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SONAR DOME COATINGS DEVELOPED UNDER NAVY CONTRACT WITH NEW YORK--ETC(U)
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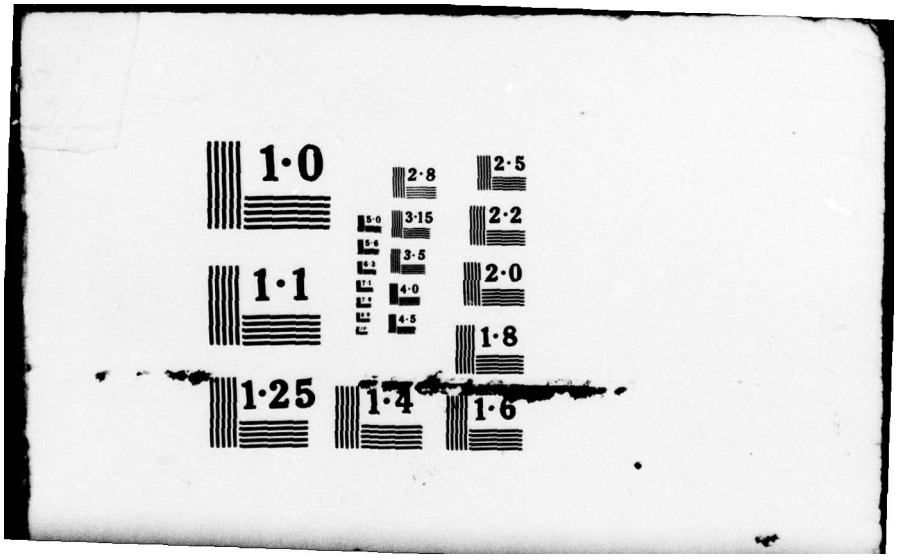
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LEVEL II

(9) Lab. Project 930-59
Technical Memorandum 5
SF 101-03-17, W.U. 8213

MOST Project -4

(6) SONAR DOME COATINGS DEVELOPED UNDER NAVY CONTRACT WITH NEW YORK UNIVERSITY.

(14) NASL-930-59-TM-5

(11) 16 Aug 68

*Material Sciences Division*

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U. S. NAVAL APPLIED SCIENCE LABORATORY
BROOKLYN, NEW YORK



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# SONAR DOME COATINGS
# DEVELOPED UNDER NAVY CONTRACT
# WITH NEW YORK UNIVERSITY

Lab. Project 930-59
Technical Memorandum 5

SF 101-03-17, Task 8213

16AUG1968



MATERIAL SCIENCES DIVISION

Approved: S. V. Kallas
D. H. KALLAS
Associate Technical Director

NAVAL APPLIED SCIENCE LABORATORY
FLUSHING AND WASHINGTON AVENUES
BROOKLYN, NEW YORK 11251

Lab. Project 930-59
Technical Memorandum 5

Ref: (a) NASL Contract N00140-67-C-0107 of 17 Oct 1967
(b) NASL Program Summary of 1 Nov 1967 for Sub. Project S2202, Task 8213, Improved Protective Coatings for Sonar Domes
(c) Fonecon btwn A. Cizek Jr. (NASL, Code 937) and R. Kramer (NAVSEC, Code 6101C01) on 21 Feb 1966
(d) NASL Program Summary of 1 Nov 1967 for SF 101-03-17, Task 8213 on Sonar Dome Materials Development
(e) NASL Program Summary of 1 Nov 1967 for SF 013-13-01, Task 12400 on Vibration and Acoustic Materials Development
(f) NASL Program Summary of 1 May 1968 for SF 013-13-01, Task 12415 on Sonar Dome Coatings
(g) N.Y.U. ltr (NASL Contract N00140-67-C-0107) to A.W. Cizek (NASL) of 2 May 1968
(h) N.Y.U. ltr (NASL Contract N00140-67-C-0107) to A.W. Cizek (NASL) of 10 May 1968
(i) Lab. Proj. 930-59, Tech. Memo 4, Improved Protective Coatings for Sonar Domes
(j) Lab. Proj. 9300-43, Progress Report 1 of 25 Mar 1966, Improved Protective Coatings for Sonar Domes
(k) NAVSEC ltr 6101C:NG:la 9190 Ser 595 of 15 Jul 1968, to NASL

