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TESTS OF A COATING APPLIED TO A DOME WITH SMOOTH FILLETS AT THE--ETC(U)
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U.S. NAVY UNDERWATER SOUND LABORATORY
FORT TRUMBULL, NEW LONDON, CONNECTICUT

TESTS OF A COATING APPLIED TO A DOME WITH SMOOTH FILLETS AT THE WINDOW AND TRUSS CONNECTIONS

By

Julius O. Natwick

USL Technical Memorandum No. 933-385-64

27 November 1964

8p

Technical memo.

INTRODUCTION

The U. S. Navy Underwater Sound Laboratory, the U. S. Naval Applied Science Laboratory, and the Mare Island Naval Shipyard, as a team, are investigating new, improved protective coatings for sonar domes. The task includes the development of antifouling coatings with good resistance to erosion by high sound-pressure levels. This effort is being directed, in particular, towards improving coatings for AN/SQS-26 sonar domes.

Reference (a) describes the procedures that have been developed at USL for testing the ability of sonar dome coatings to withstand high-power transmissions; reference (b) reports on the effects of high-power transmissions on 5 dome coatings.

This memorandum reports on the high-power transmission tests that were conducted to obtain information on what additional service might be gained from a dome coating if the voids between the trusses and the skin of the AN/SQS-26 dome are filled with a smoothing compound. The dome section that was tested was prepared by the U. S. Naval Applied Science Laboratory and is identified as USL Specimen No. 82.

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DESCRIPTION OF SPECIMEN NO. 82

Specimen No. 82 is a 4-foot square section of an AN/SQS-26 dome that was marked for test purposes into 4 areas of equal size. Figure (1) shows: two diagonally opposite areas, designated as "A" and "D", that are coated with the standard Navy vinyl system; and two remaining areas, designated as "B" and "C", that are coated with an epoxy system. The voids between the trusses and the skin of the dome in areas A and B were filled with an epoxy smoothing compound before the coatings were applied; no smoothing compound was used in areas C and D. The coatings were carefully applied to the spaces between the trusses and the dome window. Figure 1 also shows values of coating thickness, surface roughness and salt water contact angles.

As described in reference (c), the standard Navy vinyl system consists of 1 coat of 117 pretreatment primer (MIL-C-15328), 4 coats of 119 (vinyl) red lead primer (MIL-P-15929), and 2 coats of 121 (vinyl) red antifouling paint (MIL-P-15931).

The epoxy system consisted of 1 coat of Devoe and Reynolds Co. Devran coating applied to the sandblasted metal surfaces, followed by 1 coat of Devran 204 coating and 2 coats of 121 vinyl red antifouling paint. The outside of the dome section is shown in Figure 2; the transducer side of area "C" is shown in Figure 3; the unfilled voids between the trusses and the skin of the dome are shown in Figure 4; and the filled voids are shown in Figure 5.

It was the opinion of NASL that the application of the smoothing compound to an AN/SQS-26 dome was a practical job in terms of time, manpower, material and working conditions.

TEST RESULTS

Specimen No. 82 was submerged in the sea water off the USL pier for a period of 10 days without damage to the coatings. It was then moved directly from the USL pier to the USL Dodge Pond Field Station, a fresh water test facility, where it was exposed to 232 hours of high-power transmissions during the period 5 May 1964 through 8 June 1964. The water temperature during this period was 50 degrees Fahrenheit at the start of the tests and 60 degrees Fahrenheit at the end of the tests.

As previously noted, the tests of Specimen No. 82 were conducted to investigate if the addition of a filler in the voids between the trusses and the dome skin would help reduce coating damage that is caused by high-power transmissions. There is little evidence that the filler was of any help with respect to reducing damage to the coatings. Two holes, each about 1/8-inch in diameter, had eroded through the coating after only 16 hours of transmissions; there were more than 20 places, on the inside of the dome section, that started to erode after 64 hours.

Figure 5 shows 2 severe erosions that developed in area 20 of figure 1; figures 6 and 7 are close-up views of the upper and the lower eroded areas of figure 5, respectively. These damaged areas were first observed after 80 hours of transmissions; the upper erosion was approximately 1/8-inch wide by 1/2-inch long by 0.010 inches deep, and the lower erosion was approximately 1/4-inch wide by 1-inch long by 0.008-inches deep. The length and width of these damaged places remained about the same for the remainder of the tests; however, the depth of each area gradually increased to approximately 0.066 inches (0.026 inches in the coating and 0.040 inches in the HY-80 steel). From the time the damage was first observed through to the completion of the tests, the bottom of each erosion was flat within about 0.005 inches; no particular paint damage was observed on the outside surface of the dome opposite these eroded areas.

Cracks similar to those shown at the center right of figure 6 gradually developed in the antifoulant coating during the transmissions. They are approximately 0.008 inches wide, irregularly shaped and randomly located. Areas 6, 12, 20, 21 and 26 of Figure 1 show a few cracks; area 27 shows extensive cracks.

