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IMPROVED PROTECTIVE COATINGS FOR SONAR DOMES.(U)
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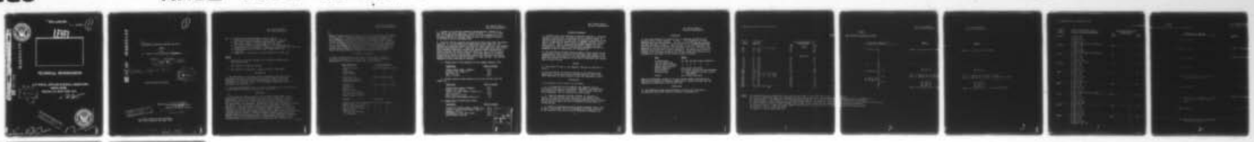

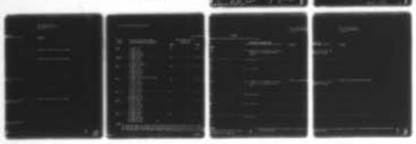

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(6) IMPROVED PROTECTIVE COATINGS FOR SONAR DOMES.

(9) Lab. Project 9300-43, Technical Memorandum #6

SS-041-001 Task 8481/2

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MATERIAL SCIENCES DIVISION

Approved: D.H. KALLAS
Associate Technical Director

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Lab. Project 9300-43
Technical Memorandum #6

Ref: (a) NAVAPLSCIENLAB Program Summary Task No. 8481/2, Improved Protective Coatings for Sonar Domes of 1 Dec 1965
(b) Lab. Project 9300-43, Technical Memorandum #2, Improved Protective Coatings for Sonar Domes of 12 May 1965
(c) Lab. Project 9300-43, Progress Report #1, "A new facility for studying protective coatings in a high power pulse field" of 25 Mar 1966
(d) NAVAPLSCIENLAB ltr 9370:AWC:mrd Lab. Project 9300-43 of 1 Apr 1965
(e) COMNABASE M.I. (Paint Lab.) ltr 9190 (303P-15) of 3 May 1965.

Tables

1 - Coded list of component coatings used to make up coating systems (and manufacturers)

2 - Test results of component coatings

3 - Test results of experimental coating systems for sonar domes

INTRODUCTION

1. The development of sonar dome coating systems which have good erosion resistance, good anti-fouling properties, and are capable of adhering when exposed to high level pulse fields generated by high power sonar transducers is continuing at the U.S. Naval Applied Science Laboratory in accordance with reference (a).

2. This memorandum presents data on coatings investigated since the submission of the technical memorandum, reference (b), in May 1965.

BACKGROUND

3. It has been the usual practice to coat the SQS-26 sonar domes with a standard Navy vinyl system consisting of one coat of formula F117 pretreatment primer, four coats of formula F119 red lead (vinyl) primer, and two coats of formula F121 red (vinyl) antifouling coating. This coating system has deteriorated in the "acoustic window" area of the dome by loosening, cracking and peeling. This deterioration caused serious interference with sonar operation. An interim solution has been the complete removal of the coating system down to the bare metal in the "window area". However this introduces a fouling problem requiring frequent scraping of the dome by divers; and results in increased rate of corrosion. A desirable solution would be one in which the "window area" would be protected with a coating system consisting of component coatings such as a pretreatment primer, an anti-corrosive coating, an anti-fouling coating, and any necessary tie-coatings which will provide high

adhesion strength between the anti-corrosive coating and the anti-fouling coating. Such a coating system must have high adhesive strength to the metal substrate, good adhesion between the individual coatings, high erosion resistance and good anti-fouling properties in order to perform its anti-corrosive and anti-fouling function in a high level sonic pulse field. This program has consisted of a screening of numerous materials in judiciously prepared combinations (several hundred combinations), to achieve the indicated desired properties. This memorandum reports on some of the more promising combination screened in recent months.

MATERIALS IN PROGRAM

4. Work is being focused on the study of the following classes of materials to determine their suitability, as component coatings, to perform specific functions in sonar dome coating systems:

Type of material	Specific function
Polyvinyl-butyral	Metal pretreatment coating
Vinyl	" " "
Polyurethane	" " "
Vinyl-urethane	" " "
Vinyl-red lead	Anti-corrosive coating
Vinyl-zinc chromate	" " "
Polyurethane-red lead	" " "
Neoprene	Erosion resistant coating
Polyurethane	" " "
Hypalon	" " "
Epoxy-polyamide	" " "
Coal tar epoxy-amine	" " "
Coal tar epoxy-polyamide	" " "
Asphalt epoxy-polyamide	" " "
Neoprene	Tie-coating
Cuprous oxide in polyisobutylene	Anti-fouling coating
Cuprous oxide plus organo-tin	" " "
TBTO in polyisobutylene	" " "
Cuprous oxide plus organo-tin	" " "
TBTO in acrylic	" " "
TRI-N-Butyltin fluoride in neoprene	" " "

5. A coded list of specific component coating materials referred to in this report, and their suppliers, is given in table 1. It is to be noted that no information was made available by any of the manufacturers as to the composition of the coatings submitted other than a general indication of the type of resin or elastomer used.