Encl: (1) Copy of Reference (g)
(2) Copy of Reference (h)
(3) Table 1 - Results of Sonic Erosion Test
(4) Photo L-21495-2, View Showing Degree of Erosion of Experimental Sonar Dome Coatings

1. The Naval Applied Science Laboratory is monitoring the reference (a) contract with New York University which was funded as noted in references (d) and (e) for Fiscal Year 1967, and as noted in reference (f) for Fiscal Year 1968. The contract concerned the development of sonar dome coating systems which would have good erosion resistance, good antifouling properties, and be able to remain adhered when exposed to the high level sonic pulses generated by high power sonar transducers. The principal investigator at N.Y.U. is Prof. M. Kronstein.

2. Under a similar development program at NASL, described in reference (b), a high sonic pulse facility was constructed which permitted evaluation of sonar dome coatings in service simulating conditions. This development program was not funded in FY 1968.

3. A request was made by NAVSEC, under reference (c), that monitoring of the N.Y.U. contract include evaluation of the more promising N.Y.U. coatings, using the NASL high sonic pulse facility. Accordingly, this evaluation is being conducted in FY 1968 under reference (d).

4. This report presents data on six coatings prepared by Prof. Kronstein under the N.Y.U. contract and submitted with formulation descriptions under references (g) and (h), for evaluation in the NASL sonic pulse facility.

5. The coating systems submitted for evaluation had been applied to sandblasted steel panels which had been previously forwarded to N.Y.U. by NASL. The coating formulations were submitted by N.Y.U. and are included with this report under enclosures (1) and (2). The facility described in reference (j), used for screening of the coatings systems, consists of a test tank and a single SQS-26 sonar transducer as the high pulse generator.

6. The results of tests on the six coating systems are tabulated in Table 1, enclosure (3), with the resulting erosion patterns shown in enclosure (4).

7. The results of tests on these most recently submitted panels indicated that the experimental coating applied to Panel IV was the most promising, in that it had the least amount of erosion. However, since erosion of this coating penetrated to the metal base, the present formulation is not considered suitable for sonar domes.

8. A total of twenty prepared test panels have been submitted by Dr. Kronstein since the contract was initiated. The most promising formulations were:

(1) Panel IV of reference (g), which consisted of one cost of wash primer (MIL-P-15328B), one coat of red lead vinyl primer (MIL-P-15929B) and three coats of N.Y.U. experimental paint V-6-7.

(2) Panel IV of reference (i), which consisted of one coat of wash primer (MIL-P-15328B), one coat of red lead vinyl primer (MIL-P-15929B) and three coats of N.Y.U. experimental paint V-5-109.

However, these are still not considered suitable for use as sonar dome coatings. Inasmuch as the contract will not be renewed after Nov. 1968 as indicated in reference (k), the Laboratory believes that Dr. Kronstein should concentrate on the improvement of the two promising formulations during the remaining period of the contract. Particular attention should be directed to a desirable total dry film thickness of coating of approximately 20 MILS (not including the antifouling topcoat.)

NEW YORK UNIVERSITY
School of Engineering and Science
UNIVERSITY HEIGHTS, NEW YORK, N.Y. 10453
AREA 212 584-0700

Research Division

Enclosure (1)

2 May 1968

U.S.Naval Applied Science Laboratory
Flushing and Washington Avenues
Brooklyn, New York 11251

Attention:Mr. A. W. Cizek, Code 937
Technical Director

Reference:Contract N00140-67-C-0107.

Dear Mr. Cizek:

At our meeting April 19, 1968, we selected four modifications of the paint V-5-109, based on Table 6 in Report No. 5; and one modified paint of the paint V-5-92 of Table 30 of Report No. 5 for further evaluation in your facilities.

The panels with the four modifications of the paint V-5-109 are prepared.

( The modification to the other paint, to which we agreed, is still being evaluated.)

