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SUBJECT

Report of Test of  
Model XE(YN) Radio Transmitting Equipment

by

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NAVY DEPARTMENT

Report of Test  
of  
Model XBZ(YN) Radio Transmitting Equipment

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## AUTHORIZATION.

1. The tests on the Model XBZ(YN) Radio Transmitting Equipment were carried out under the authority granted in reference (a) for the development of special appliances for navigation and control of landing craft--Bureau of Ships Problem D15-C (S3OR-C) Priority AAA.

Reference: (a) BuShips ltr. C-S67/52(480-H) of 28 May 1942 to NRL.

## INTRODUCTION.

2. The Model XBZ(YN) Radio Transmitting Equipment is designed to work in conjunction with the Model YL Radio Beacon Equipment. Its function is as follows: The Model XBZ(YN) Equipment is planted at a desired point and at a predetermined time begins to radiate an intermittent signal consisting of a very high frequency carrier modulated by an audio tone. The radio transmitter unit is controlled by a timer which is contained in the equipment and may be set to energize the equipment at any time between 0 to 96 hours after setting. By using the Model YL antenna as a directive receiving antenna, the Model YL Equipment may be lined up on this source of radiation. Thus, the Model XBZ(YN) Radio Transmitting Equipment acts as a marker for determining the bearing of the desired landing point during landing operations.

3. The Model XBZ(YN) Radio Transmitting Equipment is designed to be planted either on land or in the water. It consists essentially of a cylindrical steel drum which contains the transmitter unit, the timer, and the power supply system. The antenna is mounted on top of the drum. For installation in the water there is external to the drum, the antenna mast, the antenna, a stabilizer, and an anchor system with an anchor line support buoy for deep water. For land installations the antenna mast, the stabilizer and the anchor system are not used.

## OBJECT OF TESTS.

4. The object of the tests was:
- (a) To determine the extent to which the equipment complies to the general specifications issued by the Navy Department.
  - (b) To obtain such performance data as necessary for making basic specifications to be used in the purchase of additional similar equipments.
  - (c) To obtain data to serve as a basis for making recommendations regarding changes found necessary or desirable to make the equipment more suitable for Naval use.
  - (d) To determine the performance of the complete Model XBZ(YN) Equipment.

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ABSTRACT OF TESTS.

5. Specifically, tests were conducted to determine the following:
- (a) The power output and overall efficiency of the transmitter unit, (40)\*.
  - (b) The VHF carrier frequency change during the discharge of the battery with continuous operation, (44).
  - (c) The VHF carrier frequency change during the discharge of the battery with intermittent operation, (45).
  - (d) The power output change during the discharge of the battery with continuous operation, (46).
  - (e) The VHF carrier frequency change resulting from a change in ambient temperature, (47).
  - (f) The VHF carrier frequency change resulting from inclination due to roll and pitch, (50).
  - (g) The VHF carrier frequency change resulting from vibration, (51).
  - (h) The VHF carrier frequency change resulting from shock, (52).
  - (i) The VHF carrier frequency change over an extended period due to handling, (53).
  - (j) The frequency range of the VHF carrier oscillator with normal input to the transmitter, (58).
  - (k) The relative field strength of a number of equipments, (59).
  - (l) The VHF carrier frequency change resulting from a change of tubes, (54).
  - (m) The modulator frequency change resulting from a change in ambient temperature, (56).
  - (n) The modulator frequency change during the discharge of the battery with continuous operation, (57).
  - (o) The VHF carrier frequency change during a cycle of intermittent operation, (48).
  - (p) The efficiency of the vibrator pack, (62).
  - (q) The accuracy of the timer under conditions of high ambient temperature, (64).
  - (r) The accuracy of the timer under conditions of low ambient temperature, (64).

\* The numbers refer to the paragraph where the test is discussed in detail.

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- (s) The accuracy of the timer under conditions of high relative humidity, (64).
- (t) The accuracy of the timer under normal conditions, (65).
- (u) The adjustment of the timer to the proper speed, (66).
- (v) The period of free oscillation of the equipment completely assembled for sea operation, (67).
- (w) The output of the battery over six hours of continuous operation of the XBZ(YN) Radio Transmitting Equipment, (60).
- (x) The watertightness of the drum and the gastightness of the gas removal system, (68).
- (y) The VHF carrier frequency change resulting from a change in humidity, (49).
- (z) The dimensions and weights of the individual parts of the XBZ(YN) Equipment, (69).

MATERIAL UNDER TEST.

5. The material under test consisted of six Model XBZ(YN) Radio Transmitting Equipments, Serial Nos. 1 to 6, built at the Naval Research Laboratory. The majority of the tests were conducted on XBZ(YN) Equipment, Serial No. 2, which was selected to be the prototype for manufacture. Where comparative tests were required, all six equipments were used. Each equipment consisted of the following major parts:

- 1 Antenna
- 1 Antenna Mast
- 1 Drum
- 1 Transmitter Unit
- 1 Vibrator Pack
- 1 Timer
- 1 Battery
- 1 Gas escape system
- 1 Air-dryer
- 1 Anchor
- 1 Anchor Line Set
- 1 4-foot Stabilizer
- 1 6-foot Stabilizer
- 1 Anchor-line Support Buoy and Stabilizer
- 1 Frequency Meter
- 1 Test Meter Unit
- 1 Pressure Gauge Unit
- 1 Air Pump

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6. The following vacuum tubes were used in these tests:

- 10 Type CRC 8025 Vacuum Tubes
- 1 Type 6L6-G Vacuum Tube
- 1 Type 5T4 Vacuum Tube

METHOD OF TEST.

7. The tests of the XBZ(YN) Radio Transmitting Equipment were conducted simultaneously with the construction of the equipments. Each test was made at a time when a unit was sufficiently completed so that accurate data could be taken.
8. Power output measurements were made by a lamp load which was compared to a calibrated d-c lamp. The lamp load was matched to the source impedance through a capacity impedance matching device.
9. Carrier frequency changes and drifts were checked by means of a VHF drift indicator, when the transmitter was operating at full power output with 100 percent modulation. As no equipment which would measure frequency drifts at 246 megacycles was available, the frequency of the XBZ(YN) transmitter was shifted to approximately 240 megacycles for these tests.
10. Frequency range of the carrier was determined by means of a Type CRV-60028 frequency meter which is supplied with the YL Radio Beacon Equipment.
11. The frequency drift of the modulator was measured with a beat frequency oscillator which was checked against a 1000 cps standard.
12. The entire Model XBZ Equipment was placed in a test chamber and subjected to variations in ambient temperature between the limits of 50°C and 0°C and also subjected to variations in relative humidity from 30 to 95 percent.
13. The ability of the equipment to withstand vibration, shock and the simulated roll and pitch of the buoy was determined by mounting the equipment on a test table which is capable of producing the necessary conditions.
14. Field strength measurements were made by a field strength meter of the vacuum tube type.
15. The accuracy of the timer was measured by comparison with a Telechron electric clock.
16. The measurements of the period of free oscillation were made under actual operating conditions with a stop watch.
17. The percentage of carrier modulation was measured with a General Radio Type 687A Oscillograph.

