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LACQUER AND CHEMICAL CORP., ALAKA RESEARCH LABS., BROOKLYN, N.Y. (1ST QUARTERLY REPORT)

FIRST QUARTERLY REPORT ON FUNGUS RESISTANCE OF PLASTICS - JAN 9 TO MAY 9, 1951

RUGGERI, S.; WAITZE, R. 18 MAY 51 26PP TABLES

USN CONTR. NO. NORD-11215

PLASTICS - EFFECT OF FUNGI
FUNGI - GROWTH PREVENTION

MATERIALS, NON-METALLIC (8)
PLASTICS (2)

UNCLASSIFIED

FIRST QUARTERLY REPORT

on

FUNGUS RESISTANCE OF PLASTICS

to

BUREAU OF ORDNANCE
DEPARTMENT OF THE NAVY
MOISTURE AND FUNGUS PROOFING SECTION
MATERIALS AND PRESERVATION BRANCH
RESEARCH AND DEVELOPMENT DIVISION

CONTRACT NOrd 11215

by

S. Ruggeri and R. Waitze

Period covered: January 9 to May 9, 1951

ALAKA RESEARCH LABORATORIES
division of
LACQUER AND CHEMICAL CORPORATION
214 - 40th Street
Brooklyn 32, N.Y.

May 18, 1951

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S. Ruggeri and R. Waitze

May 18, 1951

FOREWORD

As a basic general assignment under Research Contract NOrd 11215, the ALAKA RESEARCH LABORATORIES have undertaken a general evaluation of the funginertness of plastic laminates as qualified under Specifications MIL-P-997A, MIL-P-3115A, MIL-P-13035A, MIL-P-15037A, and MIL-P-15047A and of thermosetting molded compounds qualified under Specification MIL-P-14A. This assignment is part of a study by several laboratories of different materials for electrical equipment.

Since "funginert" is a relatively new term a brief definition is in order. A funginert material can be defined as one which will not support fungus growth because the material does not furnish the necessary nutrients for such

growth. This is distinguished from both "fungistatic" and "fungicidal" materials which do not support fungus growth due to the presence of an agency (usually chemical) that actively prevents growth or kills fungi. For further reference on the definition of this term, see:

Ezekiel, W.N. 1950. Problems in fungus and moisture deterioration. Electrical Manufacturing 45 (3): 78-85, 178-190.
Ezekiel, W.N. 1950. "Funginert" - A designation for inherently fungus-resistant material. Science 112 (2905): 259-60.

The work to be included under this contract is as follows:

(a) Determination of the funginertness of samples obtained, using two methods as designated by the Bureau of Ordnance.

(b) During and following this evaluation of samples the validity of these prescribed methods is to be studied, along with the evaluation of other procedures for determining funginertness of materials.

(c) Other work relating to prevention of deterioration caused by fungi and moisture will be conducted as directed by the Bureau of Ordnance. Details of such work will often not be included in the regular quarterly reports.

SUPPLIERS OF PLASTICS SAMPLES

For this general evaluation, the following suppliers were contacted for samples of their products (as taken from commercial production):

American Cyanamid Co.
30 Rockefeller Plaza
New York 20, N.Y.

American Phenolic Corp.
1830 S. 54th Street
Chicago, Ill.

Bakelite Division
Union Carbide & Carbon Corp.
30 East 42nd Street
New York 17, N.Y.

The Borden Company
350 Madison Avenue
New York 17, N.Y.

Continental-Diamond Fibre Co.
Newark, Del.

Continental-Diamond Fibre Co.
Bridgeport, Pa.

Continental-Diamond Fibre Co.
Valparaiso, Ind.

Durez Plastics & Chemicals, Inc.
North Tonawanda, N.Y.

Farley & Loetscher Mfg. Co.
916 Commercial Trust Bldg.
Philadelphia 2, Pa.

The Formica Co.
4614 Spring Grove Ave.
Cincinnati 32, Ohio

General Electric Co.
Coshocton, Ohio

General Electric Co.
1 Plastics Ave.
Pittsfield, Mass.