Therefore we are submitting these four completed panels for your test exposure. They are

PANEL I : Paint V-5-146. Same as V-5-109 but increasing the amount of polyurethane(L 167 ADIPRENE,) from 30 grams to 45 grams. Total solids:42.1%.

| | | |
|---|---|---|
| Panel Preparation: | Wash-primer (MIL-P-15328 B) . . . . . | 0.7 mil |
| | Red lead vinyl primer (MIL-P-15929 B) | 4.4 mil |
| | New test paint V-5-146 (three coats) | 6.9 mil |
| | | 5.0 mil |
| | | 1.0 mil |
| | TOTAL . . . . . | 20.0 |

PANEL II: Paint V-5-147. Same as V-5-109 but <u>increasing</u> the concentration of the epichlorhydrin polymer (HYDRIN 100) solution from 25% to 33% and so increasing the Hydrin content by 8% and <u>decreasing</u> by 25% the content of the 25% solution of styrene-butadiene from 100 grams to 75 grams. Total solids: 40.6%.

| | | |
|---|---|---|
| Panel Preparation: | Wash-primer (MIL-P-15328 B) . . . . | 0.6 mil |
| | Red lead vinyl primer (MIL-P-15929 B) | 4.6 mil |
| | New test paint V-5-147 (three coats) | 6.8 mil |
| | | 7.0 mil |
| | | 2.0 mil |
| | TOTAL . . . . . | 20.0 mil. |

PANEL III: Paint V-6-4. Decreasing the content of the 25% solution of the epichlorhydrin polymer ( HYDRIN 100) from 75 grams to 60 grams ( a decrease of about 20%) and decreasing the amount of the 25% solution of styrene butadiene from 100 grams to 75 grams (a decrease of about 25%) but increasing the amount of ADIPRENE L-167( polyurethane) from 30 grams to 45 grams ( about an increase of 50%).
Total solids: 42%.

| | |
|---|---|
| Panel Preparation: Wash-primer (MIL-P-15328 B) . . . . . | 0.65 mil |
| Red lead vinyl primer (MIL-P-15929 B) | 4.45 mil |
| New test paint V-6-4 (Four coats) . . . . | 4.9 mil |
| | 5.0 mil |
| | 2.0 mil |
| | 3.0 mil |
| TOTAL . . . . . | 20.00 mil. |

PANEL IV: Paint V-6-7, with decreased pigmentation:

| | | |
|---|---|---|
| Carbon black (MONARCH 74) | | 3 grams |
| New zinc oxide (ACTOX 16) | | 7.3 grams |
| 2 Nitropropane | | 16.7 grams |
| Epichlorhydrin polymer (HYDRIN 100) | 25% soln. | 75.0 grams |
| Styrene-butadiene polymer (KRATON 101) | 25% soln. | 100.0 grams |
| TOTAL SOLIDS: 35% . . . . . | | BALL-MILLED |
| Polyurethane ( ADIPRENE L 167) . . . . . | | 30.0 grams |
| Benzothiazyl disulfide (ALTAX) . . . . . | | 1.5 grams |
| Polymer sulfur (CRYSTEX) . . . . . | | 1.5 grams |
| | | BALL-MILLED |

| | |
|---|---|
| Panel Preparation: Wash-primer (MIL-P-15328 B) . . . . . | 0.8 mil |
| Red lead vinyl primer (MIL-P-15929 B). | 5.3 mil |
| New test paint V-6-7 (Three coats) . . . | 4.9 mil |
| | 6.0 mil |
| | 3.0 mil |
| TOTAL . . . . | 20.0 mil. |

As soon as the other panel is completed, we shall let you know.

Yours very truly,

Max Kronstein
Senior Research Scientist

NEW YORK UNIVERSITY
School of Engineering and Science
UNIVERSITY HEIGHTS, NEW YORK, N.Y. 10453
AREA 212 584-0700

Research Division

Enclosure (2)

May 10, 1968

U. S. Naval Applied Science Laboratory
Flushing and Washington Avenues
Brooklyn, New York 11251

Attention: Mr. A. W. Cizek, Code 937
Technical Director

Reference: Contract N00140-67-C-0107.

Dear Mr. Cizek:

At our recent meeting we discussed that we shall supply panels No. 5 and No.6, with an attempt to improve Panels II and III which we submitted with our letter of 29 February 1968.

A. PANEL No. 5.

In PANEL No. II we had modified the earlier Paint V-5-61 ( TABLE 30, Report No. 4) by exposing the elastomer mixture first to Infrared Radiation, before compounding the test paint V-5-92. In your exposure test it had turned out that this IR treatment had polymerized the elastomer so far that the paint had become brittle.

