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Report on

Re-Test of Model XTAJ-6 Radio Transmitting Equipment

by

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BELLEVUE, D. C.

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NAVY DEPARTMENT

BUREAU OF ENGINEERING

Report on

Re-Test of Model XTAJ-6 Radio Transmitting Equipment.

(Contractor: General Electric Co.)

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D.C.

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Authorization: BuEng.ltr. C-NOs-47390(1-7-W8) of 18 Jan. 1937.

Date of Tests: March 8 to April 9, 1937 (main report)
April 7 to

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Additional test conducted from April 7 to April 9 inclusive.

AUTHORIZATION OF TEST

1. The tests herein reported were authorized by reference (a). Other pertinent data are listed as references (b) to (h), inclusive.

Reference: (a) BuEng. ltr. C-NOs-47390 (1-7-W8) of 18 Jan. 1937.
(b) BuEng. Specifications RE 13A 328J.
(c) NRL Report No. R-1328, 8 December 1936.
(d) GE Co. Memorandum of Dec. 31, 1936.
(e) GE Co. ltr. XRS-41482 of Dec. 17, 1936.
(f) INM Schenectady ltr. C-47390(53) of 12 Mar. 1937.
(g) Re-test data on Model XTAJ-6 Equipment.
(h) Contract NOs-47390 of 28 February 1936.

OBJECT OF TEST

2. The object of the tests was to determine the efficacy of the changes incorporated by the Contractor in the preliminary Model XTAJ-6 equipment in order to correct the defects disclosed by the original tests, as detailed in reference (c), and to determine whether the modified equipment complied with the terms of the governing contract.

ABSTRACT OF TEST

3. Tests were conducted to determine the degree of compliance with the mechanical and electrical requirements as set forth in references (b) and (h), with special emphasis on those aspects of operation and construction which had previously failed to meet the contractural requirements.

4. Specifically, tests were conducted to determine the following:

(a) Check of mechanical or physical construction and assembly; general workmanship, materials used and adequacy of electrical circuits to withstand operation under Naval service conditions.

(b) Power output.

(c) Quality of emitted signals.

(d) Determination of frequency overlap and cycles per division of marking of master oscillator tuning control.

(e) Check to determine ease of adjustment and flexibility of the various circuits.

(f) Check of protective circuits.

(g) Determination of percentage modulation, MCW power output and frequency of audio modulation.

(h) Frequency stability and accuracy under the following conditions:

(1) Accuracy of reset.
(2) Lost motion, backlash and torque lash.
(3) Operation of Adjust-Tune-Operate control.
(4) Detuning of circuits.
(5) Operation of power output control.
(6) Change of tubes.
(7) Variation of supply line voltage.
(8) Variation in ambient temperature.
(9) Variations in humidity.
(10) Locked key operation for two hours, CW & MCW.
(11) Key locked to intermittently keyed condition.
(12) Continuously keyed to intermittently keyed condition.
(13) Vibration.
(14) Shock.

(i) Determination of keying characteristics.

5. In general, tests were conducted at two frequencies within the range of the equipment, namely, 200 and 600 kilocycles. However, where conditions warranted, a greater number of points in the frequency range were investigated.

CONCLUSIONS

(a) A number of changes have been made in the re-submitted Model XTAJ-6 transmitting equipment which have resulted in greatly improved performance characteristics. Notably, the equipment lends itself readily to straight-forward tuning adjustments and the tendency of the frequency to drift for long periods of time which marred the performance of the original model has been eliminated.

(b) Side shields and tube access door have been perforated permitting a view of the interior of the transmitter unit. The frequency stability characteristics of the transmitter have been improved to the point where specification requirements are complied with, with the exception of the effects of humidity.

(c) Power output is substantially the same as in the original model and this output is obtainable without causing tubes to be worked to the point of adversely affecting filament emission. Standard 38161 tubes as well as the newer type of Tantalum anode tubes worked equally well in the power amplifier circuit.

(d) As a result of the modifications incorporated into the original model certain points have arisen which require correction in the re-submitted model. A number of the defects which were disclosed during the original tests have not been remedied in the re-submitted model, the Bureau of Engineering and the Contractor agreeing that these changes would be made in the production models only.

(e) The re-submitted equipment still fails to comply with the general requirement that safe and satisfactory operation under conditions encountered in the naval service be assured. This condition results from the fact that vibration causes tube and screen grid lamp failures. Certain factors, of lesser importance also require correction. Briefly, these consist of noisy relay operation, lack of symmetry in connection with certain controls, unsatisfactory overload protection and weakness in meter design. In view of the above, it must be concluded that the re-submitted XTAJ-6 equipment requires further modification and correction before it can be considered suitable for use in the Naval Service.

RECOMMENDATIONS

It is recommended:

(a) That the use of 10 watt lamps as screen grid resistors be disapproved. (See par. 31.)

(b) That the modified form of interlock switch provided on the antenna band change switch be approved. (Par. 34).

(c) That the panel carrying the filament rheostat, bias field rheostat, plate field rheostat and tube life meter be re-arranged in the interest of symmetry. Equidistant spacing of the above mentioned items items will provide the desired effect. (Par. 35).

(d) That the bias field rheostats, to be furnished in production models, possess a satisfactory range of adjustment. (Par. 36).

(e) That the overload protective circuits be further modified. (Par. 40).

(f) That the tube protective relay (5-second drop out) be considered satisfactory with respect to the timing adjustment. (Par. 41).

(g) That the new design of overload reset device be approved. (Par. 42).

(h) That the perforation of tube access door and side shields be approved. (Par. 43).

(i) That the P.A. choke coil as supplied in the re-submitted model be approved. (Par. 44).

(j) That the operating characteristics of the XTAJ-6 equipment, in so far as the factor of tube emission is concerned, be approved. (Par. 45).

(k) That the Model XTAJ-6 equipment, in its present status, be considered as failing to meet the specification requirement that "safe and satisfactory performance are assured. (Par. 46).

(l) That the mounting pedestal as furnished with the re-submitted model be approved. (Par. 47).

(m) That the design of the equipment be so modified as to prevent the failure of any part when the equipment is subjected to severe vibration. (Par. 48).

(n) That the sample type of door latch submitted be approved; that the elimination of the backing strip from the lower compartment doors be approved. (Par. 49).

(o) That the Master Oscillator dial control be approved. (Par. 51).

(p) That the improved design of flexible coupling as supplied on the antenna variometer control be approved, and that the use of Allen type set

screws be approved. (Par. 52).

(q) That the indicator lamps, using frosted color caps, as furnished with the re-submitted model, be approved. (Par. 56).

(r) That the frequency stability of the equipment with respect to variations in applied voltages be approved. (Par. 57).

(s) That the frequency stability of the equipment, when subjected to variations in ambient temperature, be approved. (Par. 58).

(t) That greater frequency stability be required from the equipment when subjected to variations in relative humidity. (Par. 59).

(u) That the frequency stability of the equipment with respect to 2-hour locked key operation be approved. (Par. 60).

(v) That the frequency stability of the equipment with respect to change from key locked to intermittently keyed condition be approved. (Par.61).

(w) That the frequency stability of the equipment with respect to change from continuously keyed to intermittently keyed condition, be approved. (Par. 62).

(x) That approval of the frequency stability of the equipment with respect to inclined operation be withheld pending such time as the transmitter can be subjected to the necessary tests. (Par. 63).

(y) That approval of the frequency stability of the equipment with respect to operation when subjected to vibration be withheld pending such time as the transmitter will function successfully when subjected to vibration. (Par. 64).

(z) That the frequency stability of the equipment, when subjected to shock, be approved, but that steps be taken to insure that all meters supplied will successfully withstand shock (Par. 65).

(aa) That the modification of the filament circuits, as incorporated in the re-submitted model, be approved. (Par. 66).

(bb) That the method provided in the re-submitted model to prevent key open oscillations in the master oscillator circuit be approved. (Par. 67).

(cc) That the overlap characteristics of the re-submitted model be approved. (Par. 68).

(dd) That the improvements incorporated in the re-submitted model to facilitate tuning adjustments, including the positioning of the IPA and PA plate ammeters in the high potential side of the circuits be approved. (Par. 69).

(ee) That the modified tuning control marker as submitted by the contractor be approved. (Par. 70).

(ff) That the dial locking mechanism on the master oscillator control

be improved to provide more securing locking action with less effect upon frequency. (Par. 71).

(gg) That the modified method of securing the shield securing studs be approved and that proper precautions be taken to insure that all studs be of sufficient length to permit removal of lower shield sections without the necessity of removing the upper shield sections. (Par. 75).

(hh) That an improved type of "Remote-Local" switch be provided. (Par. 76).

(ii) That the magnetic interlock on the automatic controller be approved. (Par. 78).

(jj) That the modified key relay furnished with the re-submitted model be approved but that the marking of the remote control circuits on the terminal panel of the transmitter unit be modified to conform with standard practise as illustrated on Navy Drawing RE 43AA 216E. (Par. 81).

(kk) That proper steps be taken to insure quiet operation of audio drop out relay (RL-6) and 5-second drop out relay (RL-3). (Par. 84).

(ll) That the Intermediate Amplifier plate current meter be changed from 0 to 300 milliampere range to 0 to 200 milliampere range. (Par. 85).

(mm) That the terminal board in the bottom compartment of the transmitter unit be made more accessible. (Par. 86).

(nn) That an improved method of mounting the test key and "Remote-Local" switch be provided to improve the appearance of these elements. (Par. 97).

(oo) That the re-submitted preliminary Model XTAJ-6 equipment, in its present form, be considered unsatisfactory for use in the Naval Service and that formal acceptance be held in abeyance until the Contractor has demonstrated that all deficient items have been corrected in a manner meeting the approval of the Bureau of Engineering.

MATERIAL UNDER TEST

6. The material under test consisted of one preliminary model XTAJ-6 transmitting equipment, as modified by the contractor, complete with motor generator equipment designed to operate from a 440 volt, 3 phase line supply. The equipment was manufactured by the General Electric Company, Schenectady, New York, under contract NOs-47390. The transmitter is rated at a nominal output of 500 watts and covers the frequency range of 175 to 600 kilocycles. The equipment is capable of both CW and MCW emission.

7. The re-submitted model was received at the Naval Research Laboratory on March 8, 1937.

METHOD OF TEST

8. The equipment, when received, was carefully examined to determine whether adequate precautions had been observed in preparing the material for shipment and whether any damage had been incurred during the process of transportation.

9. The equipment was then wired up and placed into commission.

10. Power output measurements were made using dummy antennas of the characteristics outlined in the governing specifications, employing essentially non-inductive resistors and low loss capacitors. Resistors and capacitors of ample current carrying capacity were used in order to prevent overheating from influencing the results. A precision type radio frequency ammeter, connected in the ground side of the dummy antenna, was used for measuring the radio frequency current.

11. Frequency changes and drifts were checked by means of the Model DK frequency indicator, Serial No. 2, the transmitter being operated at full power output whenever the governing specifications required this type of operation.

12. Frequency range, overlap and kilocycles per division of dial marking were determined by means of a Model LD-3 Crystal Controlled Calibrator, Serial No. 2.

13. The transmitting equipment, including motor generator, were placed within a test chamber and subjected to variations in ambient temperature between the limits of -1° and plus 50° C. and variations in relative humidity between the limits of approximately 20% and 95%.

14. The percentage of modulation was determined by means of a Model OB audio analyzer.

15. A Model RAA Receiver was employed for determining the quality of emission.

16. The keying response of the transmitter was investigated by means of an automatic sender and a cathode ray oscillograph.

17. The ability of the equipment to withstand vibration was determined by mounting the entire equipment on a test stand capable of producing the necessary vibration.

18. Shock tests were conducted by subjecting the equipment to blows from a 20 pound weight suspended in the manner outlined in the governing specifications.

19. The operation of the equipment was checked with regular 38161 tubes in the amplifier stage, as well as with special Tantalum plate tubes.

20. All vacuum tubes employed during the tests were first checked to determine their emission and static characteristics to insure that they complied with Navy Tube Specifications.

DATA RECORDED

21. Complete data were recorded during all tests conducted and this information is appended hereto as Tables 1 to 29 and Plates 1 to 6, inclusive.

PROBABLE ERRORS IN RESULTS

22. Precautions were taken to minimize errors in the results obtained through the use of accurately calibrated instruments and by rechecking results when conditions warranted. Identical tests were conducted at different frequencies in order to determine the reliable average operation of the equipment.

23. The visual frequency indicating equipment employed is capable of measuring beat note frequencies to within one or two cycles.

24. Power output determinations are considered accurate to within plus or minus 5%.

25. All external meters employed in the measurements were of the precision type whose calibrations were verified previous to use to insure accuracy.

26. The measurement of modulation is considered accurate to within 5% at the levels involved.

RESULTS OF TESTS

27. The Model XTAJ-6 equipment was received in undamaged condition. Transportation from the plant of the Manufacturer to the Naval Research Laboratory was effected by means of motor truck express.

28. The wiring diagrams submitted and the test cables provided by the manufacturer permitted the ready commissioning of the equipment.