Mica Insulator Co.
Post Office Box 1076
Schenectady 1, N.Y.

Monsanto Chemical Co.
Plastics Division
Springfield 2, Mass.

National Vulcanized Fibre Co.
Maryland Ave. & Beech Street
Wilmington 99, Del.

Panelyte Division
St. Regis Paper Co.
Enterprise Ave.
Trenton, N.J.

Plaskon Division
Libby-Owens-Ford Glass Co.
2112 Sylvan Ave.
Toledo 6, Ohio

Plastic Engineering Co.
1607 Geele Ave.
Sheboygan, Wisc.

Plastic Products Division
The J.P. Lewis Co.
Beaver Falls, N.Y.

Reilly Tar & Chemical Corp.
1615 Merchants Bank Bldg.
Indiananopolis 4, Ind.

The Richardson Company
Melrose Park, Ill.

Rogers Corporation
Goodyear, Conn.

Spaulding Fibre Co., Inc.
310 Wheeler Street
Tonawanda, N.Y.

The Synthane Corp.
Oaks, Pa.

Taylor Fibre Co.
Norristown, Pa.

Taylor Fibre Co.
LaVerne, Calif.

Watertown Mfg. Co.
Echo Lake Road
Watertown, Conn.

Westinghouse Electric Corp.
Micarta Division
Trafford, Pa.

FUNGINERTNESS OF PLASTIC LAMINATES

(PETRI-DISH METHOD)

Introduction

First work completed under this study has been tests of fungus resistance of available plastic laminated materials following the Petri-dish culture test procedure as outlined in the "Funginertness Requirement and Test, for use in MIL-I-631A" (as completed 29 January 1951), furnished by the Bureau of Ordnance with letter dated 16, February 1951.

Materials

The materials evaluated in this study include the following laminated, thermosetting, plastic materials as approved under the following specifications:

Specification	Type	Filler	Resin	Grade
MIL-P-997A	GSG	Glass Cloth	Silicone	General
MIL-P-15037A	GMG	Glass Cloth	Melamine	General
MIL-P-15047A	NPG	Nylon Cloth	Phenolic	General
MIL-P-3115A	PBG	Paper	Phenolic	General
MIL-P-3115A	PBE	Paper	Phenolic	Electrical
MIL-P-3115A	PBE-P	Paper	Phenolic	Electrical; Punching
MIL-P-15035A	FBM	Cotton Fab.	Phenolic	Mechanical
MIL-P-15035A	FBG	Cotton Fab.	Phenolic	General
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MIL-P-15035A	FBI	Cotton Fab.	Phenolic	Fine Machining

Experimental Procedure

Test Organisms

The following fungi were used in this evaluation:

Organism	American Type Culture Collection No.
Aspergillus niger	9642
Aspergillus flavus	9643
Penicillium luteum	9644
Trichoderma T-1	9645

Preparation of Inoculum

The following nutrient medium was used in the preparation of cultures of the test fungi:

Agar	20.0 gm
Dextrose	10.0 gm
Ammonium nitrate	2.0 gm
Potassium phosphate	0.5 gm
Magnesium sulfate	0.3 gm
Distilled water	1000.0 ml

Cultures of the test organisms were prepared separately on test tube slants (18mm diameter x 150 mm length) of the culture medium and incubated for 12 days at 28°C. Ten milliliters of sterile distilled water, containing 0.05 gm of dioctyl sodium sulfosuccinate per liter of water, were added to one slant of each culture and agitated to dislodge the spores. The resulting separate suspensions were mixed to obtain a composite spore suspension for use in inoculating the test specimens.

Preparation of Controls

Three agar slants prepared in the manner described above served as control blanks. The blanks were inoculated with a drop of inoculum deposited from a 0.1 ml pipette at the top of the slant, using aseptic technique. The controls were incubated along with the test specimens. All three controls were covered with fungus growth at the end of the incubation period (21 days), hence the spore suspension used in the test was satisfactory.