We therefore now pre-swelled the IR-treated elastomer with 4% (by weight) tricresylphosphate. ( 4% of the solids content of the elastomer mixture). We then compounded it into the test paint V-6-20.

We would be interested in learning if this will give the paint more resiliency and will improve the performance.

The paint formulation of V-6-20 is as follows:

| | | | |
|---|---|---|---|
| Carbon black (MONARCH 74) | - - - - - | 9 | grams |
| Zinc oxide (XX 601) | - - - - - | 22 | grams |
| 2 Nitropropane | - - - - - | 50 | grams |
| Mixture of: 60 grams | 25% solution of chlorosulfonated polyethylene (HYPALON 30) | 200 | grams |
| EXPOSED TO 100 grams | 15% solution of polyisoprene (NATSYN 400) | | |
| INFRARED LIGHT 30 grams | 33% solution of polyamide resin (VERSALON 1140) | | |
| (12 x 5 min) 25 grams | 25% solution of styrene-butadiene polymer in methylethyl ketone (KRATON 101) | | |
| | plus | | |
| addition of 1.64 grams tricresylphosphate | | | |

(Formulation continued next page)

Paint formulation V-6-20 (Continued):

THEN ADDED:

| | | |
|---|---|---|
| | Polymer sulfur (CRYSTEX) - - - - | 1.5 grams |
| and | Benzothiazyl disulfide (ALTAX) - - - | 1.5 grams |

BALL-MILLED.

The panel No 5 was prepared as follows:

| | | |
|---|---|---|
| 1. Sandblasted at the NASL | | |
| 2. Wash-Primer MIL-P-15328B - - | 0.57 | mil |
| 3. Red lead vinyl primer MIL-P-15929 B - | 4.73 | mil |
| 4. PAINT V-6-20 ( four coats) - - | 2.2 | mil |
| | 2.5 | mil |
| | 4.0 | mil |
| | 4.0 | mil |
| TOTAL | 18.00 | mil |

B. PANEL No. 6.

On PANEL No. III of our letter of 29 February 1968, we had made the attempt to use in Paint V-5-61 a more reactive zinc oxide , ACTOX 14, instead of the earlier used zinc oxide XX601. This was used on Panel No. III as PAINT V-5-93.

In your test it turned out that this new zinc oxide was too reactive in the system and the paint showed brittleness, in spite of the fact that here the elastomer mixture had not been exposed to infrared radiation

We are using the same technique as on PANEL No. 5 to soften this system, and added 5% ( by weight) tricresylphosphate to the elastomer before compounding Paint V-6-22. Therefore this paint had the composition:

| | | |
|---|---|---|
| Carbon black ( MONARCH 74) - - - - | | 9.0 grams |
| Zinc oxide ( ACTOX 14) - - - - | | 22.0 grams |
| 2 Nitropropane - - - - - | | 50.0 grams |
| Mixture of: (elastomers without IR Exposure): - - | | 201.0 grams |
| Chlorosulfonated polyethylene (HYPALON 30) 25% soln. | 60.g. | |
| Polyisoprene (NATSYN 400) 15% soln. | 100.g. | |
| Polyamide resin ( VERSALON 1140) 33% soln. | 50.g. | |
| Styrene-butadiene polymer ( KRATON 101) in MEK.25% | 25.g. | |
| with addition of: tricresylphosphate (5% by weight of elastomer solids) | 2.24 g. | |

Then added: Polymer sulfur (CRYSTEX) 1.5 grams
Benzothiazyl disulfide (ALTAX) 1.5 grams , and BALL-MILLED.

| | | |
|---|---|---|
| PANEL No. 6 was prepared as follows: | 1. Sandblasted at NASL | |
| | 2. Wash-primer MIL-P-15328B | 0.5 mil |
| | 3. Red lead vinyl primer MIL-P-15929B | 4.8 mil |
| *(2.7 mil, 3.0 mil, 3.0 mil,3.0 mil) | 4. PAINT V-6-22 (Four coats)* | 11.7 mil |
| | TOTAL | 17.0 mil |