6. Three anti-fouling coatings were supplied by Mare Island Paint Labooratory under ref. (e), as the result of a request made by NASL under ref. (d). Reference (d) requested coatings of relatively higher flexibility and suggested various formula modifications. Complying with these suggestions, Mare Island Paint Laboratory supplied; a coating with reduced pigment concentration; a flexible coating with cuprous oxide and organo-tin; and a flexible plastic resin coating with anti-fouling agent. The evident emphasis on increased flexibility was based on previous NASL studies which had shown correlation between flexibility and erosion resistance, in some coatings. The coatings submitted by Mare Island were as follows:

a. Formula 5D22-26 (Navy Formula 134 with pigment reduced by 50%).

Ingredients	Parts by weight
Cuprous Oxide, Grade I (Pigment)	372.0
Vistanex B-100 (Enjay Co.)	44.5
Rosin W.W. Gr.	30.2
Xylol, TT-X-916	559.0

b. Formula 10D139-20 (Navy Formula 134 type with cuprous oxide and organo-tin).

Ingredients	Parts by weight
Cuprous Oxide, Grade I (Pigment)	290.0
Oppanol B-50 (BASF Co.)	30.0
Tributyl Tin Oxide (Metal & Thermit Co.)	32.0
Xylol, TT-X-916	177.0
Paint Thinner, TT-T-291	13.0
Ethyl Butyl Ketone (Union Carbide Co.)	5.0

c. Formula 4F9-4 (Flexible Resin Paint)

Ingredients	Parts by weight
Tributyl Tin Sulfide (Metal & Thermit Co.)	87.6
Acryloid F-10(40% solids)(Rohm & Haas Co.)	270.0
Lampblack, TT-L-40	11.8
Diatomaceous Silica, MIL-S-15191	53.4
Paint Thinner, TT-T-291	108.0

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SCREENING PROCEDURE

7. Screening tests were conducted on materials supplied as component coatings by manufacturers for possible use in a coating system; on coating systems prepared at NASL based on information available on the physical properties and compatibility of component coatings listed in table I of this report; and on coating systems suggested by various manufacturers. Tests to determine resistance to impact and sonic pulsations were conducted in accordance with procedures outlined in paragraph 6a and 6b, respectively, of reference (b).

8. The anti-fouling coatings listed in table 3, which contain various combinations of vehicle and toxic and which have shown promise in the screening tests were applied to steel test panels and submitted to the Miami Test Station for exposure in sea water to determine their resistance to marine fouling.

RESULTS

9. The results of tests of the component coatings are tabulated in Table 2.

10. The test results of the more promising of the coating systems suggested by various manufacturers systems supplied by Mare Island Paint Laboratory and those prepared by NASL are tabulated in Table 3.

CONCLUSIONS

11. The results to date indicate the following:

a. The tough-resilient elastomeric type component coatings utilizing such polymers as polyurethane, neoprenes, polyisobutylenes and hypalons show superior resistance to impact, erosion, and sonic pulse impingement than the standard Navy vinyl system.

b. Among the component coatings screened, as tabulated in Table 2, the polyurethane primer coating 18F, the hypalon erosion resistant coating 33A, and the polyurethane erosion resistant coatings 34A and 34B show promise and will be included in future studies of coating systems.

c. Among the experimental coating system evaluated, those listed in Table 3 show promise and will be scheduled for further evaluation in the high power sonic pulse facility described in reference (c).

DISCUSSION

12 Since the submission of reference (b), 20 component coatings and 114 coating systems, either prepared at NASL or as suggested by various manufacturers, have been screened. The results of the 20 component coatings have been tabulated in table 2. Only the result of 16 coating systems found promising by screening tests have been tabulated in table 3. Results of the remaining 98 coating systems were not tabulated since results of inferior performance would contribute no useful information. The primers, anti-corrosive coatings or anti-fouling coatings of the coating systems which failed in the screening test were based on the following types of polymers:

Type	Remark
Polyamide-epoxy	too soft and poor erosion resistance
Coal tar epoxy-amine	" " " " " "
Coal tar epoxy-polyamide	" " " " " "
Asphalt epoxy-polyamide	" " " " " "
Modified neoprene	poor erosion resistance
Vinyl urethane	too brittle and poor erosion resistance
Polyisobutylene	too highly pigmented and poor erosion resistance
Acrylic	poor erosion resistance

Some of the component coatings in the poor coating systems were found to be deficient with respect to adhesion, compatibility, drying or curing time, and checking or alligatoring of the finished film.