29. Since this report covers the re-test of the model XTAJ-6 equipment, specific comment is not made on each individual paragraph of specifications RE 13A 328J. In many respects the re-submitted model does not differ from the original model, which was covered in detail in NRL Report No. R-1328. Hence, comment will be made in connection with the items listed under the summary of defects contained in paragraph 165 of NRL Report No. R-1328 and under the list of "Recommendations" set forth on pages 2-b, 2-c, 2-d and 2-e of the above mentioned report. However, the tests conducted in connection with the re-submitted model have revealed certain additional items requiring consideration

and corrective action and these will be discussed in detail with appropriate references to the particular paragraph of the governing specifications concerned. In addition, it was necessary to determine whether the various modifications made in the re-submitted model had affected the frequency stability or other operating characteristics of the equipment which had been satisfactory previous to the time these modifications were made. Therefore, all the tests required under the terms of paragraphs 3-7-1 to 3-7-15, inclusive, of Specifications RE 13A 328J were again conducted in connection with the re-submitted model. The results of these tests are described in detail in the following paragraphs of this report.

30. The following paragraphs, Nos. 31 to 83, inclusive, contain a discussion of the various items listed in paragraph 165 of Report R-1328 and under the list of "Recommendations" contained in the above mentioned report. The method of correction, the results obtained and compliance or non-compliance with the governing specifications are indicated.

31. (Reference: Par. 165 (a) & Par. (a) of page 2-b).
Bureau of Engineering letter of 18 January 1937, Reference (a), authorized the continued use of 10 watt lamps as screen grid resistors provided that it was demonstrated in the re-submitted model that these lamps operated satisfactorily under the effects of vibration. The flexible mounting supporting these lamps has been modified by the manufacturer. During the vibration tests of the re-submitted model, in the course of which the equipment was subjected to vibration of varying frequencies and amplitudes for a total period of approximately two hours twelve (12) screen grid lamps failed. The majority of lamp failures consisted of filament breakages, although it is possible that a number of the lamps burned out due to vacuum tube failures. It must be concluded, therefore, that the use of 10 watt lamps as screen grid resistors in the re-submitted model XTAJ-6 is unsatisfactory and unsuitable for service requirements.

32. (Reference: Par. 165(b) & Par. (b) of page 2-b).
Reference (a) authorizes the use of the original type of voltmeter multiplier resistors.

33. (Reference: Par. 165(c) & Par. (c) of page 2-b).
No further galling of band change switches was noted in the re-submitted model and reference (a) authorized the use of the present type of switches provided that the modifications suggested by the contractor are incorporated into the production models.

34. (Reference: Par. 165(d) and Par. (d) of page 2-b).
A modified form of interlock switch has been provided on the antenna band change switch which provides some degree of wiping or self-cleaning action. It is believed that this switch will prove satisfactory for service use.

35. (Reference: Par. 165(e) & Par. (e) of page 2-b).
The master oscillator stand-by filament rheostat has been eliminated from the re-submitted model and the remaining filament rheostat operates at sufficient tension to preclude the possibility of accidental movement. With the elimination of the stand-by filament rheostat, steps should be taken to insure that the arrangement of the remaining filament rheostat, bias field rheostat, plate field rheostat and tube life meter are re-located in the production models to provide for a symmetrical and pleasing arrangement of

these controls. Equidistant spacing of the above mentioned controls will provide the desired effect. Plate No. 6 is a view of the front panel and illustrates the unsymmetrical appearance of the panel in question.

36. (Reference: Par. 165(f) and Par. (f) of page 2-b).
No change has been made in the bias field rheostat in the re-submitted model. Reference (a) authorized the manufacturer to make this change in the production models but did not require the change to be made in the re-submitted preliminary model.

37. (Reference: Par. 165(g) and Par. (g) of page 2-b).
No change has been made in the hinge pins since the contractor explained that the present hinge pins were of stainless steel but possessed some magnetic properties.

38. (Reference: Par. 165(i) and Par. (i) of page 2-b). The use of the present type of phenolic compounds is considered satisfactory.

39. (Reference: Par. 165(i) and Par. (i) of page 2-b).
Fuses used in circuits operating at potentials of 440 volts or less are of the renewable type in the re-submitted model and hence conform with the requirements of the governing specifications.

40. (Reference: Par. 165(j) and Par. (j) of page 2-b).
An additional overload relay has been provided for the protection of the master oscillator and intermediate amplifier tubes. The coil of this relay is connected in series with the mid-taps of the M.O. and I.P.A. filament windings. The relay may be adjusted to give adequate protection to the M.O. and I.P.A. tubes and this portion of the overload protective circuit is considered satisfactory. However, the original protective relay (RL-1) is connected into the circuit in the same manner as originally, i.e., the coil of the relay is in series with the negative lead of the 1500-3000 volt plate generator. Thus the plate and screen grid current of the I.P.A., P.A. and audio oscillator tubes, when the latter tube is in use, flows through the coil of this relay. Thus, it will be seen that the I.P.A. tube plate current flows through the coils of both overload relays. This condition is unnecessary and prevents making the most effective adjustment of the relay provided for the protection of the P.A. Tube. It is recommended that the P.A. overload relay (RL-1) be connected into the midtap of the P.A. filament transformer secondary and that the current rating of the coil be reduced somewhat to permit a more accurate adjustment of the relay. At present it is necessary to turn the adjustment to the extreme minimum position before the relay will trip when P.A. plate current is in the region of 500 milliamperes.

41. (Reference: Par. 165(k) and Par. (k) of page 2-b).
The tube protective relay (5 second drop out) is capable of accurate adjustment in the re-submitted model and this phase of its operation is considered to be satisfactory. (An unsatisfactory feature of this relay, namely, the noise produced during keying operations, is discussed in paragraph 84 below).

42. (Reference: Par. 165(l) and Par. (l) of page 2-b).
Both of the overload relays provided in the re-submitted model are equipped with satisfactory re-set devices of rugged design. They are considered satisfactory for service use.

43. (Reference: Par. 165(m) and Par. (m) of page 2-b). The tube access door of the re-submitted model has been provided with perforations through which the operation of the various tubes may be observed. In addition, the side and rear shields of the transmitter, as well as the top, have been perforated in a satisfactory manner.

44. (Reference: Par. 165(n) and Par. (n) of page 2-b). A redesigned choke coil has been incorporated in the Power Amplifier circuit. During locked key tests of two hours duration at frequencies of 200, 400 and 600 Kc. the maximum temperature rise in the plate choke was 29 degrees C. During the original tests of the XTAJ-6 equipment temperature rises as high as 86 degrees C. were noted in the plate choke. The present choke coil in the re-submitted model is considered satisfactory.

45. (Reference: Par. 165(o) and Par. (o) of page 2-c). During the tests of the re-submitted model XTAJ-6 equipment no signs of tube failure due to loss of emission were noted. The 38161 tubes provided by the contractor were fitted with Tantalum plates and one of these tubes was operated in the Power Amplifier circuit for a total of 59 hours without any noticeable loss in output. It was the intention, at the completion of tests, to re-check the emission and plate current characteristics of this tube to determine definitely whether any loss in operating characteristics had been suffered by the tube. Unfortunately, the grid structure of this tube carried away during the first vibration test, destroying the tube. During the tests it was noted that the Tantalum anode operated at a high temperature causing the plate to assume a bright red color. However, this type of operation did not appear to injure the tube. In order to check the operation of the transmitter with standard tubes, CWL-38161 tube, Serial No. 27462, was subjected to locked key tests for a total of 18-1/2 hours. No falling off in power output was noted during this test. Table No. 1, appended hereto, includes the data collected during this test. During tests to determine the power output of the Model XTAJ-6 transmitter, standard 38161 tubes were substituted for the Tantalum anode tube. No appreciable difference in operation or power output could be noted with the exception that the standard (molybdenum anode) tube operated at a lower temperature. It was the original intention to operate a standard 38161 tube in the power amplifier circuit for a period of approximately 30 hours (key locked). However, due to the vibrational difficulties encountered orders were issued to abandon all further tests and the locked key test was terminated after 18-1/2 hours time. Emission checks conducted previous to and after the 18-1/2 hour locked key test showed that tube CWL-38161, Serial No. 27462, had suffered no loss in emission. It is concluded therefore, that the Model XTAJ-6 equipment, based upon the operation noted during the rather restricted tests herein reported upon, has been improved to the point where locked key operation has no deleterious effects upon the characteristics of the vacuum tubes employed.

46. (Reference: Par. 165(p) and Par. (p) of page 2-c). The Model XTAJ-6 equipment fails to comply with the requirement that safe and satisfactory operation be assured since 38161, and 38160 tubes, as well as screen grid resistor lamps, failed repeatedly under the influence of vibration. This matter is discussed in detail in paragraph No. 48 below.

47. (Reference: Par. 165(q) and Par. (q) of page 2-c). The re-submitted XTAJ-6 is provided with a solid mounting pedestal of

adequate strength and satisfactory dimensions, consisting of four inch steel channels, suitably braced. Three angle plates or washers for 1/2" mounting bolts are welded on each channel.

48. Reference: Par. 165(r) and Par. (r) of page 2-c).

(a) Vibration tests were conducted to determine whether the re-submitted model complied with the requirements of paragraphs 2-20 and 3-7-14 of Specifications RE 13A 328J. The entire equipment was securely bolted to the test stand illustrated in Plates 22, 23 and 24 of reference (c), and subjected to vibration of varying degrees of frequency and amplitude.

(b) The first test was conducted at a frequency of 200 Kc. After the test had proceeded for approximately 10 minutes the plate overload relay operated and shut the equipment down. Investigation revealed that the entire grid structure of the Power Amplifier tube (Serial No. 16153) had carried away. This tube was replaced by Serial No. 16149 and the test again attempted. Both of the foregoing tubes are of the Tantalum anode type. After approximately 15 minutes vibration, during which period the plate overload relays operated spasmodically, the P.A. amplifier tube failed. In this instance the failure was caused by the filament striking the center support and at times a short circuit would occur between the filament and grid.

(c) During the period of time which caused the failure of the 2nd 38161 tube (Ser. 16149), the 38160 tube in the IPA circuit failed after approximately 20 minutes of vibration, due to the screen grid and plate structures short circuiting. The vibration actually caused the plate structure to move sufficiently until it came in contact with the screen grid element. A second 38160 tube was substituted in the IPA circuit. After approximately 45 minutes of vibration this tube also failed, for the same reason. During this period a number of screen grid resistor lamps also failed due to filament breakage.

(d) Tests were then halted in order to permit representatives of the contractor to examine the equipment and attempt modifications in the tube cradle mounting in order to eliminate the difficulties encountered. "Lord" mountings of various types were tried and limiting washers were applied to the mountings. The action of the tube cradle was modified to some extent, although a number of screen grid lamps failed during this process. The contractor had supplied four additional 38161 tubes, two of the Tantalum plate type and two of the carbon plate type. A Tantalum tube was inserted in the P.A. circuit and attempts were made to conduct the standard vibration test called for under par. 3-7-14. After 20 minutes of vibration the P.A. tube jumped out of the upper (filament end) socket and three screen grid lamps burned out or were broken by vibration. The tube was replaced in the socket and new screen grid lamps installed. After 10 minutes of vibration the tube again left its upper socket and one screen grid lamp failed. A retainer was then secured to the upper P.A. socket to prevent the tube from leaving the clips and the defective screen grid lamps was replaced.

(e) On the next attempt the equipment withstood vibration for a period of thirty minutes without any definite tube or screen grid lamps failures and the permanent set in frequency did not exceed the specification requirements.

(f) The following morning, April 2nd, 1937, attempts were made to conduct a vibration test at 600 kilocycles. Before vibration was applied to the equipment it was discovered that another screen grid lamp had failed. The lamp was replaced and the test started. Almost immediately the plate of the 38160 tube in the audio oscillator circuit carried away from its supports. Since no more spare 38160 tubes were available, the audio oscillator tube was removed from the transmitter. It was found, however, that a number of screen grid lamps had again failed and the plate overload relays opened almost instantly upon applying vibration. During this test, on April 2nd, a carbon anode tube, Ser. 16150, was used in the power amplifier stage.

(g) At this point orders were received to discontinue all tests. Up to this time the set had been subjected to a total of approximately two hours of vibration, although it was possible to complete only one thirty minute test. Failures to date consisted of the following:

3 - 38160 tubes
2 - 38161 tubes
12 - Screen Grid Lamps
4 - Ground strips from tube cradle to frame broken off.

In addition, it is likely that the internal structures of the remaining 38160 tubes have been affected. As a result of the above tests it must be concluded that the re-submitted Model XTAJ-6 equipment fails to meet the requirements of the governing specifications with respect to vibration.

49. (Reference: Par. 165(s) and Par. (s) of page 2-c).
The re-submitted model is still fitted with the same door latches furnished with the original model. However, the manufacturer has submitted, under separate cover, a sample door fitted with an improved type of door latch. This sample latch is rugged in design, is of good appearance, locks the door securely in place and such wear as may be expected to take place during the life of the equipment will automatically be compensated for by a spring tension arrangement. The latch is limited in its motion to an angle of 90 degrees and an arrow prominently marked on the knob indicates the position of the latch. The knob is of rectangular shape, affording a good grip. In general, the latch is of excellent design and construction and should prove to be entirely satisfactory under service conditions.

50. (Reference: Par. 165(t) and Par. (t) of page 2-c).
Reference (a) authorizes the use of the main nameplate as originally submitted.