Very truly yours,

Max Kronstein
Senior Research Scientist

NAVAL APPLIED SCIENCE LABORATORY

TABLE 1
TEST RESULTS OF SONIC EROSION OF EXPE
(USING NASL HIGH SONIC PULSE FACILITY-POWE

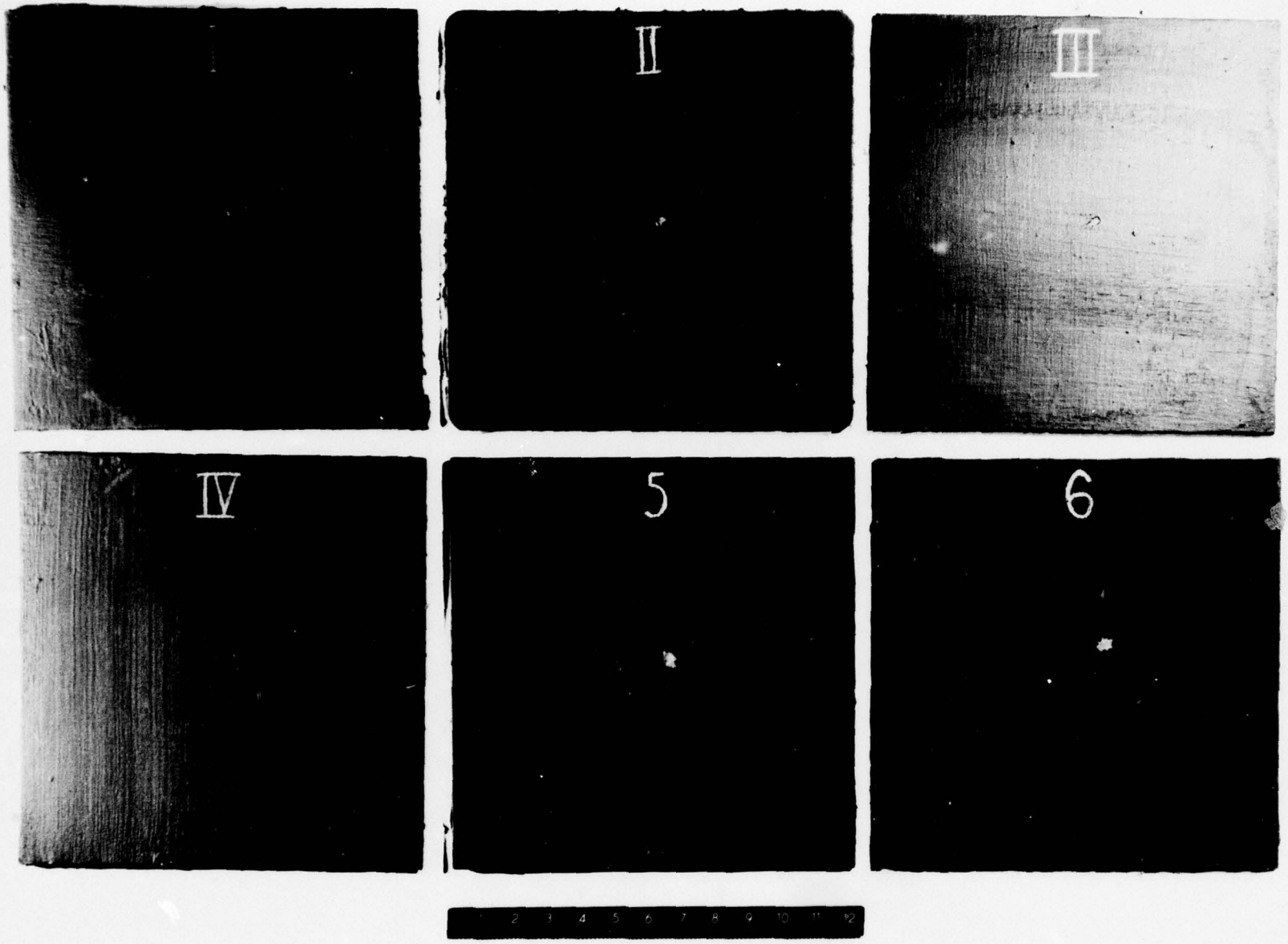
| (1) PANEL NO. | (2) PAINT COATING SYSTEM | DRY FILM (3) THICKNESS (TOTAL-MILS) | TEST PERIOD HOURS |
|---|---|---|---|
| I | Wash Primer (MIL-P-15328B)-0.35MIL<br>Vinyl Red Lead(MIL-P-15929B)-4.4MILS<br>3 Coats Paint V-5-146 -14.9MILS | 23.5 | 4 1/2<br>23 |
| II | Wash Primer(MIL-P-15328B)-0.60MIL<br>Vinyl Red Lead(MIL-P-15929B)-4.60MILS<br>3 Coats Paint V-5-147 - 15.80MILS | 23.0 | 4 1/2<br>23 |
| III | Wash Primer(MIL-P-15328B)-0.65MIL<br>Vinyl Red Lead(MIL-P-15929B)-4.45MILS<br>4 Coats Paint V-6-4 14.90MILS | 21.5 | 4 1/2<br>23 |
| IV | Wash Primer(MIL-P -15328B)-0.80MIL<br>Vinyl Red L ead(MIL-P-15929B)5.30MILS<br>3 Coats Paint V-6-7 -13.90MILS | 24.0 | 4 1/2<br>23 |
| 5. | Wash Primer(MIL-P-15328B)-0.57MIL<br>Vinyl Red Lead(MIL-P-15929B)-4.73MILS<br>4 Coats Paint V-6-20 -12.70MILS | 20.0 | 4 1/2<br>23 |
| 6. | Wash Primer(MIL-P-15328B)-0.50MIL<br>Vinyl Red Lead(MIL-P-15929B)-4.80MILS<br>4 Coats Paint Y-6-22 -11.70MILS | 19.0 | 4 1/2 |