FUTURE WORK

13. The promising coating system tabulated in table 3 will be tested in the high sonic pulse field facility described in reference (c).

TEST

Coating No.	Component Code No. (1)	FLEXIBILITY-IMPACT (2) % ELONGATION 70°F	36°F
		PRIMERS	
18F	XII (11) + XII (8) BLEND	60+	40
18G	XII (11)	20	10
18H	XII (12)	10	10
		TOP COATS	
8K	IX (7)	60+	60+
8M	IX (10)	60+	20
8N	IX (8)	40	40
8-0	IX (11)	5	5
8U	IX (15)	10	5
8V	IX (16)	20	5
8W	IX (17)	60+	60+
33A	XXIV (1)	60+	60+
12E	XII (6)	60+	60+
12F	XII (10) + XII (13) Blend	5	5
12G	XII (10) + XII (13) Blend	2	2
34A	XXV (3)	60+	60+
34B	XXV (2)	60+	60+
24C	II (2)	60+	60+
24D	II (3)	60+	60+
24E	II (4)	60+	60+
24F	II(2) + II (3) Blend	60+	60+

NOTES:
(1) Supplier source and identification of materials are listed in Table I of this report.
(2) Tests for flexibility-impact and ultrasonic tank test made in accordance with procedure ou
(3) Time indicated is that required for initial perforation (erosion) of coatings to substrate
(4) Slight erosion to metal substrate, and coating blistered between 8 and 24 hours, during pe
(5) Slight erosion to metal substrate between 8 and 24 hours, during period when no observatio
(6) Erosion of film to formula 117 primer between 8 and 24 hours, during period when no observ
(7) Erosion of film to formula 117 primer
(8) Erosion of film to metal substrate.

TABLE 2

TEST RESULTS OF COMPONENT COATINGS

ULTRASONIC TANK TEST (2) INITIAL EROSION FAILURE TIME, HOURS (3)	REMARKS
No Erosion in 24	Blend is a Mixture of 4:1 By Volu
6	
5	
2	
1	
1	
3	
1½	
1	
8 to 24	See Note (4)
No Erosion in 24	
5	
6	Blend is a Mixture of 57.5:100 By
8 to 24	Blend is a Mixture of 57.5:120 By
No Erosion in 24	
No Erosion in 24	
8 to 24	See Note (6)
2½	See Note (7)
1¼	See Note (8)
5½	Blend is a Mixture of 1:1 By Volu

report.
procedure outlined in reference (b).
to substrate or to undercoat.
s, during period when no observations were made.
o observations were made.
en no observations were made.

RS (3)

REMARKS

Blend is a Mixture of 4:1 By Volume

See Note (4)

Blend is a Mixture of 57.5:100 By Volume
Blend is a Mixture of 57.5:120 By Volume (See Note (5))

See Note (6)
See Note (7)
See Note (8)

Blend is a Mixture of 1:1 By Volume. (See Note (7))

Coating No.	Coating System (With Coded Nos. of Component Coatings)(1)	FLEXIBILITY-IMPACT (2) % ELONGATION 70°F	36°F
11-0-15	1 COAT I (1) 1 COAT I (3) 3 COATS XI (1) 1 COAT VI (3) 2 COATS I (6) and II (3) Blend (a)	60+	60+
11-0-14	1 COAT I (1) 1 COAT I (3) 3 COAT XI (1) 1 COAT XXIV (1) 2 COATS II (2) and II (3) Blend (a)	60+	60+
11-0-1	1 COAT I (1) 1 COAT I (3) 3 COATS XI (1) 1 COAT XXIV (1) 2 COATS IX (13) (a)	60+	60+
11-0-18	1 COAT I (1) 1 COAT I (3) 3 COATS XI (1) 1 COAT VI (3) 2 COATS VII (2)	60+	60+
18R3	1 COAT I (1) 1 COAT I (3) 5 COATS XII (1) 1 COAT XI (1) 1 COAT VI (3) 2 COATS I (6) (a)	60+	10
18R8	1 COAT I (1) 1 COAT I (3) 5 COATS XII (1) 1 COAT XI (1) 1 COAT VI (3) 2 COATS II (2) and II (3) Blend	60+	40
18S-1	1 COAT I (1) 1 COAT I (3) 5 COATS XII (1) 1 COAT XI (1) 1 COAT XXIV (1) 2 COATS IX (13)	60+	40
18R13	1 COAT I (1) 1 COAT I (3) 5 COATS XII (1) 1 COAT XI (1) 1 COAT XXIV (1) 2 COATS VII (2)	40+	60+
33234	1 COAT I (1) 1 COAT I (3) 1 COAT XI (1) 4 COATS XXIV (1) 2 COATS II (3) (a)	60+	60+

