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REPORT OF THE SONAR SELF-NOISE SEA TRIALS ON THE USS RICH (DD 8--ETC(U)

1963

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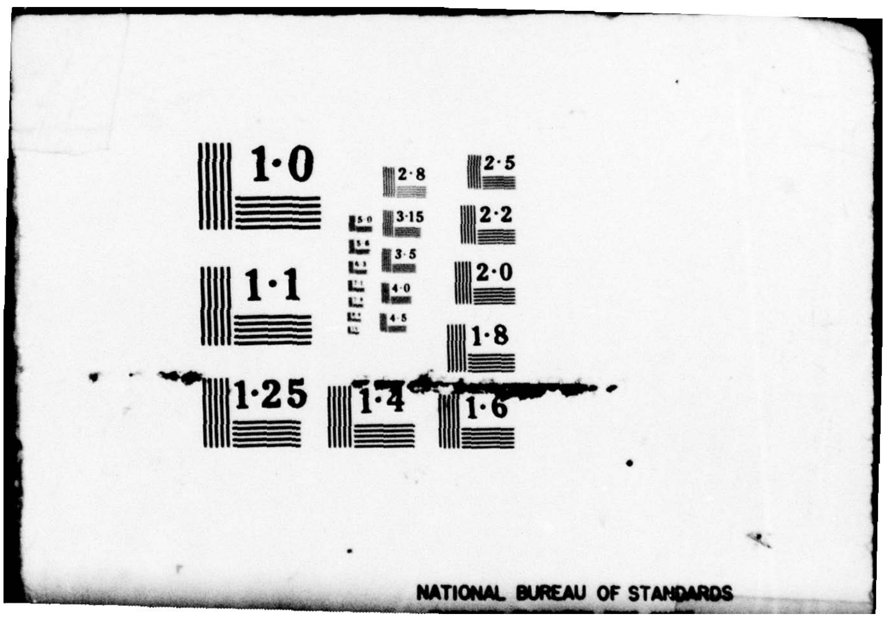
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LEVEL II

(1)

(6) REPORT OF THE SONAR SELF-NOISE SEA TRIALS ON THE USS RICH (DD 820) AND THE USS MACKENZIE (DD 836) AN/SQS-23 SONAR DOMES COATED WITH ML-SD15 VIBRATION DAMPING MATERIAL. (U)

(17) SF 013-13-01, TASK 0908

Lab. Project 9300-16, (9) Technical Memorandum #3

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Lab.Project 9300-16
Technical Memorandum #3

Ref: (a) BUSHIPS ltr F 013-13-01, Ser 634C1-441 of 9 May 1962
(b) NAVAPLSCIENLAB Lab.Project 9300-16, Technical Memorandum #2 of 18 Sep 1963
(c) Visit of Messrs. A.W. Cizek, Jr. (Code 9370) and R.R. Winans (Code 9360) NAVAPLSCIENLAB to BUSHIPS (Code 634C1 and 689C) of 18 May 1961
(d) MATLAB NAVSHIPYDNYK Project 6062, Progress Report 37 of 26 Jan 1962
(e) MIL Spec MIL-P-22581 (A)(SHIPS) Amend 2, of 12 Jun 1962
(f) MATLAB NAVSHIPYDNYK Project 6062, Progress Report 38 of 26 Jul 1962
(g) MATLAB NAVSHIPYDNYK Project 6062, Progress Report 33 of 9 Aug 1961
(h) BUSHIPS ltr F 013-13-01, Ser 634C1-1129 of 25 Jan 1963
(i) Conference between Messrs. H.P. Edelstein, A.D. Stuart and A.V. Savacchio (NAVAPLSCIENLAB (Code 9370)) and Mr. R. Pepper, (NAVSHIPYDNYK (Code 2632)) of 8 Nov 1963

Encl: (1) Curve showing Median Self-Noise Levels for the Forward 240° of the Sonar Self-Noise Versus Ship's Speed

1. Introduction.

a. The development program on sonar dome damping, authorized in reference (a), is continuing at the U.S. Naval Applied Science Laboratory.

b. This report deals specifically with the performance data obtained during the sonar self-noise sea trials on the AN/SQS-23 sonar systems of the USS RICH (DD 820) and the USS MACKENZIE (DD 836). As previously reported in reference (b), these two 360-inch domes were coated with ML-SD15, a sprayable, viscoelastic vibration damping material developed at this Laboratory.

