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RADIO COUNTERMEASURES SECTION

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27 August 1946

Vibration, Shock and Salt Spray Tests of
5, 10 and 25 Watt Diehl and 5 Watt Blake
Low Inertia A-C Servo Motor

By

H. M. Ikerd

- Report R-2950 -



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ABSTRACT

The 5 watt Blake Motor and the 5 watt, 10 watt and 25 watt Diehl Motor described in this report were built primarily for general servo use aboard ship in the fleet. All of these motors meet the necessary vibration requirements for shipboard use. The 5 watt Blake Motor passed the shock test but failed to meet the salt spray requirements for shipboard use. The 5 watt Diehl Motors failed to meet the shock and salt spray requirements. The 10 watt Diehl Motor passed the salt spray test, but failed the shock test. The 25 watt Diehl Motor satisfactorily met the shock requirements but failed the salt spray test.

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PLATE 1. 25 Watt Diehl Motor
PLATE 2. 10 Watt Diehl Motor
PLATE 3. 5 Watt Blake Motor
PLATE 4. 5 Watt Diehl Motor

INTRODUCTION

1. Vibration, shock and salt spray tests were conducted on the following motors:
 - (1) One A-C Servo Motor-2 phase, 2 pole per phase, 115 volts per phase, 0.15 amperes per phase, 60 cycles per second, output 5 watts. Type No. SM-1021, manufactured by Blake Marine Instrument Co., New York, N.Y.
 - (2) One A-C Control Motor-2 phase, 2 pole per phase, 75 or 115 volts per phase, 0.11 or 0.16 amperes per phase, 60 cycles per second, output 2 or 5 watts. Type No. F.O. 909886, manufactured by Diehl Mfg. Co., Fenderne, N.J.
 - (3) One A-C Control Motor-2 phase, 2 pole per phase, 115 volts per phase, 0.30 amperes per phase, 60 cycles per second, output 10 watts. Type No. 783423, manufactured by Diehl Mfg. Co., Fenderne, N.J.
 - (4) One A-C Control Motor-2 phase, 2 pole per phase, 115 volts per phase, 60 cycles per second, 25 watts output, attached blower and blower motor 115 volts split phase. Type No. F.O. 910808, manufactured by Diehl Mfg. Co., Fenderne, N.J.

All motors were subjected to vibration tests in accordance with reference (3) to shock tests in accordance with reference (4) and salt spray tests in accordance with reference (5). The tests were begun on 2 July 1946 and completed 5 August 1946.

VIBRATION TESTS

2. The motors were mounted rigidly on a direct drive vibration machine. Each motor was mounted with the rotor shaft parallel to a vertical line by means of four 10-24 brass bolts through mounting holes provided by the manufacturer. A brass spacer, suitably bored to clear the shafts and wide enough to allow the motors to run freely under test was employed in each case.
3. With the excursion set at .060 inch (conforms to .024" to .036" amplitude limits of 9284B). The motors were then vibrated vertically in a direction parallel to the shaft for five minutes at each interval frequency from 10 to 23 cps inclusive (as permitted in F-5E(1)a of 9284B). The motors were then vibrated for two hours at .060 inch total excursion while the frequency was uniformly and continuously varied from 10 to 23 to 10 cps in intervals of one minute.
4. The procedure described in paragraph 3 was repeated for

horizontal vibration in two directions normal to each other.
(Horizontal here is the direction normal to the shaft in each case).

5. The motors were inspected both prior to and after the conclusion of the vibration tests and no change was noted. The motors performed normally both during and after the tests.

SHOCK TESTS

6. The motors were mounted on the bulkhead fixture, figure 4a of reference (4). The entire assembly was mounted on the anvil plate of a light weight H.I. Shock Test Machine. This mounting placed all the motor shafts in horizontal planes.

7. Three blows of one, three, and five feet respectively were delivered in directions parallel to each of the three principal axes of the motors while the motors were energized. The blows were delivered in the following sequence: horizontal in a direction parallel to the shafts, vertical in a direction perpendicular to the shafts. The 5 watt Diehl Motor showed evidence of bearing damage or misalignment as a result of the first horizontal blows parallel to the shaft. The 25 watt Diehl Motor was torn loose as a result of the five foot blow from the side in a direction perpendicular to the shaft. This blow proved the 10-24 brass mounting screws to be inadequate. The motors were remounted using 10-24 steel screws and the tests were resumed. The motors were then subjected to the same number and sequence of blows as above, with the motors deenergized. The motors were checked and energized following each blow. The 10 watt Diehl Motor failed to operate following the horizontal five foot blow which was delivered normal to the shaft from the side. The motor was partially disassembled and it was made to run after realignment of the bearing. The 10 watt motor failed to operate after every blow following this first failure indicating permanent misalignment. The 25 Diehl Motor loosened up on the last two blows but not enough to prevent its operation when energized.