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DATA RECORDED.

18. Complete data was recorded during all tests conducted and this information is included in the tables and plates appended to this report.

PROBABLE ERRORS IN RESULTS.

19. Precautions were taken to minimize errors in the results obtained during the tests. When necessary or desirable, duplicate tests were conducted to confirm results already obtained.

20. The visual frequency indicating equipment is capable of measuring the frequency of the VHF carrier to within five kilocycles.

21. It is believed that all radio frequency power measurements are accurate to within 10 percent.

CONCLUSIONS.

22. The Model XBZ(YN) Radio Transmitting Equipment, in general, meets the requirements of Naval Service. However, a few minor objectionable features were found during the course of the test and these have been discussed in detail herein.

23. The frequency stability and accuracy requirements of the governing specifications have been met in all respects and the power output obtained conforms with specified requirements.

24. The appearance, construction, and performance of the equipment are such as to comply for the most part with the usual Navy standards.

SUMMARY OF DEFECTS.

25. A summary of the defects noted in the tests on the Model XBZ(YN) Radio Transmitting Equipment is given below. Certain defects were of such a nature as to permit immediate correction by Laboratory personnel. Inasmuch as the XBZ(YN) Equipments under test were to be immediately placed in service the defects were corrected in all cases where feasible before the equipments were released by the Laboratory.

26. The major defect noted was the failure of a transmission line in one of the equipments. During the vibration test the flexible transmission line connecting the coupling loop (L14) to the antenna developed a short circuit. From the appearance of the short circuit, the line had been overheated with a soldering iron when it was installed. The insulation in the line also appeared to have a low melting point and could have been low enough to be softened by the heat generated in the transmitter unit. This heat combined with the vibration caused the center conductor to work over to the outer sheath causing the short circuit. The transmission line was replaced with another of better insulating material and no further trouble was experienced.

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27. The insulator supporting the coupling loop (L14) was composed of a styramic material which softens at the temperature reached in the transmitter. Although no failures were experienced, it was recommended that the insulators be made of mycalex which is able to stand a much higher temperature than styramic material. There was not enough time available to replace the styramic insulators but ones of mycalex were provided in the spare parts.

28. The vibrator pack used in the XBZ(YN) Equipment was designed for much heavier duty than required of it. The design of the equipment would be simplified and the weight reduced if a smaller vibrator pack were used.

29. During the temperature tests the heat generated in the equipment was of a sufficient amount to melt the wax from the inductors and capacitors in the 1000 cps modulator so that the wax dripped down upon the chassis. The excess wax was cleaned off with carbon tetrachloride and no further trouble was experienced.

#### RESULTS OF TESTS.

30. The general construction and design of the Model XBZ(YN) Radio Transmitting Equipment are acceptable. The transmitter circuits are adjustable over a range from 240 to 252 megacycles with all currents at normal values. The modulator is capable of modulating the carrier 100 percent within the range of 990 to 1030 cps.

31. The component parts which go to make up the complete assembly were tested to the extent possible before they were assembled.

- (a) The vacuum tubes employed in the equipment have received Navy type approval.
- (b) Numerous units of standard design are employed in the equipment. Special designs are used where necessary in order to meet the basic requirements.
- (c) Resistors of different compositions, both the carbon type and the wire wound type are used in the equipment. In each case the resistor is supported by its pigtails. Although the mounting of resistors and condensers by their pigtails is not standard Naval practice, it should be allowable here in the interest of compactness and weight. In no instance are the supporting pig-tails over  $1/4$  of an inch long. During the course of and after the test there was no visible evidence of overheating of the resistors.
- (d) Tubular paper condensers were used in this equipment due to their compactness and light weight. In all cases the condensers were supported by their pigtails.

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32. The entire transmitting equipment was subjected to a temperature change ranging between 0 and 50°C. No operational failures were noted during this test and no signs of overheating were observed.
33. All materials subject to corrosion are fully protected by cadmium plate or Silco paint.
34. Good quality insulation has been used throughout the equipment where required by good engineering practice. Phenolic insulation has been used in several locations in d-c or low potential a-c circuits.
35. The design of the electrical circuits is such that during the course of these tests no failure of any part occurred and the overload to which it was subjected resulted in no damage.
36. The design of the equipment is such that all frame members and external shields are at ground potential.
37. Ventilation of the transmitter is accomplished by means of a perforated shield in the back of the transmitter unit. During the course of the tests the equipment was subjected to ambient temperatures as high as 50°C without undue heating.
38. The design of the equipment is such that the vacuum tubes operate within the current and voltage limitations of the tube specifications. Bias potentials for both tubes are obtained by the voltage drop across individual grid leak resistors.
39. The equipment was subjected to vibration and shock. Damage resulted from vibration. The transmission line connecting the antenna to the coupling loop (L14) developed a short circuit, probably due to a combination of several causes. The first being due to poor workmanship in the initial installation and the second being due to the use of a transmission line of inferior quality. The insulation between the inner conductor and the outer sheath appeared to have a rather low melting point so that the heat generated in the transmitter softened the insulation material. The center conductor being under some strain and aided by the vibration worked over to the outer sheath at the point where the line joins on to the coupling loop. A repair was effected by replacing with a new transmission line of better insulation material. The equipment was then subjected to vibration for a period of four hours at varying frequencies. The transmission line was inspected and found to have been unaffected by the test.
40. The Model XBZ(YN) Radio Transmitter consists of a VHF oscillator and a 1000 cps modulator.
- (a) The VHF oscillator uses one type 8025 vacuum tube in conjunction with an open wire resonant line. This circuit operates at the ambient temperature. The output frequency is 246 megacycles.

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The oscillator is coupled to the antenna by means of a coupling loop located directly over the open wire resonant line.

- (b) The modulation oscillator uses a type 6L6-G vacuum tube in a tuned plate tuned grid circuit with magnetic coupling between the grid and plate tank circuits. The frequency of the modulator is fixed at 1000 cps.
- (c) Power output tests were made on the transmitter working into a lamp load through a matching device. The results of these tests are shown in Tables 1 and 4. It is probable that the power output is in excess of the value observed since there was some power loss in the matching device between the line and the lamp load due to radiation. In all the equipments the required output may easily be obtained with normal input voltages and currents. The power output of the XBZ(YN) Equipment, Serial No. 2, with a fully charged battery was 5.7 watts while after a period of five hours of continuous operation the power had dropped to 3.7 watts. At all times during the course of the test the carrier was 100 percent modulated. These power measurements were made on the output terminal of the transmitter to which the antenna is fastened. In all cases the percentage of modulation during the power output measurements was determined by oscillographic observation of the modulated carrier.

41. Determination of the harmonic content of the VHF carrier was not undertaken.

42. The undesirable audio modulation present including hum could not be detected by aural means.

43. The carrier frequency stability tests were conducted while the transmitter was operating at full power, 100 percent modulated, into the antenna. Stability measurements were made at a frequency of about 240 megacycles since available equipment was not capable of measuring frequency drift at 246 megacycles. The frequency relation between the drift indicator and the transmitter was such that an increase in transmitter frequency resulted in an increase in beat frequency. The maximum drift of frequency in these tests was 0.081 percent. Details as to frequency variations are presented in the following paragraphs.