Preparation of Specimens

Sheets (1/8" thick) of the laminates, as received, were cut into test specimens 1" by 1", using an 8" arbor tilt saw equipped with a suitable cutting blade. Six specimens were used in this test for each of the plastic laminates.

Three of the specimens were conditioned (to determine the presence of a fugitive fungicide) for 6 hours at 85°C. The remaining three specimens received no conditioning.

Each specimen was then placed in the center of a Petri dish containing approximately 25 ml of solidified medium of the following composition:

Agar	20 gm
Distilled water	1000 ml

Inoculation and Incubation

Each of the three unconditioned and the three conditioned specimens, placed in the center of the Petri

dish, was then sprayed with the mixed spore suspension. The inoculated specimens were incubated for 21 days at 28°C.

Evaluation of Results

At the end of the 21 day incubation period, each specimen was examined separately for growth on the surface and for growth on the cut edges and rated as follows:

Observed fungus growth on the specimen	Rating
No growth	0
Traces of growth(*)	1
Slight to moderate growth: partial coverage	2
Moderate growth: considerable coverage	3
Abundant growth: complete coverage	4

(*) Traces of growth are defined as scattered, sparse fungus growth such as might develop from an unusual mass of spores in the original inoculum, or upon an occasional extraneous bit of debris. (Continuous cobwebby growth extending over the entire surface or edge of the specimen, even though not necessarily obscuring the specimen, was rated as 2.)

Table 1, pages 9 through 13, lists the observations on the individual replicates of the unconditioned specimens and the numeric rating of each replicate both for surface and edge growth. Table 2, pages 14 through 18, lists the observations on the individual replicates of the conditioned specimens and the numeric rating of each replicate both for surface and edge growth.

Interpretation of Results for Determination of Funginertness

For a material to be considered funginert it shall not support fungus growth; this shall be due to absence of

nutritive substances in the material and not to presence of a fungistatic agent. The absence of a fungistatic agent was determined from the results on the specimens which received the conditioning of 6 hours at 85°C. This conditioning was considered ample to destroy any fungus resistance which would be due to such a fungistatic agent.

On the basis of the numeric rating of the fungus growth on the six specimens for each sample of plastic laminate being evaluated, the following criteria were used for the various degrees of fungus resistance:

1) Fungiinert - where at least 2 of 3 specimens were rated 0 or 1 when tested as received and at least 2 of 3 specimens were rated 0 or 1 when tested after being conditioned.

2) Fugitive Fungistatic - where at least 2 of 3 specimens were rated 0 or 1 when tested as received and at least 2 of 3 specimens were not rated 0 or 1 when tested after being conditioned.

3) Fungus Susceptible - where at least 2 of 3 specimens were not rated 0 or 1 when tested as received and at least 2 of 3 specimens were not rated 0 or 1 when tested after being conditioned.

Since at the present stage of the evaluation it has not been determined whether the above criteria will be applied to the surface growth alone or whether they will be applied to the growth on the surface and edges, separate ratings have been assigned to the specimens based on surface growth alone and on surface and edge growth [illegible] together.

Table 3, pages 19 through 21, lists the classification, of the plastic laminates tested, based on the ratings considering surface growth alone and on the ratings considering surface growth together with edge growth.

TABLE 1

GROWTH OF FUNGUS ON PLASTIC LAMINATES
(PETRI-DISH METHOD)

Conditioning of Specimen: None

Spec. Grade	Manufacturer and Designation	Petri-dish Replicates	Description of Fungus Growth		Numeric Rating	
			Surface	Edges (**)	Surface	Surface and Edges
FBE	#3 LF -15	17A 17B 17C	Slight Slight Mod: Partial Cov.	Slight Moderate Moderate	2 2 2	2 2 2
FBG	#8 EN	18A 18B 18C	Slight Slight-Moderate Slight-Moderate	Moderate Moderate Moderate-Abundant	2 2 2	2 2 3
FBI	#8 LN	19A 19B 19C	Abundant Abundant Abundant	Abundant Abundant Abundant	4 4 4	4 4 4
FBM	#8 GN-16	20A 20B 20C	Mod: Consid. cov. Mod: Consid. cov. Mod: Consid. cov.	Abundant Abundant Abundant	3 3 3	3 3 3
PBE	#8 XXXN	21A 21B 21C	Traces Traces Traces	Moderate Moderate Moderate	1 1 1	2 2 2