51. (Reference: Par. 165(u) and Par. (u) of page 2-c).
The master oscillator dial on the re-submitted model has been adjusted so that the main and vernier markings line up suitably and the "spring" or "jump" effect previously noted when operating this dial has been eliminated. These characteristics of the master oscillator dial are now considered as satisfactory.

52. (Reference: Par. 165(v) and Par. (v) on page 2-c).
A sample design of an improved flexible coupling was supplied with the re-submitted model in connection with the antenna variometer control. The shaft collar is fastened to a flexible strip by peening collar shoulder over

strip through flatted hole in the strip. This coupling operated satisfactorily during the course of the tests reported herein. Two wrenches for the "Allen" type set screws used in the equipment have been provided. The wrenches are clipped to the frame of the transmitter in accessible places in a manner proof against vibration.

53. (Reference: Par. 165(w) and Par. (w) on page 2-c).
The various tube sockets in the re-submitted model have been marked to indicate the type of tube to be used in each socket.

54. (Reference: Par. 165(x) and Par. (x) on page 2-c).
No change has been made in the lifting devices to permit ready replacement of the rubber washers used to prevent rattling. The Contractor states that provision for ready replacement will be made in the production models.

55. (Reference: Par. 165(y) and Par. (y) on page 2-c).
No change has been made in the re-submitted model with respect to the finish of the shield securing screws. The contractor states that the shield securing screws used on the production models will be furnished with a dull finish to comply with the governing specifications.

56. (Reference: Par. 165(z) and Par. (z) on page 2-c).
The neon type indicator lamps have been eliminated from the re-submitted model and in their place the manufacturer has substituted indicator lamps of the style used in the Model TAQ-4 equipments. These lamps give satisfactory indications. The frosted type of color cap is to be preferred since it gives a more prominent indication, particularly when viewed from the side. "Power" on is indicated by a red signal, "Bias" is indicated by a green signal and "Plate" voltage is indicated by a red signal.

57. (Reference: Par. 165(aa) and Par. (aa) on page 2-c).
Variation of supply line voltage or variation of voltages applied to transmitter unit. Table No. 14 appended hereto illustrates the results of tests conducted at 200 and 600 kilocycles wherein the various voltages applied to the transmitter unit were varied independently and in unison from a value of 5% below normal to a value of 5% above normal. The frequency variations noted are less than those permitted by the governing specifications. Comparison with Table No. 17 of reference (c) reveals that the characteristics of the re-submitted model, in this respect, are superior to those of the original model. Table No. 15 appended hereto covers the results obtained during an additional test wherein the line supply voltage was varied between the limits of minus 5% to plus 5% in a time of one minute and additionally in a time of five minutes. Only negligible frequency changes resulted from such variations in supply voltage. It is concluded, therefore, that the re-submitted model XTAJ-6 complies with the provisions of paragraphs 3-7-7 and 6-3 of the governing specifications.

58. (Reference: Par. 165(bb) and Par. (aa) on page 2-c).
Variations in ambient temperature, Tables No. 16 and 17 and Plates No. 1 and 2, appended hereto, cover tests conducted to determine the effect of variations in ambient temperature between the limits of plus 51 degrees and minus 1 degree Centigrade. During these tests the relative humidity was maintained at a low value. Temperature changes were made in steps of 10 degrees. It will be noted that in all instances the frequency changes per degree change in ambient

temperature are less than that permitted by the governing specifications. Comparison with tables No. 19, 20, 21 and 22 of Reference (c) reveals that the operation of the re-submitted model has been greatly improved over that of the original model.

59. (Reference: Par. 165(cc) and Par. (aa) on page 2-c). Variations in humidity. Tables No. 18 and 19 and Plates No. 3 and 4 appended hereto, cover tests conducted to determine the effect of variations in humidity. During these tests the ambient temperature was held constant at 41 degrees Centigrade. It will be noted that at 200 Kc and 600 Kc the frequency changes noted were 0.066%, whereas the specifications permit a maximum frequency change of only 0.05%. At 200 Kc the decrease in power output during the test was 15.4% and at 600 Kc. 3.0%; specifications limit power output changes to 5%. This decrease in power output is mainly due to the falling off of the motor generator voltages rather than the effect of humidity upon the transmitter unit. Comparison with Tables No. 23 and 24 of reference (c) shows that the re-submitted model is less affected by humidity than was the original model. However, the re-submitted model fails to comply with the requirements of paragraph 3-7-9 of the governing specifications. Attention is invited to the fact that the range of humidity was somewhat greater than that specified in the governing specifications. A low value of 10% was reached during the tests, while the specifications call for a low value of 30%. Thus the tests conducted may be considered of a somewhat more strenuous nature than definitely called for by the governing specifications. The vertical dashed lines on plates No. 3 and 4 are so drawn as to embrace the frequency changes occurring between the limits of 30% relative humidity and the top value of 93%. Re-estimating the frequency changes encountered on this basis supplies the following information:

Plate 3.
Variation of frequency with humidity between 30% and 93%.
Maximum frequency variation; 200.585 to 200.463 Kc
Change in cycles - 122
Change in percent - 0.061%

Plate 4.
Variation of frequency with humidity between 30% and 93%.
Maximum variation in frequency; 600.712 to 600.382 Kc
Change in cycles - 330
Change in percent - 0.055

Thus it will be seen that altho the frequency change computed on this basis is somewhat less than that shown in Tables No. 18 and 19, the variations are still in excess of the specification requirements by a small margin.

60. (Reference: Par. 165(dd) and Par. (aa) on page 2-c). Tables No. 20, 21 and 22 cover two hour locked key tests conducted at 200, 400 and 600 Kc respectively. MCW transmission was employed during the test at 400 Kc. It will be noted that in all cases the specification requirements are complied with and that the results obtained are far superior to those obtained with the original model. No overheating of parts was noted that the undesirable drift which marred the operation of the original model is practically eliminated in the resubmitted model.

61. (Reference: Par. 165(ee) and Par. (aa) on page 2-c). Table No. 23 covers tests conducted to determine the frequency changes resulting from change from key locked to intermittently keyed condition. Tests were conducted at 200 and 600 Kc. The results of these tests indicate that the operation of the re-submitted model is greatly improved in this respect and complies with the specification requirements.

62. (Reference: Par. 165(ff) and Par. (aa) on page 2-c). Table No. 24 covers tests conducted to determine the frequency changes resulting from change from continuously keyed to intermittently keyed condition. Tests were conducted at 200 and 600 kc. The requirements of the governing specifications have been complied with and the re-submitted model shows a decided improvement over the original model in this respect.

63. (Reference: Par. 165(gg) and Par. (aa) on page 2-c). The effect of roll and pitch upon the re-submitted model was not determined due to the fact that orders were issued to discontinue all tests on account of the difficulties encountered during the vibration tests.

64. (Reference: Par. 165(hh) and Par. (aa) on page 2-c). Table No. 25 and Plate No. 5 cover the results of a vibration test conducted at a frequency of 200 Kc. As explained in paragraph 48 above, tube failures and the failure of screen grid lamps prevented the completion of tests. The maximum set in frequency noted at 200 Kc was 3 cycles or 0.0015%, whereas specifications permit a value of 0.005%. Reference to plate No. 5 reveals that at certain frequencies of vibration, notably 1500 R.P.M. or 25 cycles, the output frequency of the transmitter wavered over limits of approximately 40 cycles. Vibration frequencies of 900 R.P.M. and 1100 R.P.M. also affected the operation and most of the failures occurred while the frequency of vibration was either 15, 18 or 25 cycles, especially the latter.

65. (Reference: Par. 165(ii) and Par. (aa) on page 2-c). Table No. 26 covers the results of tests conducted at 200 and 600 Kc during which the transmitter was subjected to shocks in accordance with the procedure outlined in paragraph 3-7-15 of specifications RE 13A 328J. The changes in frequency noted fall within the limits prescribed by the governing specifications. When the equipment was subjected to the first shock, however, the antenna ammeter suffered a casualty. The meter parts are secured in the bakelite case by means of three screws spaced around the barrel-like portion of the case. The bakelite at these three points carried away permitting the meter works to drop into the transmitter. It is believed that this method of securing the meter in the case constitutes a weakness which should be remedied. Investigation revealed that meters constructed by other manufacturers have a greater factor of safety in this respect. The following table lists meters of various makes and indicates the width of material between the screw hole and the rear edge of the case.

Manufacturer	Thickness of material between screw hole and edge of case.
General Electric Company	0.085"
Weston Instrument Co.	0.1875"
Westinghouse Elec. & Mfg. Co.	0.1875"
Roller Smith Co.	0.125"

66. (Reference: Par. 165(jj) and Par. (bb) on page 2-d).
The filament circuits of the re-submitted model have been modified. The filament stand-by rheostat has been eliminated and in its place a fixed resistor of the proper value has been substituted. With a line voltage of 445 volts, the potential applied to the M.O. filament in the stand-by position was measured as 9.9 volts with a precision type meter. The voltmeter which was connected across the primary of the filament transformer in the original model has been eliminated and filament voltage adjustments are now governed by reference to a voltmeter connected across the secondary terminals of the filament transformer which supplies heating current for the power amplifier tube. It is believed that this modified arrangement is more satisfactory than the method employed in the original model. A check of the potentials applied to the various tubes with the filament voltmeter adjusted to 11 volts was made with the following results:

Filament voltmeter set at 11 volts
P.A. Ef - 10.85 volts
I.P.A. Ef - 9.95 volts
M.O. Ef - 9.85 volts
Audio Osc. Ef - 9.90 volts

67. (Reference: Par. 165(kk) and Par. (cc) on page 2-d).
The circuit arrangement of the re-submitted model has been so modified as to prevent oscillation of the master oscillator under key open conditions when the "Adjustment-Tune-Operate" switch is in the "Adjust" position. The modified arrangement is satisfactory and complies with the specification requirements.

68. (Reference: Par. 165(ll) and Par. (dd) on page 2-d).
The re-submitted model has been so modified that adequate overlap in all circuits of the transmitter is provided. This is illustrated in Table No.27 attached hereto. The percentage overlap varies between the limits of 3.1% and 6.0%. The overlap was calculated in accordance with the latest definition of the Bureau of Engineering as given in paragraph 103 of reference (c).

69. (Reference: Par. 165(mm) and Par. (ee) on page 2-d).
The re-submitted model has been so modified that tuning adjustments may be made with ease and greater facility than was the case with the original model. The I.P.A. and P.A. plate current meters are not connected in the high voltage side of the circuit and a well defined plate current dip is obtained at resonance. The almost constant drift which marred the performance of the original model has been practically eliminated in the re-submitted model. Undoubtedly the improved operation of the equipment when in the process of being tuned is partly attributable to improved choke coil and circuit design. The adjustment of the transmitter is now considered to be satisfactory.

70. (Reference: Par. 165(nn) and Par. (ff) on page 2-d).
The letters designating the tuning controls have not been increased in size on the re-submitted model. However, the contractor has submitted, under separate cover, a tuning control marker upon which the engraving is more conspicuous and of larger size. This modified type of tuning control marker is satisfactory.

71. (Reference: Par. 165(oo) and Par. (gg) of page 2-d).
Apparently no change has been made in the master oscillator dial lock on the re-submitted model. The friction caused by application of the lock is

insufficient and the dial may be rotated without any apparent resistance. The effect upon frequency of the dial lock is illustrated in Table No. 29 appended hereto. This table also illustrates the effect of the various dial locks operating on the other controls. It is believed that the variation in frequency caused by the application of the master oscillator dial lock can be minimized by a slight re-design of this lock. At present the lock tends to rotate the control slightly. The pressure should be applied perpendicular to the dial and any tendency to rotate the dial should be eliminated.

72. (Reference: Par. 165(pp) and Par.(hh) on page 2-d). No change has been made in the design of the adjustable positioning devices in the re-submitted model. The contractor states that a redesigned positioning device will be provided on the production models.

73. (Reference: Par. 165(qq) and Par. (ii) on page 2-d). All wiring in the re-submitted model was securely anchored and no trouble was encountered from broken connections, other than the failure of the grounding strips on the flexible tube cradle.

74. (Reference: Par. 165(rr) and Par. (jj) on page 2-d). As authorized by reference (a), transformer markings will be applied to the units furnished in the production equipment.

75. (Reference: Par. (165(ss) and Par. (kk) on page 2-d). The contractor has submitted samples of two improved methods of anchoring the shield securing studs. One method is for use in locations where the studs are secured into the angle frame members while the other method is to be employed for securing the shields in locations where gusset plates exist. The proposed methods are satisfactory. In this connection attention is invited to the fact that in the production equipment care should be exercised to provide securing studs of adequate length to permit the removal of the bottom section of shielding without the necessity of removing the top section of shielding.

76. (Reference: Par. 165(tt) and Par. (ll) on page 2-d). The resubmitted model has been equipped with a modified 2-position local-remote switch in place of the 3-position switch furnished with the original model. In the opinion of the Laboratory the modified local-remote switch is still unsatisfactory. The switch is of the lever operated anti-capacity type and a light accidental touch may cause it to be thrown from the "Local" to the "Remote" position. This occurred unwittingly several times during the course of the tests, preventing the starting of the equipment. Under service conditions, with changing personnel, the insecure operation of this switch would undoubtedly be a source of annoyance if not actual trouble. Hence, it is recommended that a more positive type of switch be provided in the production models.