44. Frequency Change During Battery Discharge-Continuous Operation. Table 2 gives data taken over a period of four hours. With the transmitter adjusted for normal operation the maximum frequency change from the initial frequency was 0.025% while the total overall change was very nearly zero.

45. Frequency Change During Battery Discharge-Intermittent Operation. Table 3 gives data taken over a period of nine hours. The maximum frequency change and also the total frequency drift was 0.0125%. The cycle for intermittent operation was 1-1/2 minutes "on" and 1-1/2 minutes "off".

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46. Power Output Change During Battery Discharge - Continuous Operation. Table 4 shows the drop in power output over a period of five hours. The initial power was 5.7 watts with the VHF carrier fully modulated. After five hours elapsed the power output had dropped to 3.7 watts or 65% of its initial value. The equivalent length of time for intermittent operation would be at least ten hours.
47. Variations in Ambient Temperature. Table 5 lists the data on the variation of frequency over a range of ambient temperature when operating intermittently (1-1/2 minutes "on" and 1-1/2 minutes "off") at full power, 100% modulation. The maximum percentage change of the carrier frequency per degree centigrade was 0.0012% while the total change was 0.042% between 0 and 50°C.
48. Frequency Drift of VHF Carrier During Cycle of Intermittent Operation. During a cycle of intermittent operation the transmitter is off for 1 minute, then the power for the filament is applied and approximately 30 seconds later, the plate supply power is applied and remains on for 1-1/2 minutes. The drift of the VHF carrier frequency during this cycle is dependent upon the ambient temperature. The maximum drift takes place when the ambient temperature is 0°C, the drift being 0.023%. When the ambient temperature was 50° the drift was 0.0062%.
49. Frequency Drift Resulting From a Change in Relative Humidity. Table 25 lists the data on the drift of VHF carrier frequency resulting from a change in humidity. Since the drum was sealed so that it was watertight and gastight and since the small frequency drift was of a random nature, it is believed that the humidity had little effect on the operation of the equipment.
50. Inclination From Roll and Pitch. The complete equipment, assembled for land operation, was rigidly fastened to the inclination table by means of hook bolts. It was then subjected to inclination up to 45° from the vertical in a side to side direction. Table 6 shows the results of this test. The maximum frequency change was 0.008% while the total change over 30 minutes of rolling was zero.
51. Vibration. With the complete equipment fastened to the vibration test table, varying frequencies of vibration were applied to the equipment. Table 7 lists the data. The maximum change in frequency was 0.08% while the total overall change was 0.061%. The vibration test resulted in the short circuiting of the transmission line leading from the coupling loop to the antenna. The transmission line was replaced with one of better quality and subjected to vibration for four hours after which inspection showed that the new line was unaffected by the test. This defect was discussed in detail in paragraph 39.
52. Shock. With the XBZ(YN) Equipment secured to the test table, the equipment was subjected to shock by applying the shock to the edge of the table. The results are illustrated in Table 8. With shocks of 23 and 90 G's the frequency of the carrier did not vary more than 0.025%.

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53. Frequency Drift Over an Extended Period. It was desired to know what frequency drift would be experienced when the equipment was handled from day to day simulating actual use. A record of the frequency readings was kept which is shown in Table 9. The maximum frequency change was 0.081% while the total change was 0.06% in ten days.
54. Change of the VHF Oscillator Tube. The effect of tube change on the carrier frequency is tabulated in Table 12. Ten different tubes were used in this test. The maximum change in frequency from the original value was 1.75%.
55. Frequency stability tests of the modulator were made while fully modulating the VHF carrier. The frequency of the modulation oscillator was measured by an oscilloscope and a beat frequency oscillator. The frequency at which these tests were made was 1000 cps. The maximum frequency change resulting from all causes is 0.59%.
56. Variations in Ambient Temperature. The ambient temperature test of the modulator is illustrated in Table 13. The temperature variation was from 50 to -30°C. The maximum frequency change was 0.028% per degree C.
57. Frequency Change During Battery Discharge. Table 14 gives the modulator frequency as a function of time during the discharge of the battery. Both the maximum change and total change of the modulator frequency was 0.59% over a period of seven hours.
58. Oscillator Grid Current Variation with Frequency. The proper amount of feedback to the grid of the VHF oscillator tube is necessary to insure operation at optimum efficiency. An excellent check on the selection of the amount of feedback is to measure the grid current as the frequency is varied. Tests in which the input to the oscillator was held constant as the frequency was changed are shown in Table 10. The grid current remained at the desired value when the frequency was varied between 242 to 250 megacycles.
59. Relative Field Strengths of Six Equipments. The field strength of each of the six XBZ(YN) Equipments was measured individually and under the same conditions. The maximum and minimum field strengths were within 3.5% of the mean value, indicating that the radiated power of all units is nearly equal.
60. Life Test of the Battery. Table 15 gives data on the output of the battery used in the equipment over a period of six hours of continuous operation, when the input to the transmitter was adjusted to normal operating values, i.e., 400 volts and 80 ma. At the end of three hours the power output of the battery had fallen to 92.3% of its initial output while at the end of six hours the output had fallen to 72.9% of its initial value.
61. The power supply of the XBZ(YN) equipment under test is a vibrator pack which converts the 6 volts d.c. supplied by the battery to about 400

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volts d.c. for the transmitter unit plate voltage. The vibrator pack employs a type 5T4 full wave high vacuum rectifier tube. The output voltage may be adjusted by means of a rotary switch, the normal setting being position "2".

62. Efficiency of the Vibrator Pack. Table 14 gives data on the efficiency of the vibrator pack for various loads and switch positions. The efficiency varies from a maximum of 57% for a heavy load (the rated output of the vibrator pack) to 32% for a light load. At the normal output (400 volts, 80 ma.) the efficiency is about 46%. The power output required by the transmitter is very much below the rated output of the vibrator pack. The efficiency of conversion could be increased if a smaller vibrator pack were used.

63. Timer. The timer in the XBZ(YN) Radio Transmitting Equipment is a 6 volt d-c electric clock designed to start two cams rotating after any given length of time up to 96 hours. These cams rotate at a speed of one revolution every six minutes. One cam controls the filament voltage of the transmitter unit while the other controls the input to vibrator pack and hence the plate voltage for the transmitter unit. A number of tests which were made to determine the accuracy of the timer are discussed below.

64. High and Low Ambient Temperature and Humidity. Tables 17, 18, and 19 list data illustrating the effect of temperature and humidity upon the speed of the clock in the timer. In all tests the timer continued to operate normally with the clock running at the correct rate. The high and low ambient temperatures are 60°C and -30°C, respectively, while the range of relative humidity to which the timer was subjected was between 30% and 95% at 40°C. The average time for a single revolution of the cams was 6 minutes.