* - Specimen surface was waterlogged ** - Same for 4 edges unless otherwise noted

TABLE 1

GROWTH OF FUNGUS ON PLASTIC LAMINATES
(PETRI-DISH METHOD)

Conditioning of Specimen: None

Spec. Grade	Manufacturer and Designation	Petri-dish Replicates	Description of Fungus Growth		Numeric Rating	
			Surface	Edges (**)	Surface	Surface and Edges
PBE-P	#8 XXXPN	22A 22B 22C	Traces Traces Traces	Moderate Moderate Slight-Moderate	1 1 1	2 2 2
PBG	#8 XX-23	23A 23B 23C	Traces Traces Traces	Moderate Moderate Moderate	1 1 1	2 2 2
NPG	#8 XN-25	24A 24B 24C	Traces Traces Traces	Moderate Moderate Slight	1 1 1	2 2 2
PBE	#5 XXX	25A 25B 25C	Mod: Partial cov. Mod: Partial cov. Mod: Partial cov.	Moderate-Abundant Slight Slight	2 2 2	3 2 2
PBE-P	#5 XXX-P	26A 26B 26C	Mod: Part. cov. (*) Slight: " cov. (*) Mod: Part. cov.	Abundant Abundant Abundant	2 2 2	3 3 3

*- Specimen surface was waterlogged **- Same for 4 edges unless otherwise noted

TABLE 1

GROWTH OF FUNGUS ON PLASTIC LAMINATES
(PETRI-DISH METHOD)

Conditioning of Specimen: None

Spec. Grade	Manufacturer and Designation	Petri-dish Replicates	Description of Fungus Growth		Numeric Rating	
			Surface	Edges (**)	Surface	Surface and Edges
PBE-P	#5 XXX-618	27A	Slight	Slight	2	2
		27B	Slight	Slight	2	2
		27C	Slight	Slight	2	2
PBG	#17 300	28A	Slight	Slight	2	2
		28B	Slight	Slight	2	2
		28C	Slight	Slight	2	2
GSG	#8 G-7	41A	Traces (*)	Traces	1	1
		41B	Traces (*)	Traces	1	1
		41C	Traces (*)	Slight (2 edges)	1	2
GMG	#8 FF-55	42A	Slight (*)	Slight	2	2
		42B	Slight (*)	Slight	2	2
		42C	Slight (*)	Slight	2	2
FBE	#5 [illegible]	43A	Mod. Consid. cov.	Moderate	3	3
		43B	Mod. Consid. cov.	Moderate	3	3
		43C	Abundant	Moderate	4	3

*- Specimen surface was waterlogged ** - Same for 4 edges unless otherwise noted

TABLE 1

GROWTH OF FUNGUS ON PLASTIC LAMINATES
(PETRI-DISH METHOD)

Conditioning of Specimen: None

Spec Grade	Manufacturer and Designation	Petri dish Replicates	Description of Fungus Growth		Numeric Rating	
			Surface	Edges (**)	Surface	Surface and Edges
FBI	#5 LE 594	44A	Mod: Consid. cov.	Moderate	3	3
		44B	Mod: Consid. cov.	Moderate	3	3
		44C	Abundant	Abundant	4	4
PBG	#5 XK	45A	Mod: Part. cov. (*)	Abundant	2	3
		45B	Mod: Part. cov. (*)	Abundant	2	3
		45C	Mod: Part. cov. (*)	Abundant	2	3
FBM	#5 CG	46A	Mod: Part. cov. (*)	Abundant	2	3
		46B	Abundant	Abundant	4	4
		46C	Mod: Consid. cov. (*)	Abundant	3	3
FBG	#5 CE	47A	Mod: Consid. cov.	Moderate	3	3
		47B	Mod: Consid. cov.	Abundant	3	3
		47C	Abundant	Abundant	4	4
PBE	#11 215	48A	Traces	Slight	1	2
		48B	Slight	Slight	2	2
		48C	Slight	Slight	2	2