77. (Reference: Pars. 165(uu), (vv), (ww), (xx) and Pars. (mm), (nn), (oo), (pp) on pages 2-d and 2-e. Reference (a) authorized the manufacturer to make the necessary changes covered by the above references but these changes were not required in the re-submitted model.

78. (Reference: Par. 165(yy) and Par. (qq) on page 2-e). During the course of the tests herein reported the magnetic interlock with which the automatic controller is supplied functioned successfully whenever the line voltage was removed.

79. (Reference: Par. 165(zz) and Par. (rr) on page 2-e). No changes were made in the motor generator equipment accompanying the re-submitted model. It is understood that these changes will be accomplished in the production equipments.

80. (Reference: (Par. 165(aaa) and Par. (ss) on page 2-e). The instruction books accompanying the re-submitted model were copies of the instructions accompanying the original model, with the exception of the wiring diagrams. Since the written text of the instruction books does not take cognizance of the various changes made in the re-submitted model they would not be satisfactory for use in connection with production models. The schematic diagram has been revised and is an improvement of the original diagram submitted.

81. (Reference: Par. 165(bbb) and Par. (tt) on page 2-e). A new design of keying relay has been incorporated in the re-submitted model. The keying circuit is now required to break only approximately 125 M.A., d.c., where formerly the key was required to break approximately 500 M.A. No trouble was experienced when employing an automatic sender and the keying relay operated satisfactorily and consistently over the range of 20 to 100 words per minute. Keying action was examined by means of a specially constructed circuit employing a cathode ray oscillograph. While the action of the keying and other remote control circuits is satisfactory, it is recommended that the manufacturer adhere to the standard method of marking the remote control terminals on the transmitter, as designated in BuEng Drawing RE 43AA 216E. In order to accomplish this, the numerical markings should be changed as indicated below:

Present Designation	Desired Designation
1	4
2	3
3	1
4	2

The following table lists the value of currents flowing in the various remote control circuits; the numerals enclosed in parentheses indicate the "standard" marking of the circuits, while the numerals not enclosed refer to the present marking in the re-submitted model XTAJ-6.

1 (4) - 87 M.A., a.c.
2 (3) - 277 M.A., a.c.
3 (1) - 277 M.A., a.c., and 123 M.A., d.c.
4 (2) - 123 M.A., d.c.

82. (Reference: Par. (uu) on page 2-e). Reference (a) indicated that gang operation of the range switches was not desired.

83. Certain characteristics of the transmitting equipment have been affected by the modifications incorporated in the re-submitted model. Such items as require correction are discussed in the following paragraphs, Nos. 84, 85 and 86. The parenthetical notations refer to the paragraphs of the governing specifications RE 13A 328J which cover the subjects in question.

84. (Par. 2-11). During keying operations it was noted that the audio time limit relay (RL-6) and the five second drop out relay (RL-3) were extremely noisy due to the intermittent action of the plungers and bellows. It is believed that the noise thus engendered is sufficient to interfere with the signalling systems in the radio rooms on board ship, such as buzzers, sounders or interphones. The effect of relay RL-6 could be eliminated, while the transmitter is adjusted for CW operation, by connecting the coil circuit of this relay through a pole on the CW-MCW switch. In order to obtain quiet operation of the five second drop out relay it appears that some modification of design or the application of buffers will be required. In this connection attention is invited to paragraph 5-25 of the governing specifications, which reads as follows: "All contactors, particularly those operated on A.C., shall be designed to operatedthroughout the service life with minimum production of noise due to chatter, hum or any other form of interference to reception of weak radio signals on Navy receiving equipment located within six feet of the transmitter. Attention is invited to the fact that a noise level which is not objectionable in a power plant or shop is decidedly objectionable where radio reception must be effected nearby".

85. (Par. 3-25). Due to the fact that the I.P.A. plate current meter is now connected in the high potential side of the circuit, the current passing through this meter is considerably less than was the case in the original model. The scale of the present meter is 0 to 300 M.A., while the maximum current noted during full power operation was approximately 75 M.A. It is recommended, therefore, that a 0 to 200 M.A. meter be substituted for the 0 to 300 M.A. range. This change will have the additional advantage of reducing the number of types of meters used, since the present M.O. and Audio Oscillator plate current meters are of the 0 to 200 M.A. range.

86. (Par. 3-35-3). Due to the addition of the M.O. - I.P.A. plate overload relay in the re-submitted model, the left hand portion of the terminal board is inaccessible from the front of the transmitter. This condition can be remedied by a rearrangement of the terminal connecting strips. It is recommended therefore that the contractor be required to improve the accessibility of the terminal board.

87. As mentioned in paragraph 29 above, it was necessary to determine whether the various modifications made in the re-submitted model had affected the frequency stability or operating characteristics of the equipment which had been satisfactory previous to the time these modifications were made. Tests of this nature are discussed in paragraphs 88 to 96 below.

88. (Par. 2-16). As outlined in Table No. 2 appended hereto, tests were conducted to determine the effect of short circuiting and open circuiting the antenna. No damage was incurred from these tests and in all instances a decided reduction in plate current in the power amplifier tube was noted when the antenna was misadjusted. The re-submitted model complies with the specification requirements of paragraph 2-16.

89. (Pars. 3-2-1 & 3-2-2). The power output of the resubmitted model determined with the results outlined in Tables No. 3, 4, 5 and 6. It will be noted that, in general, the power output is slightly less than that obtained with the original model. However, the specification requirements are complied with if a plus or minus 5% tolerance is applied to the accuracy of these

measurements. It will further be noted that in some instances the percentage of modulation when the transmitter was adjusted for MCW operation is somewhat less than the specification requirements. It was noted that small variations in power amplifier tuning had a decided effect upon the percentage of modulation. In general, it was possible to obtain values of modulation ranging between 90% and 100% by readjustment of the P.A. Tuning control with some small decrease in the power output.

90. (Par. 3-7-1). The accuracy of reset of the resubmitted model complies with the requirements of the governing specifications and is approximately the same as that obtained with the original model, as is illustrated in Table No. 7.

91. (Par. 3-7-2). The back-lash characteristics of the re-submitted model are superior to those of the original model. Reference to Table No. 8 reveals that the percent backlash is decidedly less than that required by the governing specifications.

92. (Par. 3-7-3). The effect upon frequency of the operation of the "Adjust-Tune-Operate" control is illustrated in Table No. 9. It will be noted that particularly at the high frequency end of the range somewhat greater variations in frequency are encountered than was the case with the original model. At 600 Kc the variation is slightly in excess of the specification requirements, however, this excess is of such minor proportions that it is recommended that the re-submitted model be approved in this respect.

93. (Par. 3-7-4). Table No. 10 illustrates the results of tests conducted at 200 and 600 Kc to determine the degree of frequency shift resulting from detuning circuits subsequent to the frequency establishing circuit. The largest shifts noted are essentially in agreement with the specification requirements.

94. (Par. 3-7-5). Table No. 11 outlines the results of tests conducted at 200 and 600 kc for the purpose of determining the frequency shift incident to the operation of the power output control, i.e., the plate motor generator field rheostat. The results obtained comply with the requirements of the specifications and are in very close agreement with the results obtained with the original model.

95. (Par. 3-7-6). Tables No. 12 and 13 cover tests conducted at 200 and 600 Kc respectively to determine the effect of changing vacuum tubes in the master oscillator, intermediate amplifier and power amplifier circuits. Comparison with the results obtained with the original model shows that the performance of the re-submitted model has been improved in this respect and the equipment complies with the requirements of the governing specifications.

96. (Par. 3-15). The variation of resonant frequency per division of dial marking of the master oscillator dial is illustrated in Table No. 28. The percentage per division of marking complies with the requirements of the governing specifications.

97. The local test key and the "Remote-Local" switch on the re-submitted model are secured to the panel by means of small plates applied over the front panel. This type of construction presents an unpleasing and unfinished appearance and steps should be taken to insure improvement of these

characteristics in the production models.

98. A summary of the defects noted and such items as fail to comply with the requirements of the governing specifications, together with such additional amendments as appear necessary to provide suitable operation for Naval use, are listed below. The numerals enclosed in parentheses refer to to the paragraph of this report under which these items are discussed in detail.

(a) (31) A total of 12 screen grid lamps failed during the course of vibration tests.

(b) (35) The panel carrying filament rheostat, bias field rheostat, plate field rheostat and tube life meter does not present a symmetrical appearance, now that the stand-by filament rheostat has been eliminated.

(c) (40) The modified overload protective system should be improved by connecting the P.A. overload relay coil in the mid-tap of the P.A. filament transformer secondary; the coil of this relay should be changed to permit adjustment at lower values of current.

(d) (46) Safe and satisfactory operation of the equipment is not assured, the greatest defect being the adverse influence of vibration.

(e) (48) Vibration causes vacuum tube and screen grid lamp failures.

(f) (59) Variations in humidity cause a greater frequency change than permitted by specifications.

(g) (65) Antenna ammeter carried away during shock test.

(h) (71) The locking device on the Master Oscillator dial is not sufficiently positive in action and tends to affect the frequency.

(i) (75) Proper precautions should be taken to insure that the shield securing studs are of sufficient length to permit removal of the bottom sections of shielding without the necessity of removing the top sections of the shields.

(j) (76) The "Remote-Local" switch provided on the re-submitted model is unsatisfactory.

(k) (81) The remote control circuit designations fail to comply with standard practise.

(l) (84) Audio drop-out relay (RL-6) and 5-second drop-out relay (RL-3) too noisy during keying operations.

(m) (85) PA plate current meter, range 0-300 MA should be replaced with meter of 0-200 MA range.

(n) (86) Left hand end of terminal board is inaccessible due to addition of MO-IPA plate overload relay.

(o) (97) Plates on test key and "Remote-Local" switch are unsightly.

CONCLUSIONS

99. A number of changes have been made in the re-submitted Model XTAJ-6 transmitting equipment which have resulted in greatly improved performance characteristics. Notably, the equipment lends itself readily to straight-forward tuning adjustments and the tendency of the frequency to drift for long periods of time which marred the performance of the original model has been eliminated.

100. Side shields and tube access door have been perforated permitting a view of the interior of the transmitter unit. The frequency stability characteristics of the transmitter have been improved to the point where specification requirements are complied with, with the exception of the effects of humidity.

101. Power output is substantially the same as in the original model and this output is obtainable without causing tubes to be worked to the point of adversely affecting filament emission. Standard 3816l tubes as well as the newer type of Tantalum anode tubes worked equally well in the power amplifier circuit.

102. As a result of the modifications incorporated into the original model certain points have arisen which require correction in the re-submitted model. A number of the defects which were disclosed during the original tests have not been remedied in the re-submitted model, the Bureau of Engineering and the Contractor agreeing that these changes would be made in the production models only.

103. The re-submitted equipment still fails to comply with the general requirement that safe and satisfactory operation under conditions encountered in the Naval Service be assured. This condition results from the fact that vibration causes tube and screen grid lamp failures. Certain factors, of lesser importance also require correction. Briefly, these consist of noisy relay operation, lack of symmetry in connection with certain controls, unsatisfactory overload protection and weakness in meter design. In view of the above, it must be concluded that the re-submitted XTAJ-6 equipment requires further modification and correction before it can be considered suitable for use in the Naval Service.

Table No. 1

Model XTAJ-6 Transmitting Equipment
Locked Key Test Using CWL-3816i Tube, Serial No. 27462, in
Power Amplifier Circuit.

Time	Frequency KC	M. O. Ip	I.P.A. Ip	P. A. Ip	P. A. Ep	Amb. °C	Ant. I	Watts Out	Line Volts
3-29-37									
0920	200.571	38	44	350	3000	22.0	6.43	421	440
0950	551	37	42	340	2920	20.5	6.27	400	442
1020	550	36	42	339	2890	21.0	6.20	393	440
1050	555	38	44	350	3000*	21.0	6.48	428	442
1120	560	38	44	350	2990	21.5	6.45	424	445
1150	565	38	44	350	3000*	22.0	6.48	428	443
1220	569	38	43	350	3000	22.0	6.48	428	443
1250	574	38	43	350	3000	24.0	6.48	428	440
1320	579	38	43	350	3000	24.0	6.46	426	436
1350	582	38	43	350	3000	24.5	6.46	426	442
1420	586	38	43	350	3000	25.0	6.46	426	442
1450	589	38	42	350	3000	25.0	6.43	421	440
1520	590	38	42	350	3000	26.0	6.42	420	440
1550	594	38	42	350	3000	27.0	6.41	420	436
1620	595	38	42	350	3000*	27.0	6.42	420	436
3-30-37									
0800	200.585	38	42	350	3000	25.5	6.41	420	430
0830	563	38	43	350	3000*	26.0	6.47	427	440
0900	563	38	43	350	3000*	27.0	6.44	423	432
0930	569	38	42	350	3000*	27.0	6.42	420	437
1000	573	38	42	349	3000	28.0	6.41	420	440
1030	579	38	42	349	3000	28.0	6.40	418	435
1100	582	38	42	350	3000*	28.0	6.43	422	440
1130	590	38	42	350	3000	28.0	6.42	420	438
1200	597	38	42	350	3000	26.5	6.42	420	440
1230	598	38	42	350	3000	27.0	6.42	420	440
1300	598	38	42	349	3000	27.0	6.38	415	436
1330	596	38	42	349	3000	27.5	6.36	414	431
1400	596	38	42	349	3000	26.5	6.37	415	433
1430	599	38	42	349	3000	26.5	6.38	415	437
1500	600	38	42	349	3000	27.0	6.39	418	439
1530	598	38	42	349	3000	28.5	6.39	418	440
1600	598	38	42	349	3000	29.0	6.37	415	432
1630	598	38	42	349	3000	28.5	6.35	412	430
3-31-37									
0800	200.574	38	42	349	3000	26.5	6.36	414	435
0830	550	38	43	350	3000*	27.0	6.41	420	440
0900	550	38	43	349	3000*	27.5	6.38	415	440
0930	557	38	43	349	3000	27.5	6.38	415	438
1000	561	38	43	349	3000	27.5	6.38	415	438
1030	565	38	43	349	3000	27.5	6.38	415	440
1100	570	38	43	349	3000	26.5	6.38	415	437

Note: * denotes that power amplifier plate voltage was readjusted.