TABLE 3

...S OF EXPERIMENTAL COATING SYSTEMS FOR SONAR DOMES

ULTRASONIC TANK TEST (2) (INITIAL EROSION FAILURE TIME, HOURS) (3)	REMARKS
24 - NO EROSION	
24 - NO EROSION	Blend is a Mixture o...
24 - NO EROSION	Blend is a Mixture o...
24 - NO EROSION	
24 - FEW PINHOLES IN I(6) TOPCOAT ONLY. REMAINING COATING INTACT.	
24 - NO EROSION	
24 - VERY, VERY SLIGHT EROSION OF IX (13) TOPCOAT ONLY. REMAINING COATING INTACT	Blend is a Mixture o...
24 - NO EROSION	
24 - FEW PINHOLES IN II (3) TOPCOAT ONLY, REMAINING COATING INTACT	

2

TEST' (2)
URE TIME, HOURS) (3)

REMARKS

Blend is a Mixture of 1:1 By Volume

Blend is a Mixture of 1:1 By Volume

I(6) TOPCOAT ONLY.
G INTACT.

Blend is a Mixture of 1:1 By Volume

T EROSION OF IX (13)
EMAINING COATING

II (3) TOPCOAT ONLY,
G INTACT

TEST RESULT OF

Coating No.	Coating System (with Coded Nos. of Component Coatings)(1)	FLEXIBILITY-IMPACT (2) % ELONGATION 70°F	36°F
33Z4	1 COAT I (1) 1 COAT I (3) 1 COAT XI (1) 4 COATS XXIV (1) 2 COATS IX (13)	60+	60+
33Z36	1 COAT I (1) 1 COAT I (3) 1 COAT XI (1) 4 COATS XXIV (1) 2 COATS VII (2) (a)	60+	60+
9W5	1 COAT I (1) 2 COATS I (2) 1 COAT VIII (1) 7 COATS VII (1) 1 COAT XI (1) 1 COAT VI (3) 2 COATS I (6) and II (3) Blend	60+	60+
9W1	1 COAT I (1) 2 COATS I (2) 1 COAT VIII (1) 7 COATS VII (1) 1 COAT XI (1) 1 COAT VI (3) 2 COATS IX (13)	60+	60+
9W9	1 COAT I (1) 2 COATS I (2) 1 COAT VIII (1) 10 COATS VII (1) 2 COATS VII (2)	60	60
9W10	1 COAT I (1) 2 COATS I (2) 1 COAT VIII (1) 7 COATS VII (1) 1 COAT XI (1) 1 COAT VI (3) 2 COATS VII (2)	60	60
9G-1	1 COAT I (1) 2 COATS I (2) 1 COAT VIII (1) 10 COATS VII (1) 2 COATS IX (13)	60	60

NOTES:

(1) SUPPLIER SOURCE AND IDENTIFICATION OF MATERIALS ARE LISTED IN TABLE I OF THIS REPORT
(2) TESTS FOR FLEXIBILITY-IMPACT AND ULTRASONIC TANK TEST MADE IN ACCORDANCE WITH PROCEDURE
(3) TIME INDICATED IS THAT REQUIRED FOR INITIAL PERFORATION (EROSION) OF COATING TO SUBSTRAT

TABLE 3

RESULT OF EXPERIMENTAL COATING SYSTEMS FOR SONAR DOMES

36°F	ULTRASONIC TANK TEST (2) (INITIAL EROSION FAILURE TIME, HOURS) (3)	REMARKS
60+	24 - EXTREMELY SLIGHT EROSION OF IX (13) TOPCOAT ONLY. REMAINING COATING INTACT.	
60+	24 - NO EROSION	
60+	24 - NO EROSION	
60+	24 - EXTREMELY SLIGHT EROSION OF IX (13) TOPCOAT ONLY. REMAINING COATING INTACT	Blend is a mixture of
60	24 - NO EROSION	
60	24 - NO EROSION	
60	24 - EROSION	

REPORT
PROCEDURE OUTLINED IN REFERENCE (b).
O SUBSTRATE OR TO UNDERCOAT

(a) Anti-fouling coatings being exposed at the Miami Test to marine fouling.

TEST (2) LURE TIME, HOURS) (3)	REMARKS
HT EROSION OF IX (13) EMAINING COATING	
	Blend is a mixture of 1:1 By Volume
HT EROSION OF IX (13) EMAINING COATING	

i-fouling coatings being exposed at the Miami Test Station to determine their resistance marine fouling.