65. Accuracy of Timer. Table 20 lists data on the accuracy of the timing dial of the timer. For any given setting of the governor screw the normal percentage error runs about 0.25% in 96 hours which indicates that the dial can be set within plus or minus 15 minutes of the desired time.

66. Adjustment of Cams to Six Minutes. Table 21 lists data for adjusting the clock to the proper speed. One half a turn of the governor screw changes the time of one revolution of the cam by about 1.7 seconds. In 96 hours one half a turn of the governor screw changes the starting time 27.2 minutes.

67. Measurements of Period of Free Oscillation. With the XBZ(YN) Radio Transmitting Equipment completely assembled for sea operation, the period was measured with a stop watch. With the four foot stabilizer rod attached to the buoy the period was about 3.1 seconds for a complete oscillation while with the six foot stabilizer rod in place, the period was about 3.4 seconds. The amount of freeboard to the rim of the drum with either stabilizer attached was about four inches. The buoy floated on an even keel.

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68. Watertightness and Gastightness. With the equipment completely assembled for land operation, air was pumped into the drum to a pressure of about five pounds. This pressure was above four pounds after a period of an hour had elapsed, so it may be assumed that the drum is watertight and the gas removal system is gastight. The same method was used to test the watertightness of the anchor line support buoy. This test is outlined in Table 24.

69. Dimensions and Weights. Table 26 lists the dimensions and weights for both the complete equipment and the individual parts.

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Table 1

Model XBZ(YN) Radio Transmitting Equipment  
 Power Output Tests  
 Equipment with Least Output  
 Serial No. 1

Voltage of Power Pack	Filament Voltage	Plate Cur. Mod. Total with Mod.	Cathode Cur. MA	Grid Mod. Osc.	Cur. VHF Osc.	Per Cent Mod.	Per Cent Mod.	Frequency		Power Output (Watts)
								VHF (MC)	Mod. (Cycles)	
395	5.8	81	48	2.2	14	30.2	100	246	1020	4.90

Equipment with Greatest Output  
 Serial No. 5

390	5.8	82	46	1.9	15	32.9	100	246	1010	5.30
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Table 2

Model XBZ (YN) Radio Transmitting Equipment  
 Carrier Frequency Change During Battery Discharge  
 Continuous Operation  
 Serial No. 2

Starting Time	Frequency (MC)	Frequency Change (Kc)
1000	240.220	
1030	240.270	
1100	240.278	+50
1130	240.280	+8
1200	240.275	+2
1230	240.270	-5
1300	240.272	-5
1330	240.265	+2
1400	240.260	-7
1430	240.221	-5
1435	Output started falling off	-39
1445	240.102	

Note: Direction of Frequency Drift Not Known.

Equipment in shielded booth.  
 Ambient temperature variation negligible.  
 Battery fully charged at start of test.

Maximum frequency change from start--60 kc---- 0.025%  
 Total frequency change during 4-1/2 hours ---- 0



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Table 3

Model XBZ(YN) Radio Transmitting Equipment  
 Serial No. 2  
 Carrier Frequency Change During Battery Discharge  
 Intermittent Operation (1 1/2 "On" - 1 1/2 "Off")

<u>Time</u>	<u>Frequency (MC)</u>	<u>Frequency Change (KC)</u>
1000		
1100	*	
1120	240.395 *	
1200	240.395 *	
1300	240.410 $\ominus$	
1400	240.407	- 3
1500	240.406	- 1
1600	240.401	- 5
1700	240.398	- 3
1800	240.395	- 3
1900	240.390	- 5
2000	240.390	0
2100	240.380	-10
2200	240.360	-20

Note: Direction of Frequency Drift Not Known.

\* Erratic operation drift indicator

$\ominus$  Adjusted frequency drift indicator. Frequency readings start from here.

Battery specific gravity at start of test 1270

Frequency drift over 8 hours----- 30 kc -----0.0125%

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Table 4  
 Model XBZ(YN) Radio Transmitting Equipment  
 Serial No. 2  
 Power Output Change During Battery Discharge  
 Continuous Operation

<u>Time Elapse</u>	<u>Start</u>	<u>Five Hours</u>	<u>Six Hours</u>
Battery Cur. Amps.	14.9	12.9	12.1
Battery Volts	6.22	5.8	5.5
Plate Volts	375	340	315
Total Plate Cur. Ma.	86	70	66
Grid Cur. Osc. Ma.	10.2	8.8	5.6
Plate Cur. Osc. Ma.	44	36	
Grid Cur. Mod. Ma.	1.7	1.4	1.4
Cath. Cur. Mod. Ma.	49	42.5	40
R-F Power Output Watts			
Modulated	5.7	3.7	---
Unmodulated	5.4	3.8	3.0
Vibrator Pack Eff., %	43.3	41.0	31.4
Battery Specific Gravity	1.285	---	1.125

[REDACTED]

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Table 5

Model XBZ(YN) Radio Transmitting Equipment  
 Serial No. 2  
 Heat Run Test

<u>Time</u>	<u>Temperature (°C)</u>	<u>Frequency (MC)</u>	<u>Frequency Change (KC)</u>
0845	50	240.200	
0900	50	240.190	
0915	50	240.180	-10
0930	50	240.165	-10
0945	50	240.162	-15
1000	50	240.155	-3
1015	50	240.155	-7
1030	50	240.151	0
1045	50	240.155	-4
1100	50	240.150	+4
1115	50	240.155	-5
1130	50	240.151	+5
1145	50	240.155	-4
1200	38	240.155	+4
1215	35	240.160	0
1230	35	240.155	+5
1245	35	240.162	-5
1300	35	240.160	+7
1315	20	240.168	-2
1330	20	240.174	+8
1345	20	240.188	+6
1400	20	240.185	+14
1415	20	240.194	-3
1430	20	240.200	+9
1445	10	240.220	+6
1500	0	240.230	+20
1515	0	240.245	+10
1530	0	240.250	+15
1545	0	240.256	+5
			+6

Note: Direction of Frequency Drift Not Known.

Battery specific gravity at start of test 1.280  
 Battery specific gravity at end of test 1.140

Maximum temperature in buoy 111°F  
 Minimum temperature in buoy 48°F

(Cont'd)

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Table 5 (Cont'd)

Summary

<u>Temp. Change (°C)</u>	<u>Carrier Change KC per Temp. Change</u>	<u>Percent Change per 1°C.</u>
50 - 35	5	0.00013
35 - 20	40	0.0011
20 - 0	56	0.0012
<u>Temp. Change (°C)</u>	<u>Carrier Change KC Total</u>	<u>Percent Change Total</u>
50 - 0	101	0.042

Table 6

Model XBZ(YN) Radio Transmitting Equipment  
Serial No. 2  
Inclination Test

<u>Time</u>	<u>Osc. Grid Cur. (MA)</u>	<u>Mod. Cathode Cur. (MA)</u>	<u>Total Plate Cur. (MA)</u>	<u>Carrier Frequency (MC)</u>
1315	13	49	82	244.680
1320	12.5	49	82	244.700
1325	12.5	49	82	244.700
1330	12.5	49	82	244.700
1335	12.5	49	82	244.700
1340	10	49	82	244.680
1345	10	50	82	245.000*
			80	245.000*

\* Frequency measured with mast in place.