SALT SPRAY TEST

8. According to the specification of reference (5) the four motors (unexcited) were placed in a continuous 20% (by weight) 95°F sodium chloride spray for 100 hours. At the end of the test the motors were washed with clean water and disassembled for inspection.

9. The 5 watt Blake Motor endbells (machine surfaces), terminals and name plates were corroded.

10. The terminals and shaft were corroded on the 5 watt Diehl motor.

11. There was no appreciable corrosion on the 10 watt Diehl Motor.

12. The 25 watt Diehl Motor blower rotor, aluminum on blower motor rotor, inside of blower motor endbell and inside of blower housing was corroded. Also, some paint was stripped off the blower housing.

COMMENTS

13. The type of failure occurring in the 10 watt Diehl Motor shows the advantage of a through hole (as used in the Blake Motor) as compared to a tapped hole (used in the Diehl Motor). The base of the 10 watt Diehl motor shows progressive fracture from these tapped holes to the outside of the motor (see Plate (2)). The heavier base of the 25 watt Diehl Motor saved it from the failure noted in the 10 watt motor. The Blake Motor showed no evidence of shock failure and needed no adjustment during the tests.

CONCLUSIONS

14. The 5 watt Blake Motor performed satisfactorily through the vibration and shock tests, however, if the noise can be considered as objectionable it would be deemed unsatisfactory. This motor failed to pass the salt spray test.

15. The 10 watt Diehl Motor is considered unsatisfactory for shock, but is considered satisfactory for vibration and salt spray requirements.

16. The 25 watt Diehl Motor performed satisfactorily during the vibration and shock tests, but failed to pass the salt spray tests.

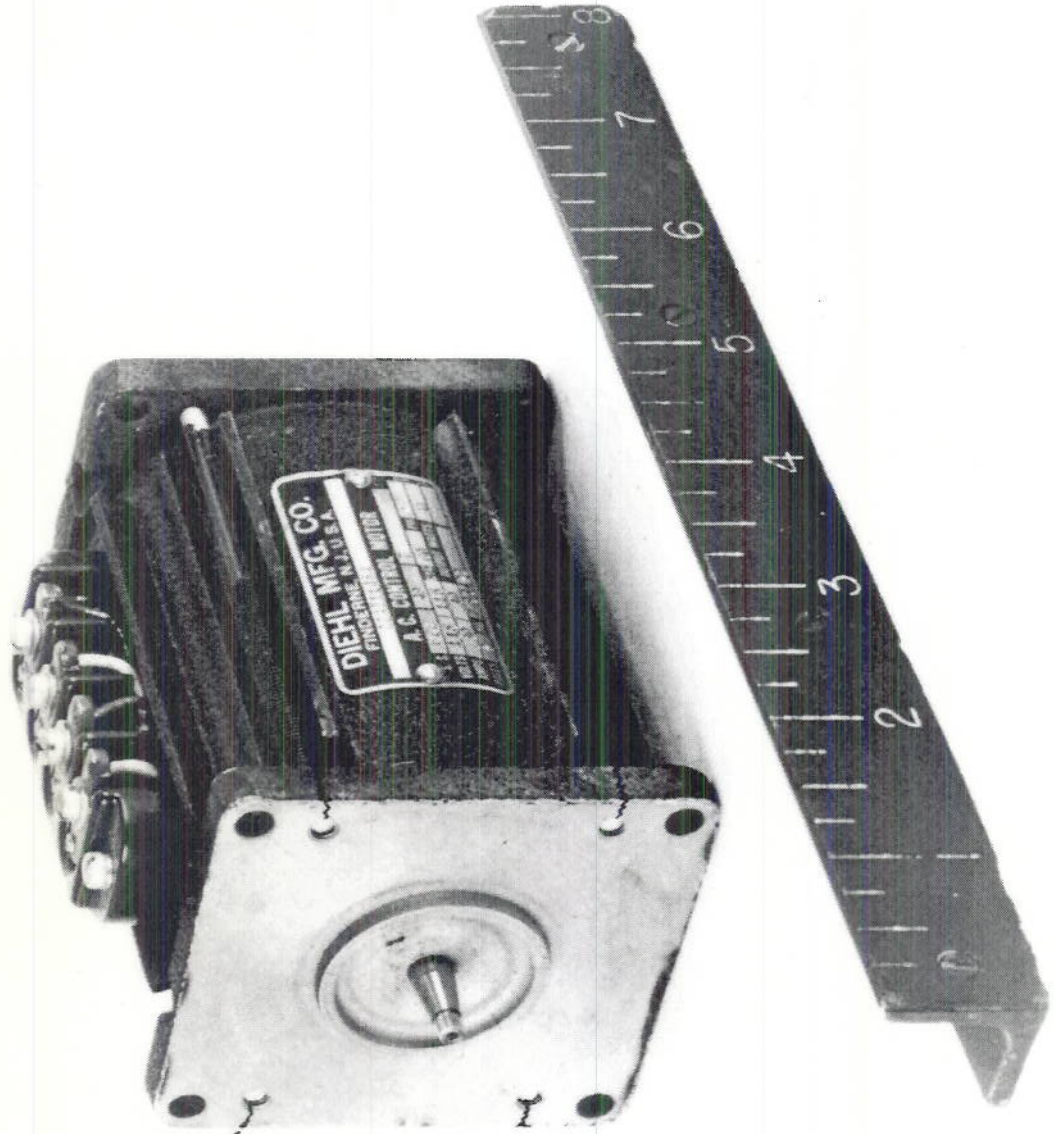
RECOMMENDATION:

17. The 10 watt Diehl Motor should be equipped with the heavy endbells similar to those on the 25 watt motor, and all the Diehl Motors should employ an assembly technique eliminating tapped holes in the mounting flanges.

18. Some anodizing process should be used on the machine surfaces of the Blake Motor endbells to prevent corrosion. Noncorroding terminals and shafts should be used through all the motors. Some measure should be taken to prevent the corrosion that occurred on practically all of the components on the 25 watt Diehl Motor's blower unit.

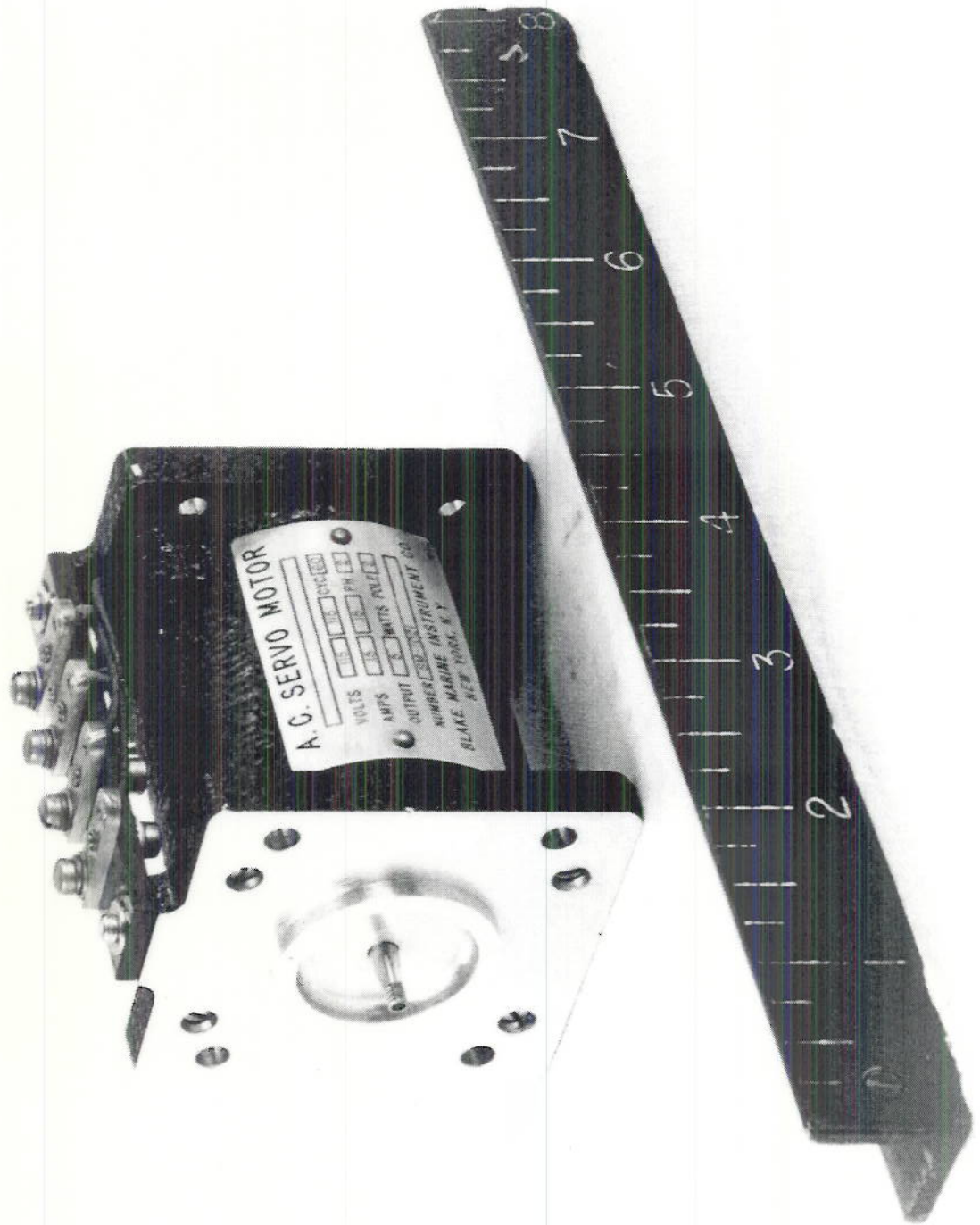
REFERENCES

1. BuShips Ltr. (915Ae) Ser. C-915A-8903 of 15 February 1945, NRL C-S67-5(700).
2. BuShips Ad Interim Specification 16M14 (RE) dated 15 April 1945.
3. BuShips Specification RE9284B, dated 1 August 1944.
4. BuShips Specification 66S3, dated 15 September 1945.
5. BuShips Specification AN-QQ-S91.

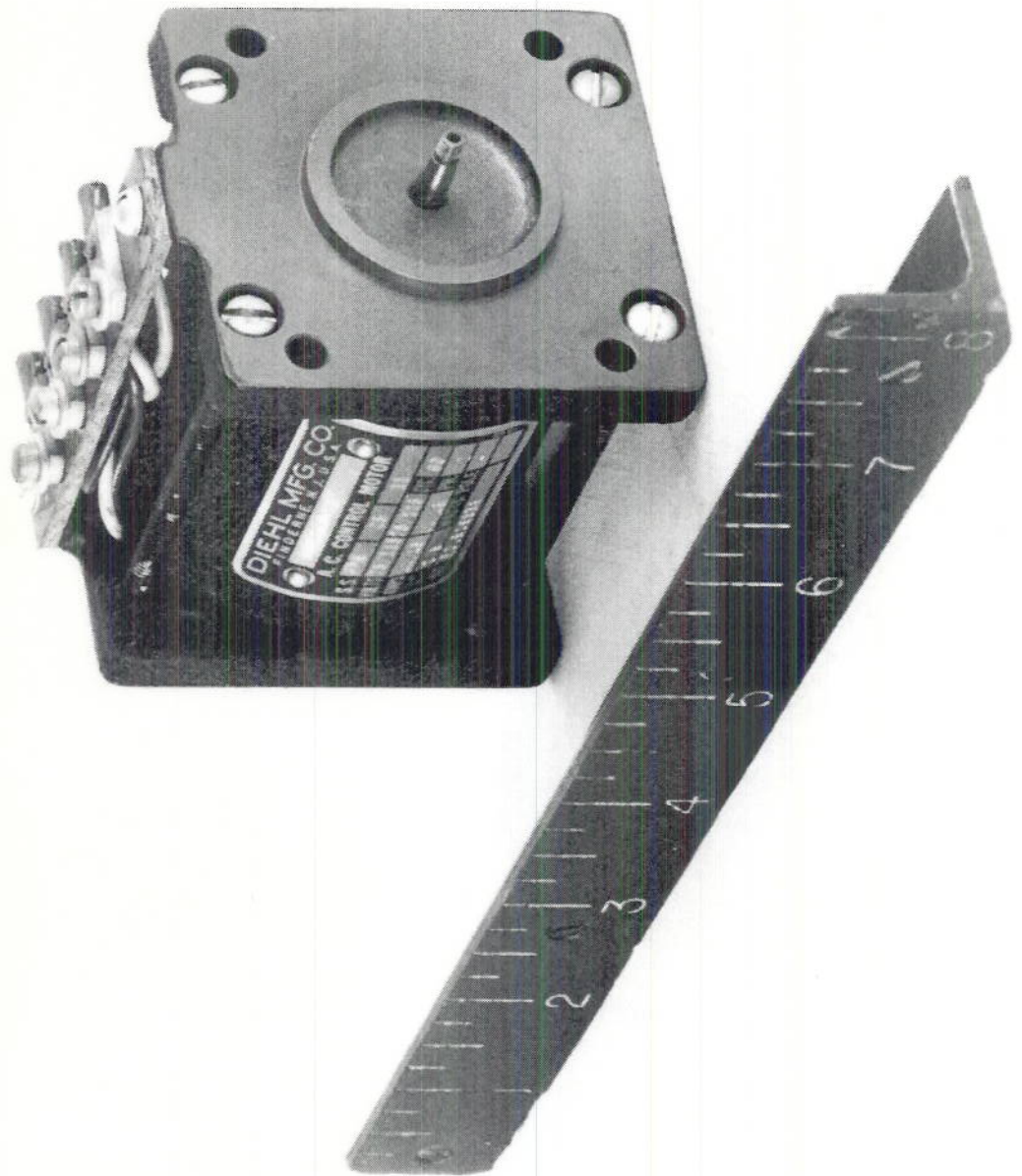


FAILURE

10 WATT DIEHL MOTOR



5 WATT BLAKE MOTOR



5 WATT DIEHL MOTOR