*- Specimen surface was waterlogged **- Same for 4 edges unless otherwise noted

TABLE 1

GROWTH OF FUNGUS ON PLASTIC LAMINATES

(PETRI-DISH METHOD)

Conditioning of Specimen: None

Spec. Grade	Manufacturer and Designation	Petri-dish Replicates	Description of Fungus Growth		Numeric Rating	
			Surface	Edges (**)	Surface	Surface and Edges
FBG	#11	49A	Slight (*)	Slight	2	2
		49B	Slight	Slight	2	2
	210	49C	Slight	Slight	2	2
FBI	#15	50A	Mod: Part. cov.	Moderate	2	3
		50B	Mod: Part. cov. (*)	Moderate	2	3
	L	50C	Mod: Consid. cov.	Moderate	3	3
PBE-P	#15	51A	Slight (*)	Abundant	2	2
		51B	Slight (*)	Abundant	2	2
	XXXP	51C	Traces (*)	Moderate	1	2
NPG	#15	52A	Mod: Consid. cov. (*)	Moderate	3	3
		52B	Slight (*)	Slight	2	2
	NS	52C	Slight (*)	Slight	2	2

*- Specimen surface was waterlogged **- Same for 4 edges unless otherwise noted

TABLE 2

GROWTH OF FUNGUS ON PLASTIC LAMINATES
(PETRI-DISH METHOD)

Conditioning of Specimen: 6 hours at 85° C

Spec. Grade	Manufacturer and Designation	Petri-dish Replicates	Description of Fungus Growth		Numeric Rating	
			Surface	Edges (**)	Surface	Surface and Edges
FBE	#8 EN-15	29A	Slight	Slight	2	2
		29B	Slight	Slight	2	2
		29C	Slight	Slight	2	2
FBG	#8 EN	30A	Slight	Moderate	2	2
		30B	Mod: Partial cov.	Moderate	2	2
		30C	Slight	Moderate	2	2
FBI	#8 LN	31A	Abundant	Abundant	4	4
		31B	Abundant	Abundant	4	4
		31C	Abundant	Abundant	4	4
FBM	#8 CN-16	32A	Mod: Partial cov.	Moderate	2	2
		32B	Mod: Partial cov.	Moderate	2	2
		32C	Mod: Partial cov.	Moderate	2	2
FBK	#8 XXXN	33A	Mod: Partial cov.	Abundant	2	3
		33B	Mod: Partial cov.	Abundant	2	3
		33C	Mod: Partial cov.	Abundant	2	3

*- Specimen surface was waterlogged **- Same for 4 edges unless otherwise noted

TABLE 2

GROWTH OF FUNGUS ON PLASTIC LAMINATES
(PETRI-DISH METHOD)

Conditioning of Specimen: 6 hours at 85° C

Spec. Grade	Manufacturer and Designation	Petri-dish Replicates	Description of Fungus Growth		Numeric Rating	
			Surface	Edges (**)	Surface	Surface and Edges
PBE-P	#8 XXPN	34A	Slight	Slight	2	2
		34B	Slight	Slight	2	2
		34C	Slight	Slight	2	2
PBG	-8 XN-23	35A	Traces	Slight	1	2
		35B	Traces	Slight	1	2
		35C	Traces	Slight	1	2
NPG	3 -25	36A	Traces	Slight	1	2
		36B	Traces	Slight	1	2
		36C	Traces	Slight	1	2
PBE	"5 XX	37A	Traces	Moderate	1	2
		37B	Traces	Moderate	1	2
		37C	Traces	Moderate	1	2
PBE-P	#5 XX-P	38A	Slight	Moderate	2	2
		38B	Slight	Moderate	2	2
		38C	Slight	Abundant	2	3