Top of mast whipped approximately six inches.

Carrier frequency change from start to finish without mast - - - - 0  
Maximum carrier frequency change during inclination -- 20 kc ---- 0.008%

Table 7

Model XBZ(YN) Radio Transmitting Equipment  
 Serial No. 2  
 Vibration Test

<u>Time</u>	<u>Carrier Frequency (MC)</u>	<u>Osc. I<sub>g</sub> (MA)</u>	<u>Mod. Cath. Cur. (MA)</u>	<u>Total Plate Cur. (MA)</u>	<u>Vibration Frequency Cycles Per Min.</u>
1045	244.700	13	52.0	87	1600
1100	244.820	12.5	52.0	87	1580
1115	244.850	12.5	51.5	86	1580
1130	244.850	12.5	51.0	86	1580
1145	244.850	12.4	51.0	85	1080
1200	244.850	12.3	50.5	85	1080
1215	244.850	12.2	50.0	85	1090
1230	-----	-----	-----	-----	0
1245	-----	-----	-----	-----	0
1300	244.850	11.9	50	82.5	1300
1315	244.870	11.8	50	82.5	1300
1330	244.870	11.5	50	82.5	1300
1345	244.870	11.4	49	81	1780
1400	244.900	11.1	48	80	1750
1415	244.850	11.0	48	80	1780
1430	244.850	10.8	48	80	900
1445	244.820	10.6	48	80	860
1500	244.850	10.5	48	79	925
1515	244.850	10.3	47	78	1000
1530	244.850	10.0	46	76	940

Battery specific gravity at start of test 1.235.  
 Battery specific gravity at end of test 1.120.  
 Maximum carrier frequency change during test -- 200 kc -- 0.08%.  
 Carrier frequency change, start to finish -- 150 kc -- 0.061%.

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Table 8

Model XBZ(YN) Radio Transmitting Equipment  
 Serial No. 2  
 Shock Test

Test Condition	Shocking Force		Carrier Oscillator		Plate Cur. Total (MA)	Carrier Frequency (MC)
	Pounds	G	Grid Cur. (MA)	Plate Cur. (MA)		
Before shock	50	23	10.5	49	80	244.680
Shock			10.5	49	80	244.680
After shock	50	23	10.5	49	80	244.680
Shock			10	48	80	244.620
Before shock	50	23	10	48	80	244.620
Shock			10	48	80	244.620
After shock	100	90	10	48	80	244.580
Shock			10	48	79	244.550
Before shock	100	90	10	48	79	244.550
Shock			10	47	79	244.550
After shock						

The direction of shock application was not changed during test.

Equipment rigidly mounted on table.

Maximum carrier frequency change -----60 kc ----- 0.025%.

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Table 9

Model XBZ(YN) Radio Transmitting Equipment  
 Serial No. 2  
 Carrier Frequency Drift Over Extended Period

<u>Date</u>	<u>Frequency (MC)</u>	<u>Remarks</u>
2 August	244.65	Initial reading
2 August	244.68	After change of battery
3 August	244.85	After vibration test
7 August	244.65	Low battery
12 August	244.50	After test on river
Total time of test . . . . .		10 days
Total frequency change . . . . .		150 kc . . . . .0.06%
Maximum frequency change . . . . .		200 kc . . . . .0.081%

Table 10

Model XBZ(YN) Radio Transmitting Equipment  
 Serial No. 2  
 Carrier Oscillator Grid Current Variation with Frequency

<u>Carrier Frequency (MC)</u>	<u>Plate Voltage (Volts)</u>	<u>Carrier Oscillator</u>	
		<u>Plate Cur. (MA)</u>	<u>Grid Cur. (MA)</u>
237.75	400	74	4
238.45	400	74	5.6
240.05	400	75	8.0
241.60	400	78	9.5
244.40	400	81	10.5
246.00	400	85	9.5
247.50	400	86	9.8
250.10	400	86	9.9
251.55	400	87	10.2
253.55	400	88	13.1
256.00	400	88	17.0
257.35	400	88	19.9
258.70	400	89	21.0
259.60	400	90	22.0

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Table 11

Model XBZ(YN) Radio Transmitting Equipment  
Serial No. 2  
Relative Field Strength of Six Equipments

<u>Buoy Serial No.</u>	<u>Battery Voltage</u>	<u>Plate Voltage</u>	<u>Relative Field Strength Volts</u>
1	6.4	400	102
2	6.4	410	95
3	6.4	420	96
4	6.3	405	96
5	6.6	390	101
6	6.6	410	98

Table 12

Model XBZ(YN) Radio Transmitting Equipment  
Serial No. 2  
Change of Carrier Oscillator Tube  
Type 8025

<u>Tube No.</u>	<u>Carrier Frequency (MC)</u>	<u>Deviation from Original Frequency</u>	
		<u>Kilocycles</u>	<u>Percent</u>
1	245.90		
2	241.60	4300	1.75
3	246.90	1000	0.46
4	249.50	3600	1.46
5	243.60	2300	0.94
6	245.60	300	0.12
7	245.20	700	0.28
8	247.20	1300	0.53
9	246.10	200	0.08
10	248.40	2500	1.02


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Table 13

Model XBZ(YN) Radio Transmitting Equipment  
 Serial No. 2  
 Modulator Frequency Drift Over a  
 Temperature Change

<u>Ambient Temp. (°C)</u>	<u>Plate Volts</u>	<u>Plate Amps</u>	<u>Frequency* (CPS)</u>	<u>Frequency Change (CPS)</u>
50	400	85	1051	
30	400	84	1049	-2
10	400	82	1051	+2
-10	400	82	1056	+5
-30	400	81	1062	+6

<u>Temp. Change (°C)</u>	<u>Modulation Frequency Change CPS per 20°C</u>	<u>Percent Change per 1°C</u>
50 - 30	2	0.0095
30 - 10	2	0.0095
10 - -10	5	0.0238
-10 - -30	6	0.0285

<u>Temp. Change (°C)</u>	<u>Modulation Frequency Change CPS Total</u>	<u>Percent Change Total</u>
50 - -30	11	1.045

\* Frequency measured when it had stabilized at the given temperature.

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Table 14

Model XBZ(YN) Radio Transmitting Equipment  
 Serial No. 2  
 Modulator Frequency Change During Battery Discharge

<u>Time in Operation</u>	<u>Plate Voltage</u>	<u>Battery Voltage</u>	<u>Modulator Frequency (CPS)</u>
0	373	5.55	1050
1	362	5.47	1020
2	352	5.40	1019
3	346	5.28	1021
4	340	5.18	1021
5	308	5.05	1018
6	300	4.60	1015
6.75	165	3.2	1016
7	123	2.75	1014
7.05	----	----	No output

Assuming the first reading to be false.