The bonding of the filler to the metal and to the coating proved to be excellent; there was no evidence of failure.

CONCLUSION

The use of a filler, in the form of a smoothing compound, applied as a fillet between a dome window and the supporting trusses, does not in any way reduce dome coating failures or improve the ability of a coating to withstand high-power sonar transmissions.

OTHER COMMENTS

The use of a filler has some advantages. It has been shown from previous tests that, even under carefully controlled laboratory conditions, many of the places between the trusses and the dome skin are poorly coated, because they are difficult to reach for the surface preparation and for a coating application even by means of a spray-gun. The uncoated steel corrodes, and causes an increase in water contamination. This contamination then tends to lower the source level that can be transmitted before the onset of cavitation, thereby impairing the performance of the sonar. The use of the filler should reduce the amount of corrosion; in addition, it provides a surface that is smooth for the coating application.

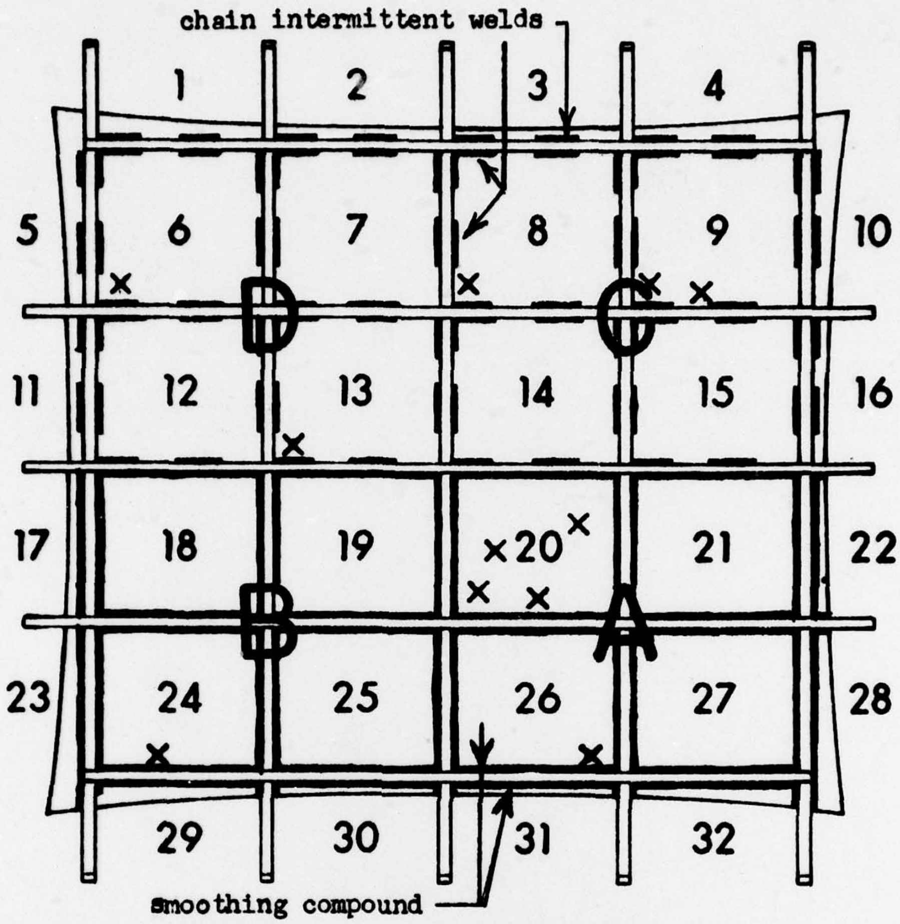
OTHER INVESTIGATIONS

A program is underway to determine the reasons why dome coatings fail. One unknown concerns the possible build-up of free plate bending waves that are generated by the interaction between the forced wave dome skin motion and the supporting trusses. The peak amplitudes of these free waves may be significantly greater than those of the forced waves generated by sonar transmissions. Specimen No. 82 will be used for some of the investigations.

Julius O. Natwick
JULIUS O. NATWICK
General Engineer

List of References

(a) Julius O. Natwick, "Test Method for Evaluating Sonar Dome Coatings," USL Technical Memorandum No. 933-0153-64 of 19 June 1964 (C)
(b) Julius O. Natwick, "Tests of Five Sonar Dome Coatings," USL Technical Memorandum No. 933-174-64 of 23 June 1964 (U)
(c) "Improved Protective Coatings for Sonar Domes," NAVAPLSCIENCLAB, Lab. Project 9300-43, Technical Memorandum No. 1, SF001-03-03, Task 8213, of 15 July 1964



Coatings: A Standard vinyl dome paint with voids filled
B Epoxy paint with voids filled
C Epoxy paint without voids filled
D Standard vinyl dome paint without voids filled