Note: (1) and (2) - Panel No. designation and coating system description.
(3) Dry Film Thickness measured by NASL.

TABLE 1
TEST RESULTS OF SONIC EROSION OF EXPERIMENTAL COATING SYSTEMS
(USING NASL HIGH SONIC PULSE FACILITY-POWER LEVEL 235 VOLT-AMPERES AVERAGE)

| (2) ITEM | DRY FILM (3) THICKNESS (TOTAL-MILS) | TEST PERIOD HOURS | ERODED AREA, Sq. In. TOPCOAT PAINT REMOVED | ERODED AREA, Sq. In. PAINT REMOVED TO BARE METAL | REMARKS |
|---|---|---|---|---|---|
| P-15328B)-0.35MIL<br>L-P-15929B)-4.4MILS<br>-146 -14.9MILS | 23.5 | 4 1/2<br>23 | 0.010<br>0.038 | 0.009<br>0.036 | After 23 hours, Erosion to Metal Base in 2 Areas in Approx. Center of Panel. |
| -15328B)-0.60MIL<br>L-P-15929B)-4.60MILS<br>-147 - 15.80MILS | 23.0 | 4 1/2<br>23 | 0.028<br>0.063 | 0.023<br>0.058 | After 23 Hours, Badly Eroded To metal Base in One Spot In approx. Center of Panel |
| -15328B)-0.65MIL<br>L-P-15929B)-4.45MILS<br>-4 14.90MILS | 21.5 | 4 1/2<br>23 | 0.024<br>0.060 | 0.022<br>0.056 | After 23 hours, badly eroded To Metal Base in one spot in approx. center of panel. |
| -15328B)-0.80MIL<br>IL-P-15929B)5.30MILS<br>-7 -13.90MILS | 24.0 | 4 1/2<br>23 | 0.008<br>0.013 | 0.007<br>0.012 | After 23 hours, erosion to metal base in one small spot in approx. center of panel. |
| -15328B)-0.57MIL<br>L-P-15929B)-4.73MILS<br>-20 -12.70MILS | 20.0 | 4 1/2<br>23 | 0.068<br>0.173 | 0.063<br>0.160 | After 23 hours, badly eroded to metal base in one spot in approx. center of panel |
| -15328B)-0.50MIL<br>L-P-15929B)-4.80MILS<br>-22 -11.70MILS | 19.0 | 4 1/2 | 0.073 | 0.061 | After 23 hours, Badly eroded to metal base in one spot in approx. center of panel. |

, designation and coating system description were supplied by Prof. Kronstein as per references (e) and (f)
asured by NASL.

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VIEW SHOWING DEGREE OF EROSION OF N.Y.U. EXPERIMENTAL SONOR DOME COATING SYSTEMS

U.S. NAVAL APPLIED SCIENCE LABORATORY

LAB. PROJECT 930-59
Technical Memorandum 5
Enclosure (4)