2. Background.

a. Sand-foam damping systems for domes: Although instrumentation for sonar detection has progressed to a fairly advanced stage, the presence of interference noises still remains the fundamental controlling factor in establishing sonar range and accuracy. Some of the interference noise is transmitted to the sonar transducers as a result of vibrations due to hydrodynamic or structure-borne excitations in the hull-mounted sonar dome itself. One of the methods currently used to reduce the vibrations in the AN/SQS-23 sonar dome is to fill the lower section, below the acoustic "window", with approximately 5-6 inches of Ottowa sand and to blanket this sand with foamed-in-place, high density polyurethane foam.

b. Deficiencies in sand-foam damping system: In reference (c), Bureau of Ships and Laboratory representatives discussed the deficiencies inherent in the sand-foam system. Field reports had indicated that the foam blanket loosened and

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permitted water to penetrate the sand. This water penetration, coupled with movement of the sand, resulted in both corrosion and erosion degradation of the dome, and decreased damping efficiency. It was concluded that greater damping of the sonar dome, without the resultant corrosive condition, might be accomplished by substituting a viscoelastic material.

c. Poured ML-D2 damping system for domes: In reference (d), the Laboratory reported that 160 lb of ML-D2 material, reference (e), poured into the bottom of a 100-inch sonar dome, produced damping essentially equivalent to that obtained with 300 lb of sand and foam, and, furthermore, that neither the ML-D2 material nor the primer applied to the hull was affected in anyway by immersion in 4% salt water solution.

d. Sprayable ML-SD15 damping system for domes:

(1) Reference (f) reported the development of a vibration damping spray system consisting of the following:

(a) A high aggregate, non-sag, viscoelastic formulation, designated as ML-SD15, which could be sprayed on vertical and overhead surfaces.

(b) Equipment for spraying this material at relatively low pressures.

(2) Test results indicated that the vibration damping characteristics of the ML-SD15 formulation (4.5 lb/sq ft at a nominal thickness of 1/2") as determined by the Disc Method, reference (e), were somewhat better than the conventional ML-D2 material over the frequency range from 1600 cps to 9000 cps, and superior to a 6" sand-foam system, (approximately 49 lb/sq ft) over the frequency range from 3,000 cps to 11,000 cps, reference (g).

(3) In view of the above described developments, it was recommended that the Bureau authorize the Laboratory to spray the ML-SD15 formulation on the bottom and non-window vertical surfaces of a 360-inch sonar dome of one of the vessels scheduled for conversion under the FRAM program at the New York Naval Shipyard, for the purpose of establishing a technique of application in a large dome, and to determine the performance of the ML-SD15 sprayed dome under ship service conditions.

e. Application of ML-SD15 Formulation to Sonar Domes;

(1) On the basis of the recommendation in reference (f), the Bureau, in

reference (h), authorized the application of ML-SD15 to the AN/SQS-23, 360-inch sonar domes of the USS RICH (DD 820) and the USS MACKENZIE (DD 836) both scheduled for FRAM conversions at the New York Naval Shipyard.

(2) Spraying of domes: ML-SD15 was sprayed on to the interior surfaces of the two 360-inch sonar domes as follows:

(a) USS RICH (DD 820): Material was applied to the bottom of the dome to replace the area currently being damped with the standard sand-foam installation. In addition, the ML-SD15 formulation was sprayed along the sides of the "non-window" areas in line with the bottom of the transducer.

(b) USS MACKENZIE (DD 836): All practicable "non-window" areas were covered, including the bottom of the dome, a 7 1/2" wide strip below the flange around the periphery of the entire dome, and a 12" wide strip on each side of the dome at the after sonar baffle.

(c) The ML-SD15 formulation was sprayed to a nominal thickness of 1/2" (approximately 4.5 lb/sq ft) over sound painted surfaces consisting of Formula 117 pre-treatment primer, 119 anti-corrosive paint, and 121 anti-fouling paint. A metal probe was used to determine the thickness of the coating. In the case of the vertical surfaces, it was necessary to spray multiple coats of ML-SD15 to obviate the possibility of sagging.

Note: One unit of material (approximately 48.5 pounds) covered 14-15 sq ft of area at 1/4" thickness.