<u>Maximum Percentage Variation</u>	<u>Total Percentage Variation</u>
0.588	0.588

Table 15

Model XBZ(YN) Radio Transmitting Equipment  
 Serial No. 2  
 Frequency Drift During Cycle of Intermittent Operation

Cycle: 1 1/2 min. on, 1 1/2 min. off

<u>Ambient Temperature (°C)</u>	<u>Frequency Change During Cycle - (KC)</u>	<u>Percentage Change During Cycle</u>
50	15	0.0062
35	25	0.0104
20	35	0.0146
0	55	0.0230

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Table 16

Model XBZ(YN) Radio Transmitting Equipment  
 Efficiency of Vibrator Pack  
 Electronic Laboratories, Inc. Type 606B Vibrator Type 495

<u>Switch Position</u>	<u>Input (Volts)</u>	<u>Input (Amps.)</u>	<u>Input (Watts)</u>	<u>Output (Milliamps)</u>	<u>Output (Volts)</u>	<u>Output (Watts)</u>	<u>Efficiency (%)</u>
1	5.95	19.6	116.8	200	319	63.8	54.6
1	5.98	18.1	108.2	180	329	59.2	54.6
1	6.00	16.8	100.8	160	340	54.4	54.0
1	6.01	15.2	91.5	140	351	49.1	53.6
1	6.02	14.0	84.4	120	364	43.6	51.7
1	6.02	12.5	75.6	100	376	37.6	48.4
1	6.06	11.1	67.3	80	386	30.85	45.8
1	6.10	9.9	60.4	60	398	23.6	39.1
1	6.12	8.4	51.4	40	410	16.4	31.9
2	5.91	22	130.5	200	362	72.4	55.6
2	5.95	20	119.0	180	377	67.3	57.0
2	5.98	18.6	111.2	160	389	62.3	56.0
2	6.00	17.0	102.0	140	400	56.0	54.9
2	6.03	15.3	92.4	120	413	49.6	53.7
2	6.06	13.6	82.5	100	428	42.8	51.9
2	6.08	12.1	73.5	80	441	35.3	48.0
2	6.01	10.3	62.9	60	455	27.3	43.4
3	5.89	24.4	143.8	200	401	80.2	55.7
4	5.81	28.6	166.0	200	459	91.8	55.2

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Table 17

Model XBZ(YN) Radio Transmitting Equipment  
 High Temperature Run on Timer  
 Wallace and Tiernan Mech. No. FU 924  
 Serial No. WP 10742

<u>Time</u>	<u>Rel. Hum. (%)</u>	<u>Ambient Temp. (°C)</u>	<u>Counter for Filament Contacts</u>	<u>Counter for Plate Contacts</u>
0845	27	59.0	148	97
0900	25	59.0	151	100
0915	23	59.0	153	102
0930	23	59.5	156	105
0945	20	60.0	158	107
1000	20	61.0	161	110
1015	19	62.0	163	112
1030	17	62.0	166	115
1045	16	60.0	168	117
1100	16	61.0	171	120
1115	17	60.0	173	122
1130	17	61.0	176	125
1145	17	60.0	178	127
1200	15	60.0	181	130
1215	16	59.5	183	132
1230	16	60.0	186	135
1245	16	60.0	188	137
1300	16	61.0	191	140
1315	17	60.0	193	142
1330	17	60.0	196	145
1345	16	60.0	198	147
1400	16	60.0	201	150
1415	16	61.0	203	152
1430	16	61.0	206	155
1445	16	60.0	208	157
1500	16	61.0	211	160
1515	16	60.0	213	162
1530	17	61.0	215	164
1545	17	60.0	218	167
1600	17	60.0	220	169
1615	17	61.0	223	172

Average time for revolution of cams 6 minutes.  
 Cams were cut for 2 minutes on 4 minutes off.

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Table 18

Model XBZ(YN) Radio Transmitting Equipment  
 Low Temperature Run on Timer  
 Wallace and Tiernan Mech. No. FU 924  
 Serial No. WP 10742

<u>Time</u>	<u>Ambient Temp.</u>	<u>Counter for Filament Contacts</u>	<u>Counter for Plate Contacts</u>
0845	2	223	172
0900	0	225	174
0915	0	228	177
0930	0	230	179
0945	0	233	182
1000	0	235	184
1015	-10.5	238	187
1030	-10.0	240	189
1045	-10.5	243	192
1100	-10	245	194
1115	-10	248	197
1130	-20	250	199
1145	-20	253	202
1200	-20.5	255	204
1215	-20	258	207
1230	-20	260	209
1245	-30	263	212
1300	-30	265	214
1315	-30	268	217
1330	-30	270	219
1345	-31	273	222
1400	-30	275	224
1415	-30	277	226
1430	-29	280	229
1445	-30	282	231
1500	-31	285	234
1515	-31	287	236
1530	-30	289	238
1545	-30	292	241

Average time for revolution of cams 6.08 minutes.  
 Cams were cut for 2 minutes on 4 minutes off.

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Table 19

Model XBZ(YN) Radio Transmitting Equipment  
 Humidity Run on Timer  
 Wallace and Tiernan Mech No. FU 924  
 Serial No. WP 10742

<u>Time</u>	<u>Rel. Hum. (%)</u>	<u>Ambient Temp. (°C)</u>	<u>Counter for Filament Contacts</u>	<u>Counter for Plate Contacts</u>
0830	29	39.5		
0900	29	39.0	73	11
0930	96	40.0		
1000	96	40.0		
1030	97	39.5	94	32
1100	29	40.5	99	37
1130	27	40.0	104	42
1200	27	39.5	109	47
1230	26.5	40.0		
1300	96	40.0		
1330	96	39.5		
1400	96	39.0		
1430	30	40.0		
1500	33	40.5		
1530			143	81
1600			148	86

Average time for revolution of cams 6 minutes.  
 The cams were cut for 2 minutes on 4 minutes off.

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Table 20

Model XBZ(YN) Radio Transmitting Equipment  
 Accuracy of Timer  
 Wallace and Tiernan Mech. No. FU 924  
 Serial No. WP 10742

<u>Time Setting</u>	<u>Time Error</u>	<u>Percentage Error</u>	<u>Remarks</u>
96:00	-00:12	-0.21	1st setting of gov
96:00	-00:27	-0.47	
48:00	-00:13	-0.45	
24:00	-00:06	-0.42	
48:00	-00:21	-0.73	2nd setting of gov
24:00	-00:10	-0.70	
24:00	-00:11	-0.76	
24:00	-00:08	-0.56	
48:00	-00:15	+0.52	3rd setting of gov
48:00	+00:36	+1.25	
24:00	-00:13	-0.90	
24:00	+00:01	+0.07	
96:00	-00:55	-0.96	4th setting of gov
72:00	-00:01	-0.02	
48:00	-00:21	-0.73	
24:00	-00:12	-0.83	
24:00	+00:01	+0.07	
96:00	+01:03	+1.09	Settings were changed after each reading.
48:00	+00:21	+0.73	
48:00	+00:16	+0.56	
24:00	-00:23	-1.60	
24:00	-00:10	-0.70	
24:00	+00:08	+0.56	
24:00	+00:07	+0.49	
24:00	+00:06	+0.42	
24:00	+00:06	+0.42	
24:00	+00:15	+1.04	13th setting of gov
24:00	+00:20	+1.39	

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Table 21

Model XBZ(YN) Radio Transmitting Equipment  
 Adjustment of Cams to Six Minutes  
 Wallace and Tiernan Mech. No. FU 924  
 Serial No. WP 10742

A stop watch was used to determine the time for one revolution.