*= Specimen surface was waterlogged **- Same for 4 edges unless otherwise noted

TABLE 2

GROWTH OF FUNGUS ON PLASTIC LAMINATES
(PETRI-DISH METHOD)

Conditioning of Specimen: 6 hours at 85° C

Spec. Grade	Manufacturer and Designation	Petri-dish Replicates	Description of Fungus Growth		Numeric Rating	
			Surface	Edges (**)	Surface	Surface and Edges
FBE-P	#5 XXX-618	39A	Slight	Slight	2	2
		39B	Slight	Slight	2	2
		39C	Slight	Slight	2	2
PBG	#17 300	40A	Slight	Slight	2	2
		40B	Slight	Moderate	2	2
		40C	Slight	Moderate	2	2
GSG	#3 G-7	53A	Traces	Slight (2 edges)	1	2
		53B	Traces	Traces	1	1
		53C	Traces (*)	Slight (1 edge)	1	2
GMG	#3 F1-55	54A	Complete waterlog	Slight	0	2
		54B	Slight (*)	Slight	2	2
		54C	Slight	Slight	2	2
FBE	5 LE	55A	Mod: Consid. cov.	Moderate	3	3
		55B	Mod: Consid. cov.	Moderate	3	3
		55C	Mod: Consid. cov.	Moderate	3	3

* - Specimen surface was waterlogged. ** - Same for 4 edges unless otherwise noted

TABLE 2

GROWTH OF FUNGUS ON PLASTIC LAMINATES

(PETRI-DISH METHOD)

Conditioning of Specimen: 6 hours at 85° C

Spec. Grade	Manufacturer and Designation	Petri-dish Replicates	Description of Fungus Growth		Numeric Rating	
			Surface	Edges (**)	Surface	Surface and Edges
FBI	#5	56A	Mod: Partial cov.	Moderate	2	2
		56B	Mod: Partial cov.	Moderate	2	2
	E 594	56C	Mod: Partial cov.	Moderate	2	2
PBG	#5	57A	Mod: Part. cov. (*)	Abundant	2	3
		57B	Mod: Part. cov. (*)	Abundant	2	3
	X	57C	Slight (*)	Abundant	2	3
FBM	#5	58A	Abundant	Abundant	4	4
		58B	Mod: Consid. cov.	Abundant	3	3
	C	58C	Mod: Consid. cov.	Abundant	3	3
FBG	#5	59A	Abundant (*)	Abundant	4	4
		59B	Abundant (*)	Abundant	4	4
	CE	59C	Abundant	Abundant	4	4
PBE	#11	60A	Slight	Moderate	2	2
		60B	Slight	Moderate	2	2
	215	60C	Slight	Slight	2	2

*- Specimen surface was waterlogged **- Same for 4 edges unless otherwise noted

TABLE 2

GROWTH OF FUNGUS ON PLASTIC LAMINATES

(PETRI-DISH METHOD)

Conditioning of Specimen: 6 hours at 85° C

Spec. Grade	Manufacturer and Designation	Petri-dish Replicates	Description of Fungus Growth		Numeric Rating	
			Surface	Edges (**)	Surface	Surface and Edges
FBG	#11	61A	Slight (*)	Slight	2	2
		61B	Slight (*)	Slight	2	2
	#10	61C	Slight (*)	Slight	2	2
FBI	#15	62A	Slight (*)	Moderate	2	2
		62B	Complete waterlog	Moderate	0	2
	L	62C	Slight	Moderate	2	2
PBE-P	#15	63A	Slight (*)	Moderate	2	2
		63B	Slight (*)	Moderate	2	2
	XXXP	63C	Slight (*)	Moderate	2	2
NPG	#15	64A	Slight (*)	Slight	2	2
		64B	Slight (*)	Moderate	2	2
	NS	64C	Slight (*)	Slight	2	2

*- Specimen surface was waterlogged **- Same for 4 edges unless otherwise noted

TABLE 3

FUNGUS RESISTANCE OF PLASTIC LAMINATES
(PETRI-DISH METHOD)