Table No. 2

Model XTAJ-6 Transmitting Equipment.

ANTENNA SHORT CIRCUITED AND OPEN CIRCUITED

Test as per paragraph 2-16 of Specifications RE 13A 328J

Frequency Kc	Antenna	Plate Current
200	Normal	350 MA
200	Shorted	165
200	Open	155
600	Normal	350
600	Shorted	100
600	Open	120

No damage was incurred by any portion of the equipment.

For comparison see Table No. 1 of NRL Report No. R-1328.

TABLE No. 3

Model XTAJ-6 Transmitting Equipment

DETERMINATION OF POWER OUTPUT

Test as per paragraph 3-2-1 of Specifications RE 13A 328J.

Control or Meter	175 Kcs	300 Kcs	400 Kcs
A	1	3	5
B	193	853	602
C	1	4	5
D	30	34	74
E	1	4	5
F	33	16	72
G	5	3	3
H	6	12	14
I	29	64	17

	CW	MCW	CW	MCW	CW	MCW
MO Ip	36	36	41	41	46	45
IPA Ip	40	20	69	30	72	32
PA Ip	340	260	347	271	341	295
Ant I ext*	6.18	4.61	7.81	6.2	8.52	6.85
Ant I set	6.2	5.0	8.4	7.0	8.8	8.0
MO Ep	1310	1320	1320	1320	1320	1320
Eg	115	115	115	115	115	115
PA Ep	3000	3000	3000	3000	3000	3000
Ant Res	12.4	12.4	8.2	8.2	6.4	6.4
Ant.Cap	807	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
%MCW-CW Pr		55.5		63.0		63.6
%Modulation		85		69		67
Aud Osc Ip		140		140		139
Watts Out	475	264	500	315	365	296
Specification Requirements	475	238	475	238	460	230

Note: * denotes precision meter connected into circuit between base of dummy antenna resistor and ground.

For comparison see Table No. 3 of NRL Report R-1328.

TABLE NO. 4

Model XTAJ-6 Transmitting Equipment

DETERMINATION OF POWER OUTPUT

Test as per paragraph 3-2-1 of Specifications RS 13A 328J

Control or Meter	500 Kcs	600 Kcs
A	6	7
B	680	674
C	6	7
D	86	81
E	6	7
F	82	72
G	3	3
H	14	15
I	64	33

	CW	MCW	CW	MCW
MO Ip	46	46	47	46
IPA Ip	62	28	56	26
PA Ip	350	300	358	272
Ant I ext*	10.1	8.10	10.9	8.5
Ant I Set	10.5	9.0	11.5	9.2
MO Ep	1320	1320	1320	1320
Eg	115	115	115	115
PA Ep	3000	3000	3000	3000
Ant Res	4.5	4.5	3.74	3.74
Ant Cap	852	852	957	957
Watts Out	460	295	445	274
% MCW-CW Pr		64		61.6
% Modulation		64		73
Aud Osc Ip		140		142
Specification Requirements	460	230	445	223

Note: * denotes precision meter connected into circuit between base of dummy antenna resistor and ground.

For comparison see Table No. 4 of NRL Report R-1328.

TABLE NO. 5

Model XTAJ-6 Transmitting Equipment

DETERMINATION OF POWER OUTPUT

Test as per paragraph 3-2-2 of Specifications RE 13A 328J

Control or Meter	175 Kcs	200 Kcs	400 Kcs
A	1	1	4
B	193	700	820
C	1	1	4
D	22	74	95
E	1	1	4
F	33	73	88
G	5	5	3
H	3	6	13
I	36	35	58

	CW	MCW	CW	MCW	CW	MCW
MO Ip	36	36	37	37	44	43
IPA Ip	40	19	42	20	70	30
PA Ip	350	230	350	260	350	300
Ant I ext*	7.1	5.0	7.4	5.4	10.2	8.25
Ant I set	7.4	5.5	7.8	6.0	10.5	9.0
MO Ep	1320	1320	1330	1330	1320	1320
Eg	115	115	115	115	115	115
PA Ep	3000	3000	3000	3000	3000	3000
Ant Res	6.2	6.2	6.2	6.2	4.28	4.28
Ant Cap	600	600	600	600	903	903
Watts Out	312	155	338	181	444	292
% MCW-CW Pr		50		53.6		65.6
% Modulation		84		84		54
Aud Osc Ip		140		140		140
Specification Requirements	325	163	345	173	432	216

Note: * Denotes precision meter connected into circuit between base of dummy antenna resistor and ground.

For comparison see Table No. 5 of NRL Report No. R-1328.

TABLE NO. 6

Model XTAJ-6 Transmitting Equipment

DETERMINATION OF POWER OUTPUT

Test as per paragraph 3-2-2 of Specifications RE 13A 328J

Control or Meter	500 Kcs	600 Kcs
A	6	7
B	680	674
C	6	7
D	88	79
E	6	7
F	88	73
G	1	1
H	14	15
I	88	61

	CW	MCW	CW	MCW
MO Ip	46	46	46	45
IPA Ip	62	28	35	25
PA Ip	360	320	350	280
Ant I ext*	12.5	9.85	15.0	11.8
Ant I set	13.0	10.8	16.2	12.5
MO Ep	1320	1320	1320	1320
Eg	115	115	115	115
PA Ep	3000	3000	3000	3000
Ant Res	2.56	2.56	1.62	1.62
Ant Cap	1190	1190	1393	1393
Watts Out	400	249	365	216
% MCW-CW Pr		62		59.2
% Modulation		69		75
Aud Osc Ip		140		140
Specification Requirements	405	203	334	167

Note: *denotes precision meter connected into circuit between base of dummy antenna resistor and ground.

For comparison see Table No. 6 of NRL Report R-1328.

TABLE NO. 7

Model XTAJ-6 Transmitting Equipment

ACCURACY OF RESET TO PREVIOUSLY CALIBRATED FREQUENCIES

Test as per paragraph 3-7-1 of Specifications RE 13A 328J

Trial No.	Frequency Kc	Time Seconds	Deviation in Frequency Cycles	Percent
Original	200.600			
1	605	34	5	0.002
2	589	28	11	0.005
3	617	32	17	0.008
4	619	37	17	0.009
5	611	29	11	0.005
		Average:	13 cycles	0.006
Original	400.742			
1	730	38	12	0.003
2	728	31	14	0.003
3	765	30	23	0.006
4	763	27	21	0.005
5	767	31	25	0.006
		Average:	19 cycles	0.0046%
Original	600.405			
1	415	30	10	0.0017
2	458	26	53	0.009
3	460	30	55	0.009
4	428	34	23	0.004
5	450	31	45	0.007
		Average:	37 cycles	0.006

Permitted by Specifications:
Average: 0.01%
Maximum: 0.015%

For comparison see Table No. 10 in NRL Report No. R-1328.

TABLE NO. 8

Model ATAJ-6 Transmitting Equipment

TEST FOR LOST MOTION, BACK LASH AND TORQUE LASH

Test as per paragraph 3-7-2 of Specifications RE 13A 328J

Trial No.	Frequency when approached in Counter Clockwise Direction	Clockwise Direction	Back Lash Cycles	Back Lash Percent
1	200.631	200.617	14	0.007
2	638	613	25	0.012
3	638	610	28	0.014
4	632	603	29	0.014
5	640	613	27	0.013
		Average:	25	0.012
1	600.723	600.673	50	0.008
2	723	690	33	0.005
3	714	678	36	0.006
4	723	698	25	0.004
5	721	715	6	0.001
		Average:	30	0.005

Permitted by Specifications:
Average: 0.03%
Maximum: 0.06%

For Comparison see Table No. 11 of NRL Report No. R-1328.

TABLE NO. 9

Model XTAJ-6 Transmitting Equipment

OPERATION OF ADJUST-TUNE-OPERATE CONTROL

Test as per paragraph 3-7-3 of Specifications RE 13A 328J

Position 1 Adjust	Position 2 Tune	Position 3 Operate	Maximum Cycles	Frequency Change Percent
200.524	200.532	200.535	11	0.005
300.710	300.692	300.702	18	0.006
400.705	400.696	400.700	9	0.002
500.665	500.680	500.697	32	0.008
600.600	600.655	600.679	79	0.013*

Note: * denotes this point re-checked twice with similar results, measurements showing 70 and 71 cycles respectively.

Permitted by Specifications: 0.01%

For comparison see Table No. 12 of NRL Report No. R-1328.

TABLE NO. 10

Model XTAJ-6 Transmitting Equipment

DETUNING OF CIRCUITS

Test as per paragraph 3-7-4 of Specifications RE 13A 328J

Circuit Detuned	Frequency Kc	Change in Frequency Cycles	Percent
Normal	200.598		
IPA "D" cc	605	7	0.003
IPA "D" c	590	8	0.004
PA "F" cc	600	2	0.001
PA "F" c	598	0	-
Ant "I" cc	599	1	0.0005
Ant "I" c	595	3	0.0015
Normal	600.833		
IPA "D" cc	772	61	0.01
IPA "D" c	902	69	0.011
PA "F" cc	842	9	0.001
PA "F" c	832	1	0.0001
Ant "I" cc	831	2	0.0003
Ant "I" c	832	1	0.0001

Note: IPA "D" cc denotes circuit detuned in counter clockwise direction.
IPA "D" c denotes circuit detuned in clockwise direction.

Permitted by specifications: 0.01%

For comparison see Table No. 13 of NRL Report No. R-1328.

TABLE NO. 11

Model XTAJ-6 Transmitting Equipment

OPERATION OF POWER OUTPUT CONTROL

Test as per paragraph 3-7-5 of Specifications RE 13A 328J

Power Output Watts	Percent Power	Antenna Current	Plate Volts	Frequency Kc	Frequency Change Cycles	Frequency Change Percent
486	100	6.9	3000	200.601		
365	75	5.98	2670	601	0	-
243	50	4.87	2250	600	1	0.0005
122	25	3.46	1700	599	2	0.001
500	100	7.00	3000	600.733		
375	75	6.06	2670	730	3	0.0005
250	50	4.74	2180	720	13	0.002
125	25	3.90	1820	714	19	0.003

Antenna Constants: Resistance 10.2 ohms; Capacity - 970 uuf.

Permitted by Specifications: 0.005%

For comparison see Table No.14 of NRL Report No. R-1328.