<u>Reading</u>	<u>Time for One Revolution</u>
1	5:58.96
2	5:59.30
3	5:58.42
4	5:57.92
5	5:59.25
6	5:58.51
7	5:58.55
Average Time	5:58.7

The governor screw was given a half turn to increase the time for one revolution.

<u>Reading</u>	<u>Time for One Revolution</u>
1	6:00.29
2	6:00.29
3	6:00.36
4	6:00.24
5	6:00.38
6	5:59.79
7	6:00.78
8	6:00.92
9	6:00.50
Average Time	6:00.39

One half a turn of the governor screw changes the time for one revolution of the cam about 1.7 seconds.

In 96 hours one half turn of the governor screw changes the time approximately 27.2 minutes.



Table 22

Model XBZ(YN) Radio Transmitting Equipment  
 Serial No. 2  
 Measurements of Period of Free Oscillation of Buoy

Four Foot Stabilizer Rod Attached

<u>Time in Seconds</u>	<u>No. of Oscillations</u>
9.4	
9.2	3
9.6	3
9.4	3
9.2	3
9.6	3
9.4	3
9.2	3
	<u>3</u>
Totals 75.0	27

Average Time = 3.1 seconds

Six Foot Stabilizer Rod Attached

<u>Time in Seconds</u>	<u>No. of Oscillations</u>
10.2	
6.7	3
6.6	2
6.7	2
10.3	2
6.7	3
6.9	2
6.8	2
6.8	2
	<u>2</u>
Totals 67.7	20

Average Time = 3.4 seconds

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Table 23

Model XBZ(YN) Radio Transmitting Equipment  
 Life Test of Battery  
 Willard Storage Battery Co. Radio Type 102-6

Battery (Amps)	Battery (Volts)	Specific Gravity	Time Operating	Battery (Watts)	Percent Decrease
14.6	6.2	1285	0	90.5	0
14.3	6.2	----	1	88.7	2.0
14.1	6.2	----	2	87.4	3.5
13.7	6.1	----	3	83.5	7.7
13.1	6.0	----	4	78.6	13.1
12.8	5.8	1150	5	74.3	17.9
12.1	5.5	1125	6	66.5	27.1

XBZ Serial No. 2 was used as a load for the battery and was adjusted to give normal operating conditions at the start of the test.

Total ampere-hour drain over 6 hours -- 81.9 ampere hours.

Table 24

Model XBZ(YN) Radio Transmitting Equipment  
 Test for Watertightness

With the equipment completely assembled for operation on land, the watertightness was determined by installing a pressure gauge unit on the drum cover and pumping air into the buoy until a pressure of 5 pounds was reached. This pressure did not decrease materially over a period of an hour so it may be safely assumed that the drum is completely watertight. It may also be assumed that there are no leaks in the gas removal system.

A similar test was made on the anchor line support buoy.

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Table 25

Model XBZ(YN) Radio Transmitting Equipment  
 Serial No. 2  
 Humidity Run Test

<u>Time</u>	<u>Temp. (°C)</u>	<u>Rel. Hum. (%)</u>	<u>Frequency (Mc)</u>	<u>Frequency Change (KC)</u>
1030	39	34		
1045	39	34	245.610	0
1100	40	33	245.610	0
1115	39	32	245.610	0
1130	39	32	245.610	0
1145	39	97	245.590	-20
1200	39	95	245.570	-20
1215	39	95	245.550	-20
1230	39	95	245.530	-20
1245	39	96	245.530	0
1305	39	36	245.530	0
1315	39	34	245.530	0
1345	39	31	245.510	-20
1400	40	30	245.550	+40
1415	40	30	245.570	+20
1430	37	97	245.610	+40
1445	39	98	245.590	-20
1500	39	95	245.550	-40
1515	39	95	245.530	-20
1530	39	95	245.530	0
1545	39	95	245.510	-20
1600	39	94	245.530	+20
			245.550	+20

Maximum Frequency Change 100 KC  
 Maximum Percentage Frequency Change 0.04%

Note: The buoy was assembled for land operation but was checked for gastightness and watertightness.

Table 26

Model XBZ(YN) Radio Transmitting Equipment  
Serial No. 2  
Dimensions and Weights

Unit	Height (In.)	Width (In.)	Depth (In.)	Weight (Lbs.)
Equipment complete for land operation.	41	23 1/4(dia.)		100
Antenna	19 1/4	23 1/4	23 1/4	2
Drum	24 7/8	23 1/4(dia.)		31
Transmitter Unit	7 1/2	9 1/4	11 3/4	7
Vibrator Pack	6 1/4	7	8	15 3/4
Timer	9 1/8	14	6	4
Battery	9 7/8	8 7/8	7	39 1/2
Water-trap bottle, tubing and air dryer				3/4
Equipment complete for sea operation - shallow water (less anchor line)	157 1/2	23 1/4(dia.)		148 1/4
Anchor	29	14 1/4	14 1/4	15
Stabilizer	52	4 3/8		30 1/2
Anchor line				5 1/4
				100 foot section plus two sockets
Equipment complete for sea operation - deep water (less anchor line)	157 1/2	23 1/4(dia.)		186
Stabilizer	52	4 3/8(dia.)		30 1/2
Anchor	29	14 1/4	14 1/4	15
Anchor-line support buoy and stabilizer	66 1/2	21(dia.)		38
Anchor line				5 1/4
				100 foot section plus two sockets