Spec. Grade	Manufacturer and Designation		Surface Growth Only			Surface and Edge Growth		
			Numeric Rating		Fungus Resistance	Numeric Rating		Fungus Resistance
			Uncond	Cond		Uncond	Cond	
FBE	#8	LEN-15	2 2 2	2 2 2	Fungus Susceptible	2 2 2	2 2 2	Fungus Susceptible
FBG	#8	CEN	2 2 2	2 2 2	Fungus Susceptible	2 2 3	2 2 2	Fungus Susceptible
FBI	#8	LN	4 4 4	4 4 4	Fungus Susceptible	4 4 4	4 4 4	Fungus Susceptible
FBM	#8	CN-16	3 3 3	2 2 2	Fungus Susceptible	3 3 3	2 2 2	Fungus Susceptible
PBE	#8	XXXN	1 1 1	2 2 2	Fugitive Fungistatic	2 2 2	3 3 3	Fungus Susceptible
PBE-P	#8	XXX-PN	1 1 1	2 2 2	Fugitive Fungistatic	2 2 2	2 2 2	Fungus Susceptible
PBG	#8	XXN-23	1 1 1	1 1 1	Funginert	2 2 2	2 2 2	Fungus Susceptible
NPG	#8	YN-25	1 1 1	1 1 1	Funginert	2 2 2	2 2 2	Fungus Susceptible

TABLE 3

FUNGUS RESISTANCE OFPLASTIC LAMINATES
(PETRI-DISH METHOD)

Spec. Grade	Manufacturer and Designation		Surface Growth Only			Surface and Edge Growth		
			Numeric Rating		Fungus Resistance	Numeric Rating		Fungus Resistance
			Uncond	Cond		Uncond	Cond	
PBE	#5	XXX	2 2 2	1 1 1	Fungus Susceptible	3 2 2	2 2 2	Fungus Susceptible
PBE-P	#5	XXX-P	2 2 2	2 2 2	Fungus Susceptible	3 3 3	3 2 2	Fungus Susceptible
PBE-P	#5	XXX-618	2 2 2	2 2 2	Fungus Susceptible	2 2 2	2 2 2	Fungus Susceptible
PBG	#1	300	2 2 2	2 2 2	Fungus Susceptible	2 2 2	2 2 2	Fungus Susceptible
GSG	#8	G-7	1 1 1	1 1 1	Funginert	1 1 2	2 1 2	Fugitive Fungistatic
GMG	#8	FF 55	2 2 2	0 2 2	Fungus Susceptible	2 2 2	2 2 2	Fungus Susceptible
FBE	#5	LE	3 3 4	3 3 3	Fungus Susceptible	3 3 3	3 3 3	Fungus Susceptible
FBI	#5	LE 594	3 3 4	2 2 2	Fungus Susceptible	3 3 4	2 2 2	Fungus Susceptible

TABLE 3

FUNGUS RESISTANCE OF PLASTIC LAMINATES
(PETRI-DISH METHOD)

Spec. Grade	Manufacturer and Designation		Surface Growth Only			Surface and Edge Growth		
			Numeric Rating		Fungus Resistance	Numeric Rating		Fungus Resistance
			Uncond	Cond		Uncond	Cond	
PBG	#5	XX	2 2 2	2 2 2	Fungus Susceptible	3 3 3	3 3 3	Fungus Susceptible
FBM	#5	CG	2 4 3	4 4 3	Fungus Susceptible	3 4 3	4 3 3	Fungus Susceptible
FBG	#5	CE	3 3 4	4 4 4	Fungus Susceptible	3 3 4	4 4 4	Fungus Susceptible
PBE	#11	215	1 2 2	2 2 2	Fungus Susceptible	2 2 2	2 2 2	Fungus Susceptible
FBG	#11	210	2 2 2	2 2 2	Fungus Susceptible	2 2 2	2 2 2	Fungus Susceptible
FBI	#15	L	2 2 3	2 0 2	Fungus Susceptible	3 3 3	2 2 2	Fungus Susceptible
PBE-P	#15	XXXP	2 2 1	2 2 2	Fungus Susceptible	2 2 2	2 2 2	Fungus Susceptible
NPG	#15	NS	3 2 2	2 2 2	Fungus Susceptible	3 2 2	2 2 2	Fungus Susceptible