3. Sonar Self-Noise Sea Trials

a. Results: On the occasion of reference (i), Laboratory personnel met with a New York Naval Shipyard representative, Mr. R. Pepper (Code 2632), who conducted the sonar self noise sea-trials on the USS RICH (DD 820) and the USS MACKENZIE (DD 836). The results of the trials were submitted to the Laboratory in the form of curves, which compared the sonar self-noise levels of the USS RICH and the USS MACKENZIE to those of the USS ELLISON (DD 864), damped with the currently used sand-foam system, and to the Bureau of Ships Sonar Standard. It was indicated by the Shipyard that the noise levels obtained on both the USS RICH and the USS MACKENZIE were the lowest ever achieved by the Shipyard and were probably attributable to the improved damping characteristics of the ML-SD15 coated sonar domes. It was further indicated that the Shipyard would shortly forward this information to the Bureau.

b. Analysis: Enclosure (1) shows the median self-noise levels for the forward

240° of the sonar domes versus ship's speeds. This graph compares the self-noise levels of the USS RICH, the USS MACKENZIE and the USS ELLISON, and the Bureau of Ships Sonar Standard. The reduction realized in the self-noise of the USS RICH and the USS MACKENZIE at varying speeds is demonstrated in the following table:

	Sonar Self-Noise DB// ubar				Self-Noise Improvement Using ML-SD15 In Lieu of Sand-Foam DB// ubar	
Speed (Knots)	BUSHIPS STD(1)	USS ELLISON (Sand-Foam)	USS RICH (ML-SD15)	USS MACKENZIE (ML-SD15)	USS RICH	USS MACKENZIE
5	-46	--	-48	-54	--	--
10	-42	-44	-48	-51	4	7
15	-34	-36	-45	-45	9	9
20	-26	-32	-37	-41	5	9
25	-18	-26	-29	-35	3	9
30	-10	-14	-21	-16	7	2

(1) BUSHIPS ltr Ser C-9670/13, Ser 689C-0268 of 14 Dec 1961

As indicated in the table above, substantial reduction in ships self-noise resulted from the modification made to the sonar domes by applying the Laboratory-developed ML-SD15 material. It is important to note that self-noise was reduced by 9db, in the trials of the USS MACKENZIE, at speeds from 15 knots through 25 knots. This is particularly significant as these speeds are within the operating range for the ship.

4. Conclusions: The ML-SD15 vibration damping formulation, a development of the U.S. Naval Applied Science Laboratory, was successfully sprayed on to the bottom and "non-window" vertical surfaces of the interiors of the two 360-inch sonar domes. On the basis of the sonar self-noise sea trial data obtained on the sonar systems of the USS RICH (DD 820) and the USS MACKENZIE (DD 836), and on the basis of the experience of the Laboratory with viscoelastic materials, it is concluded that the following advantages will be obtained by the application of the sprayable ML-SD15 material in lieu of the currently used sand-foam system.

a. Improved sonar efficiency: Substantial improvement in sonar efficiency because of superior vibration damping characteristics of the ML-SD15 formulation. Self-noise reductions have been demonstrated over the entire range of ship's speeds - 5 knots through 30 knots.

b. Lower cost: Cost of installing the ML-SD15 formulation (labor, materials, etc.,) is approximately 48% less than the cost of the sand-foam installation. This will result in a cost savings of approximately $1,000.00 per dome (reference (b)).

c. Lower weight: A reduction of approximately 4,000 pounds in the overall weight of the damped dome was effected by using 1,000 pounds of the ML-SD15 materials, as compared to 5,000 pounds of material required for the sand-foam installation.

d. Increased coverage: Additional dome coverage achieved by the ability to spray "non-window" vertical surfaces, thereby providing more damping than can be obtained by restricting the damping application to only the bottom of the dome.

e. Improved application procedure: Ease of application over curved surfaces, in corners, and between closely spaced structural members.

f. Improved adhesion. Excellent adhesion to primed or unprimed steel surfaces subject to shock and heavy vibrations.

g. Improved water resistance: Resistant to prolonged water immersion:

h. Flame retardant: Self-extinguishing characteristics, where required, in accordance with ASTM method D-635.

5. Recommendations. On the basis of the performance data presented in this report, indicating substantial improvement in sonar efficiency, it is recommended that the Laboratroy-developed, sprayable vibration damping material, ML-SD15 be approved for use in sonar domes in lieu of the currently used sand-foam system.

6. Future Work. Future work in this program, directed towards further reducing sonar self-noise in the ASW program to increase sonar capability, will include:

a. Development of acoustically transparent materials in order to completely cover the interior sonar dome surface without restricting sound transmission.

b. Further development of the ML-SD15 formulation and spray equipment to achieve greater cost savings and improved application procedures.

c. Investigation of the feasibility of using the sprayable ML-SD15 formulation in those shipboard applications where other types of vibration reduction materials are presently being installed.

d. Determination of the characteristics of the ML-SD15 formulation under conditions of deep submergence for possible application in deep-diving submarines.

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