TABLE NO. 12

Model XTAJ-6 Transmitting Equipment

CHANGE OF TUBES

Test as per paragraph 3-7-6 of Specifications RE 13A 328J

Tube No.	Frequency	Deviation from Mean Frequency Cycles	Percent
		Master Oscillator Circuit	
GE 365	200.505	13	0.006
GE 368	496	4	0.002
GE 369	505	13	0.006
GE 367	475	17	0.008
GE 696	480	25	0.012
Mean:	200.492	14	0.007
		Intermediate Amplifier Circuit	
GE 366	200.497	1	Negligible
GE 368	498	0	
GE 369	498	0	
GE 367	497	1	
GE 696	498	0	
Mean:	200.498	Negligible	Negligible
		Power Amplifier Circuit	
GE 16153	200.497		
GE 16149	498		
WE 26498	498		
Mean:	200.4977	Negligible	Negligible

Permitted by specifications:
Master Oscillator: 0.02%
Subsequent stages: 0.005%

For comparison see Table No. 15 of NRL Report No. R-1328

TABLE NO. 13

Model XTAJ-6 Transmitting Equipment

CHANGE OF TUBES

Test as per paragraph 3-7-6 of Specifications RE 13A 328J

Tube No.	Frequency	Deviation from Mean Frequency Cycles	Percent
	Master Oscillator Circuit		
GE 365	600.613	29	0.0048
GE 367	557	27	0.0045
GE 368	595	11	0.0018
GE 369	641	57	0.0095
GE 696	514	99	0.0165
Mean:	600.584	45	0.0075
	Intermediate Amplifier Circuit		
GE 366	600.635	14	0.0023
GE 696	658	9	0.0015
GE 367	650	1	-
GE 368	655	6	0.001
GE 369	645	4	0.0006
Mean:	600.649	7	0.001
	Power Amplifier Circuit		
GE 16149	600.645	1	
GE 16153	645	1	
WE 26498	648	2	
Mean:	600.646	1.3	Negligible

Permitted by specifications:
Master Oscillator: 0.02%
Subsequent Stages: 0.005%

For comparison see Table No. 16 of NRL Report No. R-1328

TABLE NO.14

Model XTAJ-6 Transmitting Equipment

VARIATION OF VOLTAGE APPLIED TO TRANSMITTER UNIT

Test as per paragraph 3-7-7 of Specifications RE 13A 328J

Frequency Kc	M.O. Ep	P.A. Ep	E fil	% Voltage Change	Frequency Change Cycles	Frequency Change Percent
200.603	1320	3000	11.0			
603	1320	3000	11.55	+5 Fil.	0	-
600	1320	3000	10.45	-5 Fil.	3	0.0015
603	1320	3150	11.0	+5 PA Ep	0	-
603	1320	2850	11.0	-5 PA Ep	0	-
603	1386	3000	11.0	+5 MO Ep	0	-
601	1253	3000	11.0	-5 MO Ep	2	0.001
606	1386	3150	11.55	+5 All	3	0.0015
600	1253	2850	10.45	-5 All	3	0.0015
600.600	1320	3000	11.0			
594	1320	3000	11.55	+5 Fil.	6	0.001
613	1320	3000	10.45	-5 Fil.	13	0.002
602	1320	3150	11.0	+5 PA Ep	2	0.0003
598	1320	2850	11.0	-5 PA Ep	2	0.0002
591	1386	3000	11.0	+5 MO Ep	9	0.0015
611	1253	3000	11.0	-5 MO Ep	11	0.002
583	1386	3150	11.55	+5 All	17	0.003
620	1253	2850	10.45	-5 All	20	0.003

Permitted by specifications: 0.01%

For comparison see Table No. 17 of NRL Report No. R-1328

TABLE NO.15

Model XTAJ-6 Transmitting Equipment

VARIATION OF LINE VOLTAGE

Test as per pars. 3-7(7) and 6-3 of Specifications RE 13A 328J

Line Volts	Fil. Volts	Bias Volts	M.O. Ep	P. A. Ep	Antenna Current	Frequency Kc	Change in Frequency Cycles	Change in Frequency %
418	10.4	114.5	1330	2995	6.88	200.599		
440	11.0	115.0	1335	3000	6.90	601		
462	11.6	115.5	1335	3000	6.92	604	5	0.0025
418	10.4	114.5	1315	2990	7.25	600.559		
440	11.0	115.0	1320	3000	7.30	557		
462	11.6	115.0	1320	3000	7.32	555	4	0.0006

Note: During the above test the line voltage was varied from 5% below to 5% above normal in a period of one minute.

418	10.4	114.5	1330	2995	6.88	200.599		
440	11.0	115.0	1335	3000	6.91	602		
462	11.6	115.5	1335	3000	6.92	605	6	0.003
418	10.4	114.0	1315	2990	7.25	600.554		
440	11.0	115.0	1320	3000	7.30	553		
462	11.6	115.0	1320	3000	7.31	550	4	0.0006

Note: During the above test the line voltage was varied from 5% below to 5% above normal in a period of five minutes.

No damage to parts resulted from variation of line voltage.

For comparison see Table No. 18 of NRL Report No. R-1328.

TABLE NO. 16

Model xTAJ-6 Transmitting Equipment

VARIATIONS IN AMBIENT TEMPERATURE

Test as per paragraph 3-7-8 of Specifications RE 13A 328J

Time	Ambient Temp °C	Frequency KC	P. A. Ip	I.P.A. Ip	M.O. Ip	Ant. I	Watts Out	Rel Hum	P. A. Ep	Line Volts
0830	51.5	200.390	332	40	36	6.69	457	6	2900	432
45	51.0	373	321	39	35	6.48	428	7	2830	432
0900	51.0	384	319	37	34	6.37	414	7	2800	428
15	51.0	389	309	36	34	6.23	396	7	2760	432
30	51.0	406	300	36	34	6.13	384	7	2750	428
0945	40.5	433	300	36	33	6.15	386	10	2750	424
1000	40.5	431	310	36	33	6.20	393	10	2750	426
15	40.5	432	311	36	33	6.23	396	10	2750	430
30	40.5	432	312	36	33	6.24	397	10	2750	425
45	40.5	431	319	36	33	6.26	400	10	2760	428
1100	30.0	447	320	36	33	6.30	404	9	2770	428
15	30.0	444	325	36	33	6.35	411	9	2780	424
30	30.0	440	328	36	33	6.38	417	9	2780	432
45	30.0	437	328	36	33	6.38	417	9	2780	430
1200	30.0	434	330	36	33	6.39	418	9	2790	430
1215	20.0	448	330	36	33	6.42	420	13	2800	440
30	20.0	453	332	36	33	6.43	421	13	2800	440
45	20.0	451	339	36	33	6.49	428	13	2810	437
1300	20.0	449	339	36	33	6.51	433	13	2820	436
15	20.0	446	340	36	33	6.52	434	13	2830	426
1330	12.0	455	340	36	33	6.55	437	17	2850	434
45	10.0	461	341	36	34	6.56	438	16	2870	432
1400	10.0	461	342	36	34	6.57	440	16	2880	425
15	10.0	459	345	37	34	6.60	444	16	2890	426
30	10.0	457	348	38	34	6.64	450	16	2900	432
1445	1.0	488	349	38	34	6.66	452	-	2900	432
1500	-2.0	495	349	39	35	6.70	457	-	2950	432
15	-2.0	483	350	39	35	6.71	458	-	2990	432
30	-1.0	505	353	40	35	6.80	472	-	3000	431
45	-1.0	503	354	40	35	6.84	477	-	3000	425

TABLE No.16 - Cont'd

SUMMARY

Temperature Degrees C	Cycles Change per 10 Deg.C.	Percent Change per 1 Deg. C
50 to 40	25	0.00125
40 to 30	3	0.00015
30 to 20	12	0.0006
20 to 10	11	0.00055
10 to-1	46	0.0021

Permitted by Specifications - 0.005%

For comparison see Tables No. 19 and 20 of NRL Report R-1328.

TABLE NO.17

Model XTAJ-6 Transmitting Equipment

VARIATIONS IN AMBIENT TEMPERATURE

Test as per paragraph 3-7-8 of Specifications RE 13A 328J

Time	Ambient Temp. °C	Frequency Kc	P. A. Ip	I.P.A. Ip	M.O. Ip	Ant. I	Watts Out	Rel Hum	P.A. Ep	Line Volts
0915	52.0	600.365	340	54	45	7.30	542	8	2970	426
30	51.0	328	325	50	44	7.05	507	8	2870	426
45	51.0	326	320	49	43	6.95	493	8	2820	428
1000	51.0	358	320	49	42	6.90	484	8	2810	428
15	51.0	407	315	48	42	6.87	481	8	2800	436
1030	41.0	490	315	47	42	6.84	477	10	2800	432
45	41.0	470	315	46	41	6.80	473	10	2790	432
1100	41.0	451	315	46	41	6.80	473	10	2790	430
15	41.0	447	315	46	41	6.80	473	10	2800	434
30	41.0	458	317	46	41	6.81	474	10	2800	436
1145	30.5	500	320	46	41	6.85	478	7	2810	436
1200	30.5	482	322	49	42	6.89	486	7	2830	442
15	30.5	482	323	49	42	6.92	490	7	2830	444
30	30.5	493	321	49	42	6.90	484	7	2820	436
45	30.5	496	323	49	42	6.91	487	7	2830	440
1300	22.0	522	325	49	42	6.93	491	12	2850	434
15	20.0	570	327	49	42	6.96	494	10	2870	432
30	20.0	587	330	49	43	7.00	500	10	2880	440
45	20.0	588	330	49	43	7.00	500	10	2890	436
1400	20.0	589	330	50	43	7.02	503	10	2900	436
1415	12.0	616	332	50	43	7.06	507	12	2900	432
30	10.0	640	337	50	44	7.11	516	10	2910	436
45	10.0	643	340	52	44	7.16	522	10	2920	436
1500	10.0	647	340	53	44	7.17	524	10	2950	435
15	10.0	645	340	56	45	7.22	532	10	2950	436
1530	2.5	789	340	56	45	7.21	530	-	2960	436
45	-1.0	800	342	56	45	7.22	532	-	2980	424
1600	-1.0	808	348	59	45	7.27	539	-	3000	425
15	-1.0	800	350	60	46	7.29	542	-	3000	425
30	-1.0	791	350	61	47	7.36	550	-	3040	428

TABLE NO. 17 (Cont'd)

SUMMARY

Temperature Degrees C	Cycles Change per 10 Deg. C.	Percent Change per 1 Deg. C.
50 to 40	51	0.00085
40 to 30	38	0.00063
30 to 20	93	0.00155
20 to 10	56	0.00093
10 to -1	146	0.00218

Permitted by Specifications - 0.005%

For comparison see Tables No. 21 and 22 of NRL Report R-1328.

TABLE NO. 18

Model XTAJ-6 Transmitting Equipment

VARIATIONS IN HUMIDITY

Test as per paragraph 3-7-9 of Specifications RE 13A 328J

Time	Ambient Temp. °C	RelHum. %	Frequency Kc	P.A. Ip	I.P.A. Ip	M.O. Ip	Ant. I	Watts Out	P.A. Ep	Line Volts
0830	41.0	10	200.565	346	41	37	6.90	485	3000	420
45	41.0	10	575	340	40	37	6.79	470	2950	424
0900	41.0	10	595	339	39	36	6.73	463	2900	432
15	41.0	58	569	331	39	36	6.68	455	2900	428
30	41.0	93	482	323	40	37	6.48	428	2890	436
45	41.0	93	477	320	40	36	6.47	426	2900	432
1000	41.0	93	470	320	40	36	6.43	422	2890	430
15	41.0	93	467	318	39	36	6.41	419	2880	432
30	41.0	93	463	312	39	35	6.43	410	2870	432
45	41.0	58	509	320	39	35	6.42	420	2870	426
1100	41.0	27	545	320	39	35	6.45	424	2870	428
15	41.0	20	572	321	39	35	6.48	428	2870	432
30	41.0	20	583	323	38	35	6.50	431	2870	434
45	41.0	14	598	326	38	35	6.52	434	2880	436
1200	41.0	14	610	326	38	35	6.50	431	2870	440

Greatest frequency variation noted during second and third tests from that prevailing at end of first test; 132 cycles; 0.066%.
Permitted by specifications 0.05%.
Decrease in power output during test: 15.4%
Permitted by specifications: 5.0%
Antenna Constants: Res. 1022 ohms; Cap. 970 mmfd

For comparison see Table No. 23 of NRL Report No. R-1328.

TABLE NO.19

Model XTAJ-6 Transmitting Equipment

VARIATIONS IN HUMIDITY

Test as per paragraph 3-7-9 of Specifications RE 13A 328J

Time	Ambient Temp °C	Rel.Hum. %	Frequency Kc	P.A. Ip	I.P.A. Ip	M.O. Ip	Ant. I	Watts Out	P.A. Ep	Line Volts
1230	41.0	10	600.762	346	52	45	7.44	565	3000	436
45	41.0	10	779	345	52	45	7.40	559	2990	434
1300	41.0	10	785	345	52	45	7.39	557	2990	434
15	41.0	60	689	340	52	45	7.38	556	2990	438
30	41.0	93	524	340	54	45	7.38	556	2990	432
45	41.0	93	434	340	53	45	7.33	548	2990	438
1400	41.0	93	420	340	53	45	7.33	548	2990	426
15	41.0	93	385	340	52	45	7.32	547	2990	434
30	41.0	93	389	340	53	45	7.32	547	2990	436
45	41.0	39	557	340	52	45	7.32	547	2980	426
1500	41.0	25	622	340	52	45	7.35	552	2980	434
15	41.0	23	657	340	52	45	7.31	546	2960	432
30	41.0	18	691	340	52	45	7.31	546	2970	420
45	41.0	14	724	340	52	45	7.35	552	2980	428
1600	41.0	13	753	340	52	45	7.35	552	2980	424

Greatest frequency variation noted during second and third tests from that prevailing at end of first test: 400 cycles; 0.066%.
Permitted by specifications 0.05%.
Decrease in power output during test: 3.0%
Permitted by specifications: 5%
Antenna Constants: Res. 10.2 ohms; Cap. 970 mmfd.

For comparison see Table No. 24 of NRL Report R-1328.