Coating thickness: A and D - 0.022 to 0.027 inches
B and C - 0.024 to 0.026 inches

Surface roughness: A,B,C, and D at vertical and horizontal directions-
600 to 900 microinches rms

Salt water contact angle: A,B,C, and D: approximately 75 degrees

X : Some areas of paint damage

TRANSDUCER SIDE OF USL SPECIMEN NO. 82

Figure 1 of USL Tech Memo No. 933-385-64

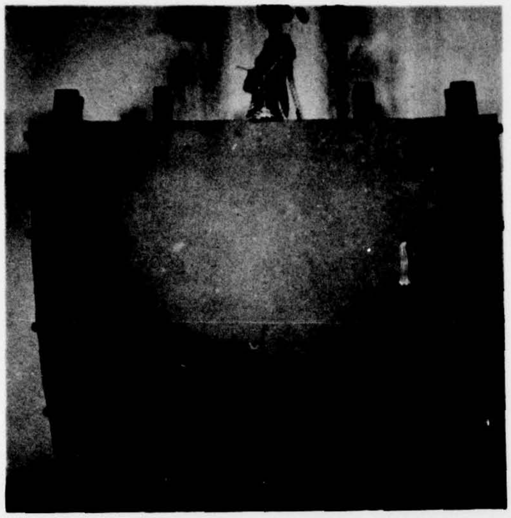


Fig. 2

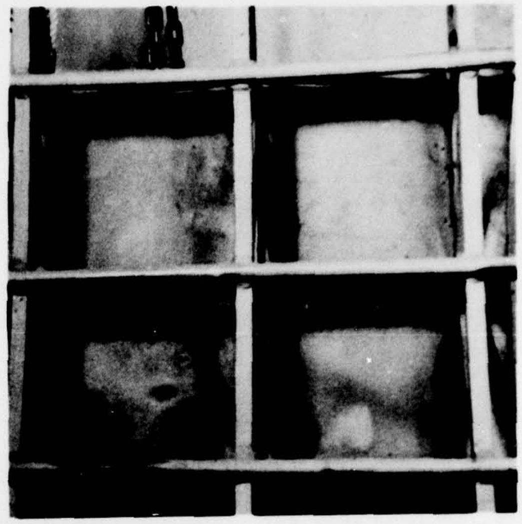


Fig. 3

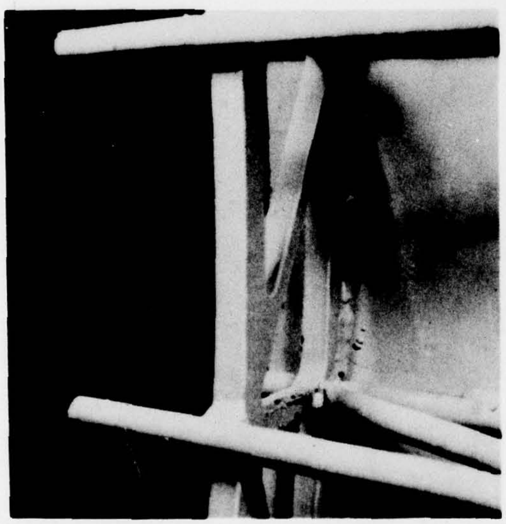


Fig. 4

Fig. 5

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~~Official Photograph~~

Fig. 6

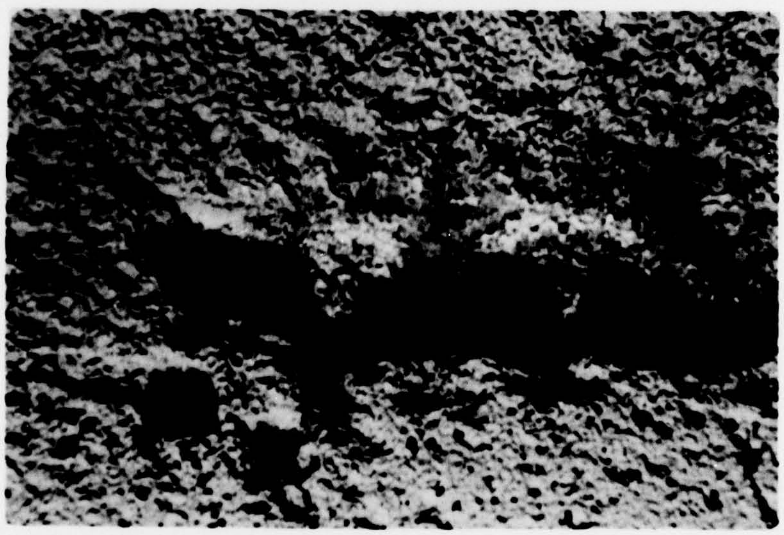

Fig. 7

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Code 904
Code 904.2S(5)