2.65-3.20 DAAP	soil L 14 days	unknown	Hercules Powder Co.	S	
189.	manila fiber rope	0.8% metallic copper as contained in copper napthanate 9?4G	soil L; 1,2, & 3 weeks outdoors weathering 1, 2, 4, 8, and 12 months. Alaska & WPAFB.	Columbian Rope Co.	Nuodex Corp.	S	
190.	manila fiber rope	1.8 ± 0.2% DAAP	soil L; 1, 2, & 3 weeks. outdoors weathering 1, 2, 4, 8, & 12 mos. Alaska and WPAFB	Plymouth Cordage Co.	Hercules Powder Co.	Un	

Table XVI, Rope, synthetic.

191.	1/4" OD nylon	none	soil L 2 & 4 mos. outdoor weathering 1, 2, 4, 8, & 12 mos.	Du Pont and Columbian Co.	none utilized	S	

Table XVI, Rope, synthetic . (Cont.)

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
192.	1/4" natural color nylon	none	soil L 2 & 4 mos. outdoor weathering 1, 2, 4, 8, & 12 mos.	Du Pont and Columbian Co.	none utilized	Un	
193.	1/4" natural color Orlon	none	soil L 2 & 4 mos. outdoor weathering 1, 2, 4, 8, and 12 mos.	Du Pont and Columbian Co.	none utilized	S	
194.	1/4" natural color saran	none	soil L 4 mos. outdoor weathering 1, 2, 4, 8, and 12 mos.	Du Pont and Columbian Co.	none utilized	S	
195.	1/4" poly-ethylene (yellow #1104)	none	tests discontinued	Plymouth Cordage Co.	none utilized		C81

Table XVII, Vapor Corrosion Inhibitor.

196.	treatment applied to optical instruments	Prevent chemical	agar plate 14 days vapor phase corrosion	developed by Dr. Otsuki of Japan	experimentally	S/R	C82

Table XVIII, Viscose rayon parachute tapes.

197.	viscose rayon	2.4, 4.7, 7.0, 9.2% Nuodex 100 S.S	soil L 14 days	unknown	Nuodex Corp.	Un	C83

Table XIX, Wood Preservatives.

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
198.	green wood	Santo Brite, Dowicide G, 7 lbs./ 100 gals. of H_2O	outdoor storage	A. D. Chapman & Co.	Monsanto Chemical Co.	S	C84
199.	green wood	Permatox 10S, 10 lbs./100 gals. H_2O	outdoor storage	unknown	unknown	S	

Table XX, Zipper Tapes

200.	cotton tape, brass slide	0.18 ± .05% metallic copper content in Cu-8-Q	soil L 14 days agar plate L 14 days	Talon Co.	Scientific Oil Compounding Co.	S	C85
201.	cotton tape, aluminum or zinc alloy slide	1.25 ± 0.25% zinc 2-dispersion No. 8007	soil L 14 days agar plate L, 14 days	Talon Co.	Interchemical Corp.	S	C86
202.	cotton tape, aluminum or zinc alloy slide	1.25 ± 0.25% DAAP	soil L 14 days agar plate L, 14 days	Talon Co.	Hercules Powder Co.	S	C86
203.	cotton tape, zinc alloy slide	0.20-0.24% metallic copper as Cu-8-Q	soil L 14 days	Crown Co.	Scientific Oil Compounding Co.	S	C86
204.	cotton tape, zinc alloy slide	0.16% metallic copper as Cu-8-Q	soil L 14 days	Crown Co.	Scientific Oil Compounding Co.	Un	C87
205.	cotton tape, zinc alloy slide	salicylanilide	soil L 14 days	Crown Co.	Du Pont	Un	

Table XX, Zipper Tapes (Cont.)

Item No.	Material	Treatment	Test Method	Manufacturer	Source of Fungicide	Fungus Resistance	Comments
206.	cotton tape, zinc alloy with Cronak corrosion preventative coating	0.30-0.4% metallic copper content in solubilized Cu-8-Q treatment	soil L 14 days	unknown	Scientific Oil Compounding Co.	S	C86
207.	cotton tape, zinc alloy with Cronak corrosion preventative coating	0.3-0.4% metallic copper content in Cu-8-Q emulsion treatment	soil L 14 days	unknown	Scientific Oil Compounding Co.	Un	C88
208.	cotton tape, brass slide	1.5% Cu-8-Q / 2.0% chlorinated bi-phenyl in toluene	agar plate 14 days	unknown	Scientific Oil Compounding Co.	S	
209.	cotton tape, brass slide coated with black oxide	0.2% solubilized Cu-8-Q (0.08-0.09% metallic copper content)	soil L 14 days	Conmar Zipper Co.	Scientific Oil Compounding Co.	Un	C89
210.	cotton warp, nylon fill tape with aluminum slide fastener chain and zinc alloy components	dihydroxy dichloro-diphenyl methane / aquasol water repellant	soil L 14 days	Crown Zipper Co.	Arkansas Chemical Co.	Un	C90