TABLE NO.20

Model XTAJ-6 Transmitting Equipment

LOCKED KEY OPERATION FOR TWO HOURS

Test as per paragraph 3-7-10 of Specifications RE 13A 328J

Time	Ambient Temp °C	Frequency KC	Cycles Change	% Change	Ant. Cur.	Watts Out	Plate Volts	P.A. Ip	M.O. Ip
13:10	(Filaments energized)								
15	27.8	200.747	-	-	6.90	485	3000	350	1325
20	27.9	741	6	0.003	6.85	478	3000	350	1320
25	28.0	735	12	0.006	6.80	472	2980	348	1310
30	27.9	733	14	0.007	6.80	472	2960	347	1305
35	28.0	730	17	0.008	6.75	465	2950	345	1300
40	27.8	730	17	0.008	6.75	465	2930	345	1300
45	28.0	729	18	0.009	6.70	457	2920	343	1295
50	28.0	728	19	0.009	6.65	451	2920	341	1295
55	28.0	727	20	0.01	6.65	451	2910	341	1295
14:00	28.1	727	20	0.01	6.65	451	2910	341	1295
05	28.2	727	20	0.01	6.65	451	2900	340	1290
10	28.3	727	20	0.01	6.65	451	2900	340	1290
15	28.3	724	23	0.011	6.62	447	2900	340	1282
20	28.8	724	23	0.011	6.60	444	2900	340	1282
25	28.8	724	23	0.011	6.60	444	2900	339	1280
30	28.8	724	23	0.011	6.60	444	2900	339	1280
35	28.8	726	21	0.01	6.60	444	2900	339	1280
40	28.9	727	20	0.01	6.60	444	2900	339	1280
45	28.9	729	18	0.009	6.60	444	2900	339	1280
50	28.7	730	17	0.008	6.60	444	2900	339	1280
55	28.7	731	16	0.008	6.60	444	2900	339	1280
15:00	28.5	731	16	0.008	6.55	438	2890	339	1277
05	28.2	733	14	0.007	6.55	438	2890	339	1277
10	28.0	736	11	0.005	6.55	438	2890	339	1277
15	27.6	736	11	0.005	6.55	438	2890	339	1277
		(Voltages readjusted to normal)							
16	27.6	736	11	0.005	6.80	472	3000	350	1325

Temperature of Antenna Coil: Start - 27.8; finish 44.0° C.
Temperature of P.A. Plate Choke: Start - 27.8: finish 56.5°C
Antenna Constants: Resistance - 10.2 ohms; Cap. - 960 mmf.

Frequency change during 1st five minutes: 6 cycles; 0.003%
Specification requirements: 0.015%
Frequency change during remainder of test: 17 cycles; 0.008%
Specification requirements: 0.03%

For comparison see Table No. 25 of NRL Report No. R-1328.

TABLE NO.21

Model XTAJ-6 Transmitting Equipment

LOCKED KEY OPERATION FOR TWO HOURS (MCW)

Test as per paragraph 3-7-10 of Specifications RE 13A 328J

Time	Amb. Temp.	Frequency KC	Cycles Change	% Change	Ant. Cur.	Watts Out	Plate Volts	P.A. Ip	Aud. Osc. Ip
13:30		(Filaments energized)							
35	25.0	400.800			5.90	355	3000	302	140
40	25.2	773	27	0.007	5.90	355	2980	300	138
45	25.3	758	42	0.010	5.85	349	2960	295	137
50	25.2	750	50	0.012	5.80	343	2940	292	136
55	25.4	745	55	0.014	5.75	338	2930	290	135
14:00	25.6	742	58	0.014	5.75	338	2920	290	135
05	25.5	738	62	0.015	5.70	331	2910	288	135
10	25.8	738	62	0.015	5.70	331	2910	288	135
15	25.8	738	62	0.015	5.70	331	2910	288	135
20	25.8	738	62	0.015	5.70	331	2900	287	135
25	25.9	736	64	0.016	5.70	331	2900	287	134
30	26.0	737	63	0.016	5.70	331	2900	285	134
35	25.8	737	63	0.016	5.65	326	2900	285	134
40	26.1	739	61	0.015	5.65	326	2900	285	134
45	25.9	741	59	0.015	5.65	326	2900	285	134
50	25.8	743	57	0.014	5.65	326	2900	285	134
55	25.8	745	55	0.014	5.65	326	2900	285	134
15:00	25.8	747	53	0.013	5.65	326	2900	285	134
05	25.7	749	51	0.013	5.65	326	2900	283	134
10	25.5	751	49	0.012	5.65	326	2890	282	133
15	25.7	754	46	0.011	5.65	326	2890	282	133
20	25.7	756	44	0.011	5.65	326	2890	282	133
25	25.7	758	42	0.010	5.65	326	2890	282	133
30	25.7	758	42	0.010	5.62	322	2890	281	133
35	25.5	760	40	0.010	5.60	320	2880	281	133
		(Voltages re-adjusted to normal)							
36	25.5	760	40	0.010	5.90	355	3000	295	140

Temperature of Antenna Coil: Start - 25.0; Finish 46.0°C
" " P.A. Choke : " 25.0 " 41.0
" " Audio Transf: " 25.0 " 70.0
Antenna Constants: Resistance - 10.2 ohms; Cap. - 960 mmf.

Frequency change during 1st five minutes: 27 cycles; 0.007%
Specification requirements : 0.015%
Frequency change during remainder of test: 37 cycles: 0.009%
Specification requirements : 0.03%

For comparison see Table No. 26 of NRL Report No. R-1328.

TABLE NO. 22

Model ATAJ-6 Transmitting Equipment

LOCKED KEY OPERATION FOR TWO HOURS

Test as per paragraph 3-7-10 of Specifications RE 13A 328J

Time	Ambient Temp °C	Frequency Kc	Cycles Change	% Change	Ant. Cur.	Watts Out	Plate Volts	P.A. Ip	M.O. Ep
14:20	(Filaments energized)								
25	27.0	600.882	-	-	7.00	500	3000	350	1310
30	26.0	833	49	0.0082	6.90	486	2970	348	1300
35	26.9	810	72	0.012	6.90	486	2950	346	1295
40	27.2	798	84	0.014	6.85	480	2930	345	1285
45	26.9	789	93	0.015	6.85	480	2920	345	1280
50	26.9	784	98	0.016	6.80	472	2900	343	1280
55	26.8	782	100	0.016	6.80	472	2900	341	1280
15:00	26.9	780	102	0.017	6.80	472	2900	340	1277
05	27.0	780	102	0.017	6.80	472	2900	340	1270
10	26.9	780	102	0.017	6.77	468	2900	340	1270
15	26.9	780	102	0.017	6.77	468	2890	340	1265
20	26.8	780	102	0.017	6.75	465	2890	340	1265
25	26.7	780	102	0.017	6.75	465	2890	340	1265
30	26.5	782	100	0.016	6.75	465	2890	340	1265
35*	-	-	-	-	-	-	-	-	-
40	26.7	800	82	0.014	6.65	450	2890	337	1265
45	25.5	790	92	0.015	6.65	450	2870	337	1265
50	25.6	790	92	0.015	6.65	450	2870	337	1260
55	25.9	791	91	0.015	6.65	450	2870	335	1258
16:00	26.1	792	90	0.015	6.65	450	2860	335	1255
05	26.3	795	87	0.015	6.65	450	2860	335	1255
10	26.0	797	85	0.014	6.65	450	2860	335	1255
15	26.2	799	83	0.014	6.65	450	2860	335	1250
20	26.2	798	84	0.014	6.65	450	2860	335	1250
25	26.0	799	83	0.014	6.65	450	2860	335	1250
	(Voltages re-adjusted to normal)								
26	26.0	785	97	0.016	7.10	509	3000	350	1320

Note: * denotes momentary line power failure.

Temperature of Antenna Coil : Start - 27.0; finish - 40.0°
Temperature of P.A. Plate Choke: Start - 27.0; finish - 51.0°
Antenna Constants: Resistance: 10.2 ohms; Cap. 960 mmf.

Frequency change during 1st five minutes: 49 cycles; 0.0082%
Specification requirements: 0.015%
Frequency change during remainder of test: 53 cycles; 0.0088%
Specification requirements: 0.03%

For comparison see Tables No. 27 and 28 of NRL Report R-1328.

TABLE NO. 23

Model ATAJ-6 Transmitting Equipment

CHANGE FROM KEY LOCKED TO INTERMITTENTLY KEYED CONDITION

Test as per paragraph 3-7-11 of Specifications RE 13A 328J

Test Condition	Frequency at end of 10 min key locked period (Kc)	Frequency at end of 10 sec dash 20 min later (kc)	Change in Frequency cycles	Change in Frequency percent
MO filament lighted	200.582	200.575	7	0.003
MO filament not lighted	200.573	200.598	23	0.011
MO filament lighted	600.616	600.633	17	0.003
MO filament not lighted	600.580	600.675	95	0.016

Permitted by Specifications:
Filament lighted: 0.015%
Filament not lighted: 0.03%

For comparison see Table No. 29 of NRL Report No. R-1328.

TABLE NO. 24

Model XTAJ-6 Transmitting Equipment

CHANGE FROM CONTINUOUSLY KEYED TO INTERMITTENTLY KEYED CONDITION

Test as per paragraph 3-7-12 of Specifications RE 13A 328J

Frequency at end of 30 minutes of continuous keying	Frequency at end of 10 sec. dash after 20 min pause	Change in Frequency Cycles	Percent
200.575	200.578	3	0.0015
600.518	600.529	11	0.002

Filaments remained energized during entire test.

Permitted by specifications: 0.015%

For comparison see Table No. 30 of NRL Report No. R-1328

TABLE NO. 25

Model XTAJ-6 Transmitting Equipment

VIBRATION

Test as per paragraph 3-7-14 of Specifications RE 13A 328J

Transmitter secured rigidly to Test Stand

Time	Frequency	
1515	200.283	Start
1520	280	
1525	295	
1530	297	
1535	275	
1540	275	
1545	275	
	280	Finish

Maximum set in frequency between beginning and end of test:
3 cycles
0.0015%

Permitted by specifications: 0.005%

TABLE NO. 26

Model ATAJ-6 Transmitting Equipment

SHOCK TEST

Test as per paragraph 3-7-15 of Specifications RE 13A 328J

Shock Applied to:	Frequency 1 Minute before shock	Frequency 2 Minutes after shock	Set in Frequency Cycles	Set in Frequency Percent
Front	200.615	200.604	11	0.0055
Left	620	619	1	0.0005
Right	599	602	3	0.0015
Back	631	625	6	0.0030
Front	600.670	600.700	30	0.0050
Left	555	565	10	0.0016
Right	612	615	3	0.0005
Back	565	546	19	0.0030

Specification Requirements: 0.005%

Note: On "Front" shock at 200 Kc (1st test) antenna ammeter broke out of case; was replaced with spare meter.

For comparison see Table No. 36 of Report R-1328.

TABLE No. 27

Model XTAJ-6 Transmitting Equipment

DETERMINATION OF OVERLAP

Test as per paragraph 3-11 of Specifications RE 13A 328J

Control

A	1	1	2	2	3	3	4	4	5	5	6	6	7	7
B	022	900	0	900	0	900	0	900	0	900	0	900	0	900
C	1	1	2	2	3	3	4	4	5	5	6	6	7	7
D	0	95	15	98	13	99	15	98	16	98	22	99	16	98
E	1	1	2	2	3	3	4	4	5	5	6	6	7	7
F	16	75	6	91	1	82	1	88	4	80	12	93	1	100
G	5	5	5	5	5	4	3	5	5	6	5	5	5	5
H	6	9	9	11	11	12	12	13	13	14	14	14	14	15
I	58	86	57	69	47	94	73	64	57	47	45	79	74	45

Freq.Kcs.	168.7	209.67	202.7	253.2	242.0	303.5	289.8	361.9	350.6	437.9	424.4	529.27	510.58	637.33
Overlap Kc.	6.28		7.0		11.2		13.7		11.3		13.5		18.69	37.33
Mean Freq.	171.86		206.18		247.6		296.6		356.2		431.1		519.9	
% Overlap	3.96		3.4		4.5		4.6		3.2		3.1		3.6	6.0

Measurements made with LD-4 Crystal Controlled Calibrator Serial No. 2

For comparison see Tables 37, 38 and 39 of NRL Report R-1328.

TABLE NO. 28

Model XTAJ-6 Transmitting Equipment

VARIATION OF RESONANT FREQUENCY OF MASTER OSCILLATOR PER DIVISION OF DIAL MARKING.

Test as per paragraph 3-15 of Specifications RE 13A 328J

Control "A"	Control "B"	Frequency Kcs	Divisions Change	KC per Division	Per Cent per Division
1	000	166.84			
1	193	175.00	193	0.042	0.024
1	714	200.00	521	0.048	0.024
2	461.0	225.00			
2	833.0	250.00	372	0.067	0.027
3	538	275.00			
3	838	300.00	300	0.083	0.028
4	503	325.00			
4	763	350.00	260	0.096	0.027
5	310	375.00			
5	565	400.00	255	0.098	0.025
5	776	425.00	211	0.118	0.027
6	277.	450.00			
6	497.5	475.00	220.5	0.113	0.028
6	683	500.00	185.5	0.135	0.027
6	849	525.00	166	0.150	0.029
7	343	550.00			
7	522	575.00	179	0.140	0.024
7	676.5	600.00	154.5	0.162	0.027
7	816	625.00	139.5	0.179	0.029
7	900	637.93	84	0.094	0.015

Specification Requirements: Not more than 0.03% or less than 0.015% per division of marking.

Measurements made with LD-3 Crystal Controlled Calibrator, Ser.No.2

For comparison see Table No. 41 of NRL Report No. R-1328.