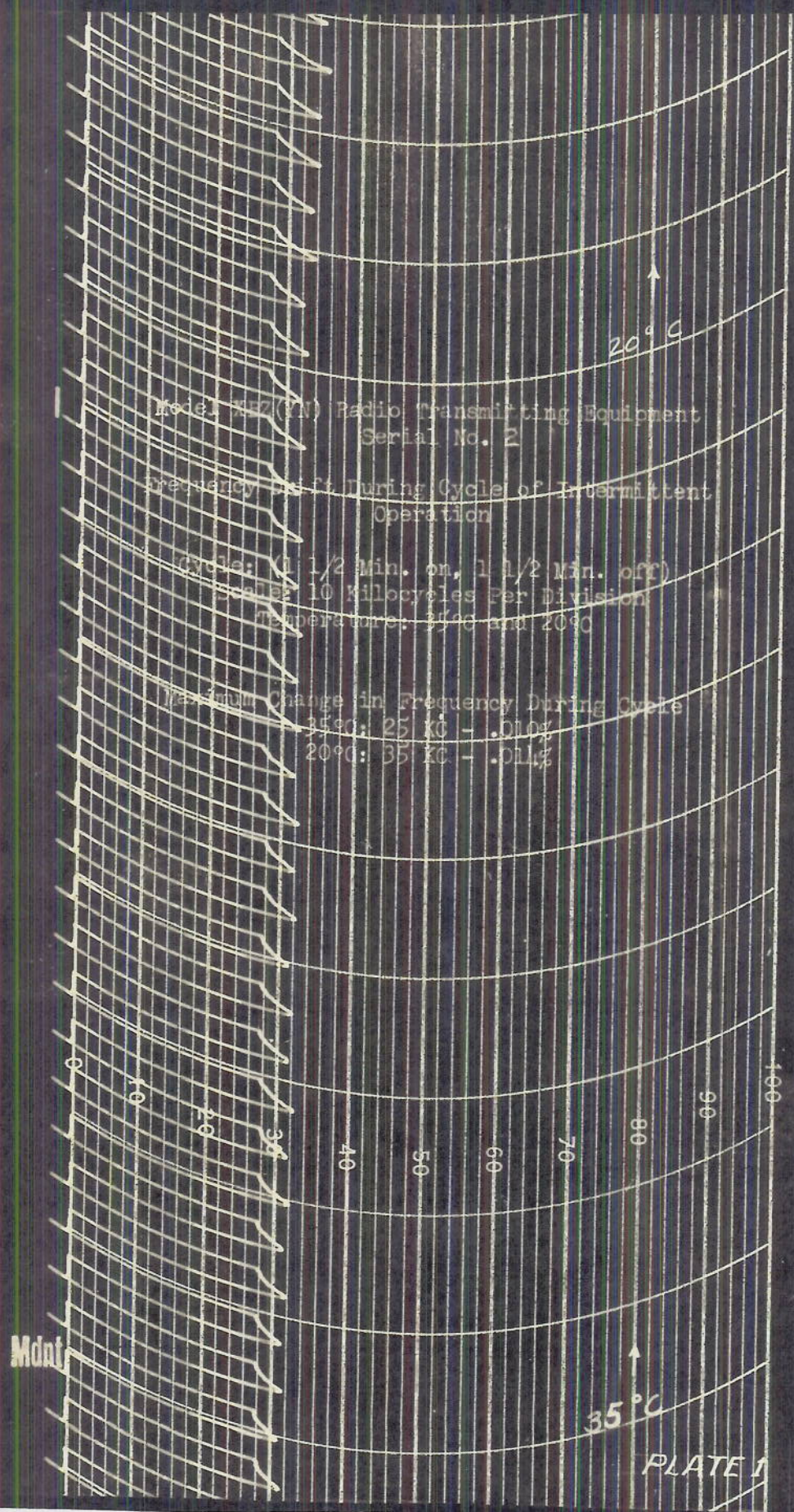
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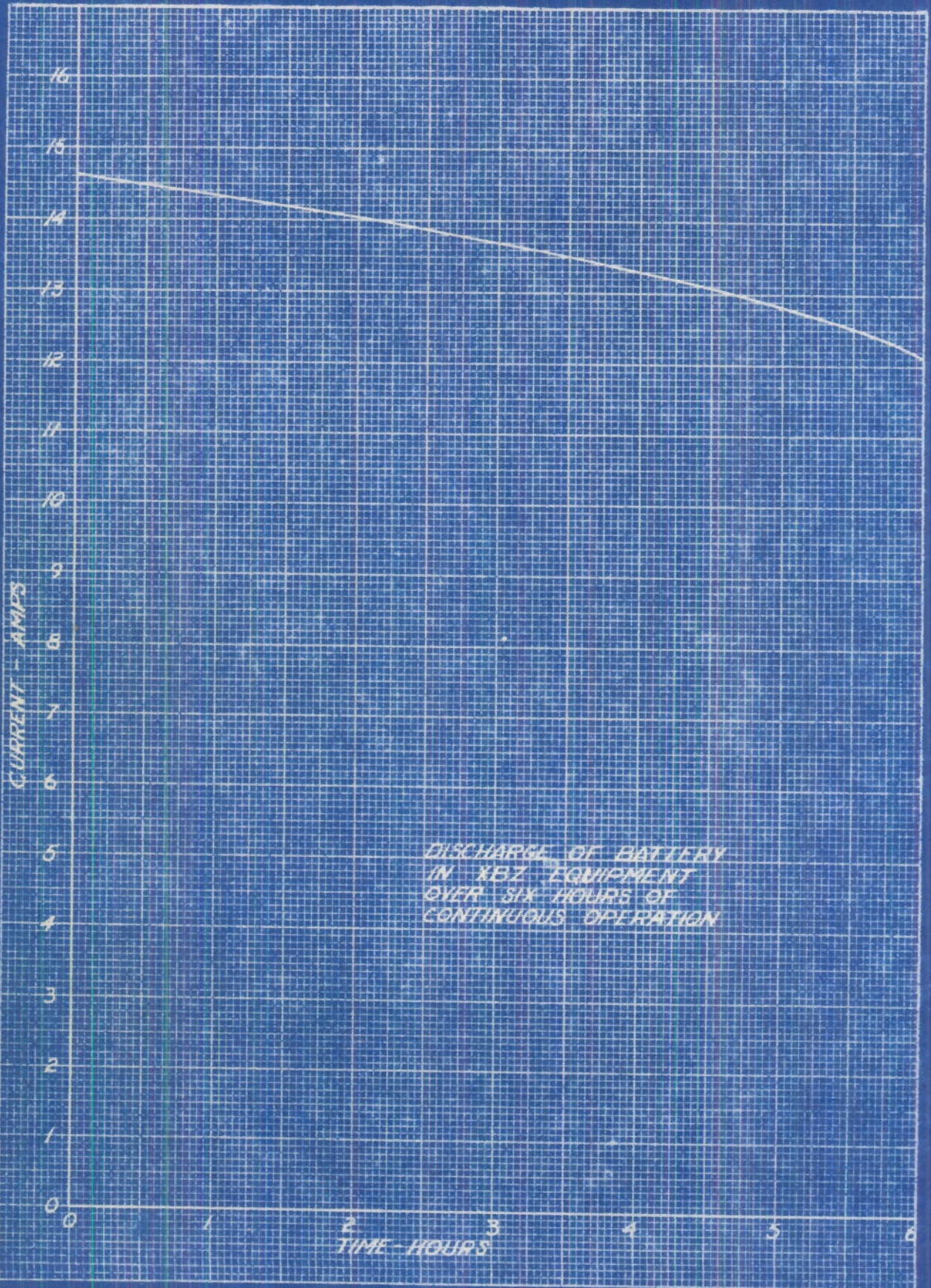
(Cont'd)

Table 26 (Cont'd)

<u>Unit</u>	<u>Height (In.)</u>	<u>Width (In.)</u>	<u>Depth (In.)</u>	<u>Weight (Lbs.)</u>
Auxiliary Test Equipment Consists of the Following:				
Type CRV-60028 VHF Frequency Meter (a unit of Model YL Equipment)	6 5/8	18 1/4	18 5/8	14 1/2
Test Meter Unit	3 3/4	11 1/4	3 3/4	3 1/4
Pressure-Gauge Unit	8 1/2	4 3/4	1 3/4	1 1/4
Air Pump	23 1/2	8	2 3/4	3 1/4

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