Summary of Observations

Surface Growth Alone

The following samples showed traces of growth on all six replicates:

Manufacturer	Designation	Grade
#8	G-7	GSG
#8	YN-25	NPG
#8	XXN-23	PBG

The following samples showed traces of growth on the three unconditioned replicates but slight growth on the three conditioned replicates:

Manufacturer	Designation	Grade
#8	XXXN	PBE
#8	XXX-PN	PBE-P

The following samples showed slight or moderate growth on all six replicates:

Manufacturer	Designation	Grade
#5	XX	PBG
#5	XXX-P	PBE-P
#5	XXX-618	PBE-P
#8	FF-55	GMG
#8	CN-16	FBM
#8	CEN	FBG
#8	LEN-15	FBE
#11	215	PBE
#1[illegible]	[illegible]	[illegible]
#15	NS	NPG
#15	XXXP	PBE-P
#15	L	FBI
#17	300	PBG

The following sample showed moderate growth on the three unconditioned replicates and only traces of growth on the three conditioned replicates:

Manufacturer	Designation	Grade
#5	XXX	PBE

The following samples showed moderate or abundant growth on all six replicates:

Manufacturer	Designation	Grade
#5	CG	FBM
#5	CE	FBG
#5	LE	FBE
#5	LE 594	FBI

The following sample showed abundant growth on all six replicates:

Manufacturer	Designation	Grade
#8	LN	FBI

A number of the specimens had large water drops on the surface after the 21 day incubation period. At this time we cannot state the significance of this water to the growth of the fungi on the specimen and hence the numeric rating. Therefor at this time we are merely indicating those replicates which show such a water drop on the surface. In such cases where this waterlogging has taken [illegible] based on the growth on the remainder of the surface which is not waterlogged.

Surface and Edge Growth

The following sample showed traces or slight growth on all six replicates:

Manufacturer	Designation	Grade
#8	G-7	CCG

The following samples showed slight growth on all six replicates:

Manufacturer	Designation	Grade
#5	XXX-618	PBE-P
#8	FF-55	GMG
#11	210	FBG

The following samples showed slight or moderate growth on all six replicates:

Manufacturer	Designation	Grade
#5	XXX	PBE
#8	YN-25	NPG
#8	XXN-23	PBG
#8	XXX-PN	PBE-P
#8	LEN-15	FBE
#11	215	PBE
#15	NS	NPG
#17	300	PBG

The following samples showed moderate growth on all six replicates:

Manufacturer	Designation	Grade
#5	LE	FBE
#8	CEN	FBG
#15	L	FBI

The following samples showed moderate or abundant growth on all six replicates:

Manufacturer	Designation	Grade
#5	XXX-P	PBE-P
#5	CE	FBG
#5	LE 594	FBI
#8	XXXN	PBE
#8	CN-16	FBM
#15	XXXP	PBE-P

The following samples showed abundant growth on all six replicates:

Manufacturer	Designation	Grade
#5	XX	PBG
#5	CG	FBM
#8	LN	FBI

OTHER WORK RELATING TO

DETERIORATION CAUSED BY FUNGI AND MOISTURE

First assignment under the heading of other work relating to deterioration caused by fungi and moisture has been the laboratory check on some experimental varnishes prepared by Westinghouse Electric Corporation. These varnishes are a part of the Navy-Westinghouse Tropicalization Program (Reference Rele-B-47) in connection with coil impregnating varnishes. The eight experimental varnishes are being evaluated for various properties including: drying time, color, dielectric strength, flammability, adhesion and resistance to salt water, fungistatic effectiveness, and fluorescence. The results of this evaluation are being reported in a separate special report to the Bureau of Ordnance.