TABLE NO.29

Model XTAJ-6 Transmitting Equipment

CHANGE IN FREQUENCY DUE TO OPERATION OF DIAL LOCKING DEVICES

Test as per paragraph 3-16 of Specifications RE 13A 328J

Control	Frequency Not locked	Frequency Locked	Change in Frequency Cycles	Change in Frequency Percent
MO "B" cc	200.490	200.478	12	0.006
MO "B" c	498	488	10	0.005
IPA "D" cc	491	491	0	
IPA "D" c	490	490	0	
PA "F" cc	490	490	0	
PA "F" c	490	490	0	
Ant "1" cc	489	489	0	
Ant "1" c	488	488	0	
MO "B" cc	600.575	600.568	7	0.001
MO "B" c	568	559	9	0.0015
IPA "D" cc	556	557	1	
IPA "D" c	545	547	2	
PA "F" cc	548	547	1	
PA "F" c	547	547	0	
Ant "1" cc	547	547	0	
Ant "1" c	546	546	0	

Note: MO "B" cc denotes that dial setting had been approached in counter clockwise direction before applying dial lock.

MO "B" c denotes that dial setting had been approached in clockwise direction before applying dial lock.

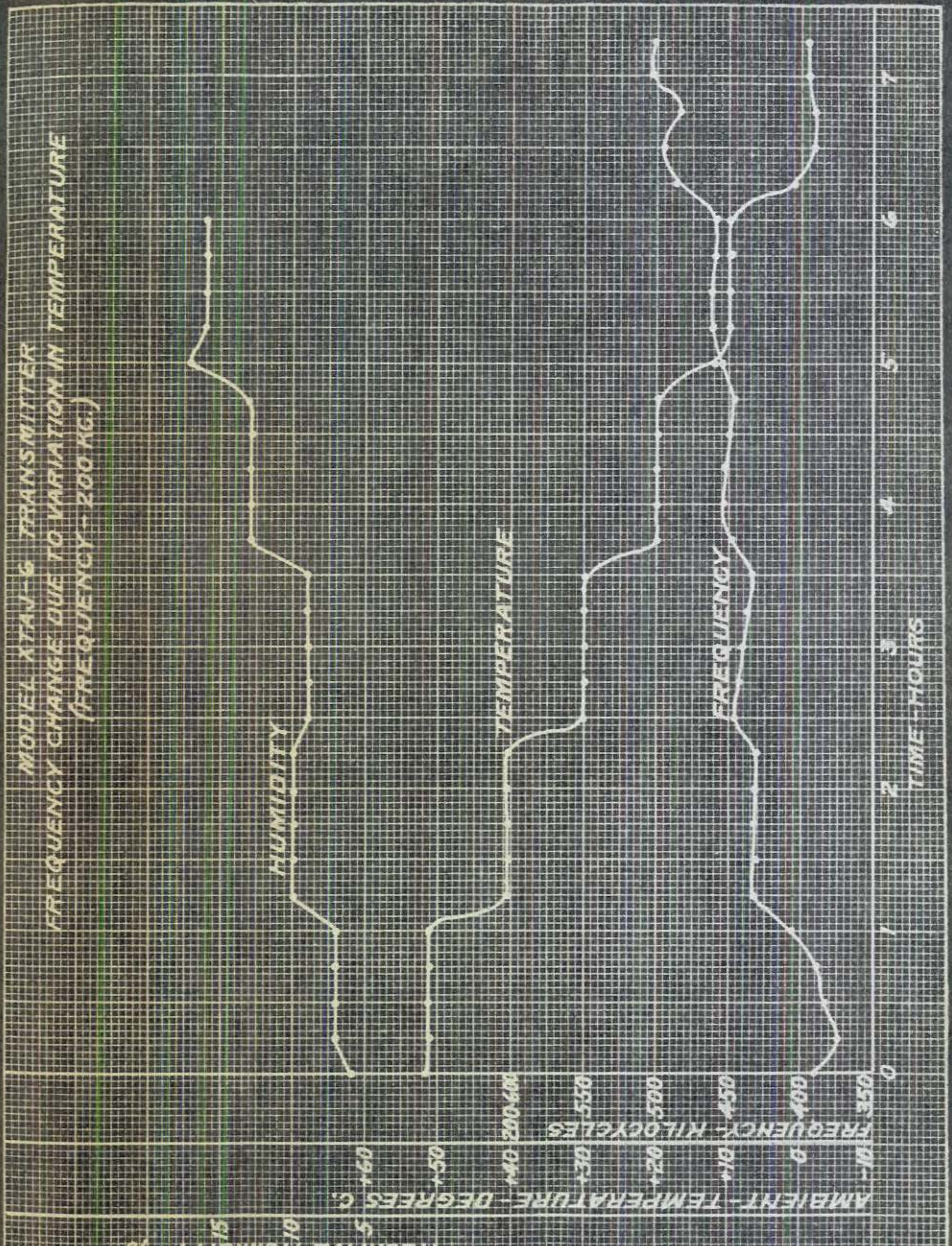

MODEL XTAJ-6 TRANSMITTER
FREQUENCY CHANGE DUE TO VARIATION IN TEMPERATURE
(FREQUENCY - 200 KC.)
HUMIDITY
TEMPERATURE
FREQUENCY
TIME - HOURS
0
1
2
3
4
5
6
7
RELATIVE HUMIDITY %
5
10
15
AMBIENT - TEMPERATURE - DEGREES C.
+60
+50
+40
+30
+20
+10
0
-10
FREQUENCY - KILOCYCLES
550
500
450
400
350

PLATE 1

U. S. NAVAL RESEARCH LABORATORY
BELLEVUE, D. C.

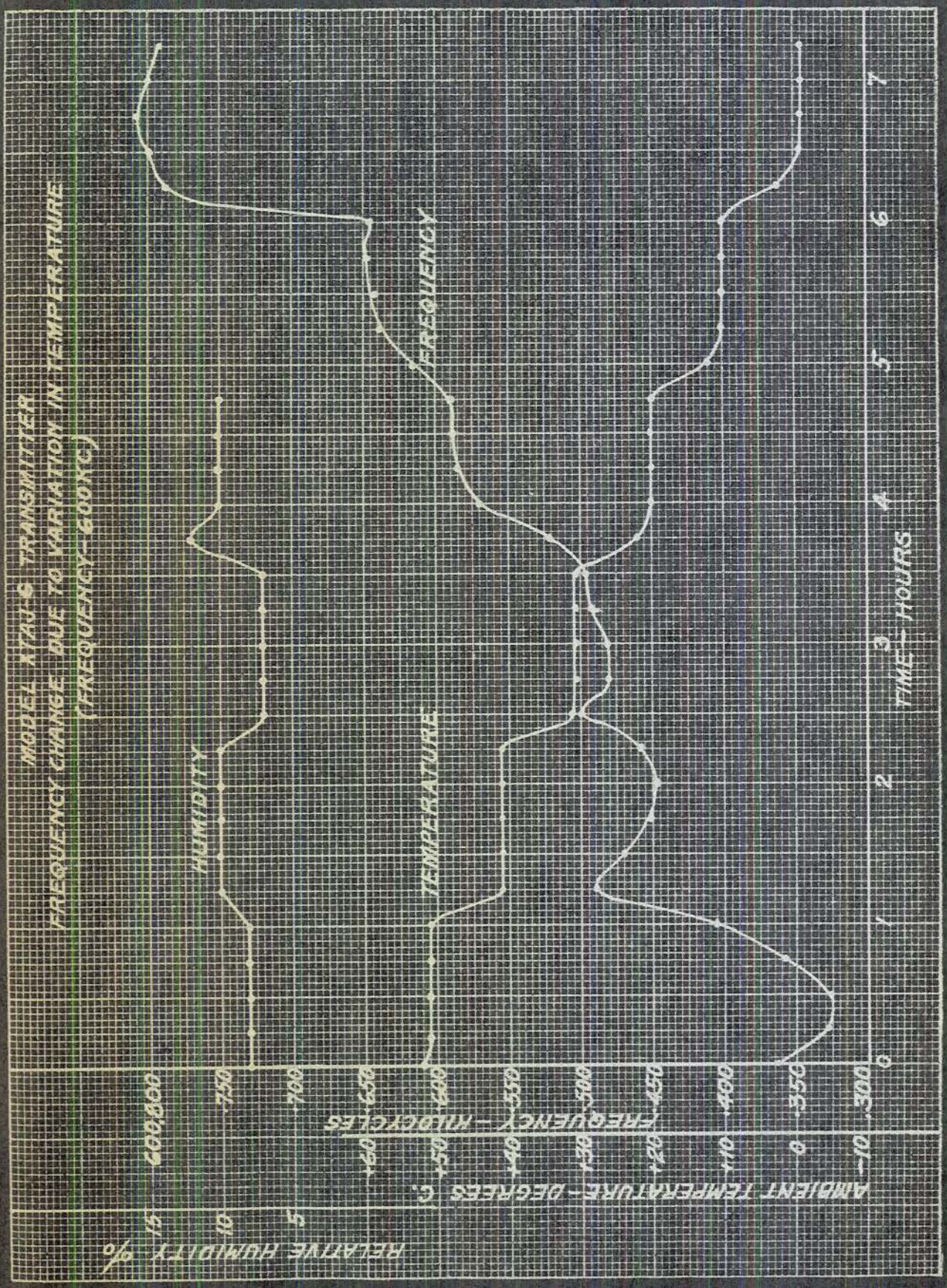


PLATE 2

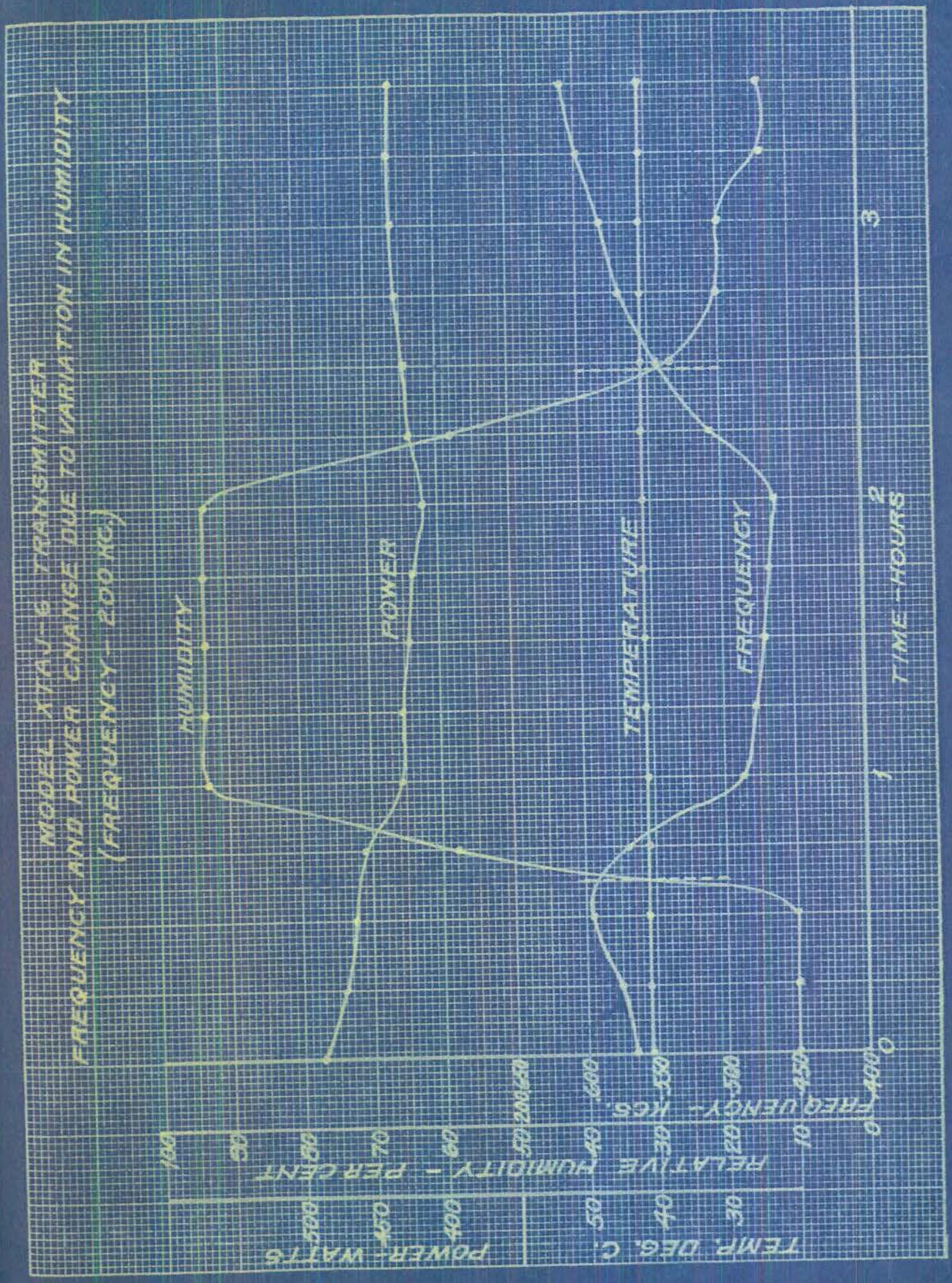

MODEL AN/AIC-6 TRANSMITTER
FREQUENCY AND POWER CHANGE DUE TO VARIATION IN HUMIDITY
(FREQUENCY—200 KC)
HUMIDITY
POWER
TEMPERATURE
FREQUENCY
TIME-HOURS
0
1
2
3
FREQUENCY - KCS.
RELATIVE HUMIDITY - PER CENT
TEMP. DEG. C.
POWER - WATTS

PLATE 3

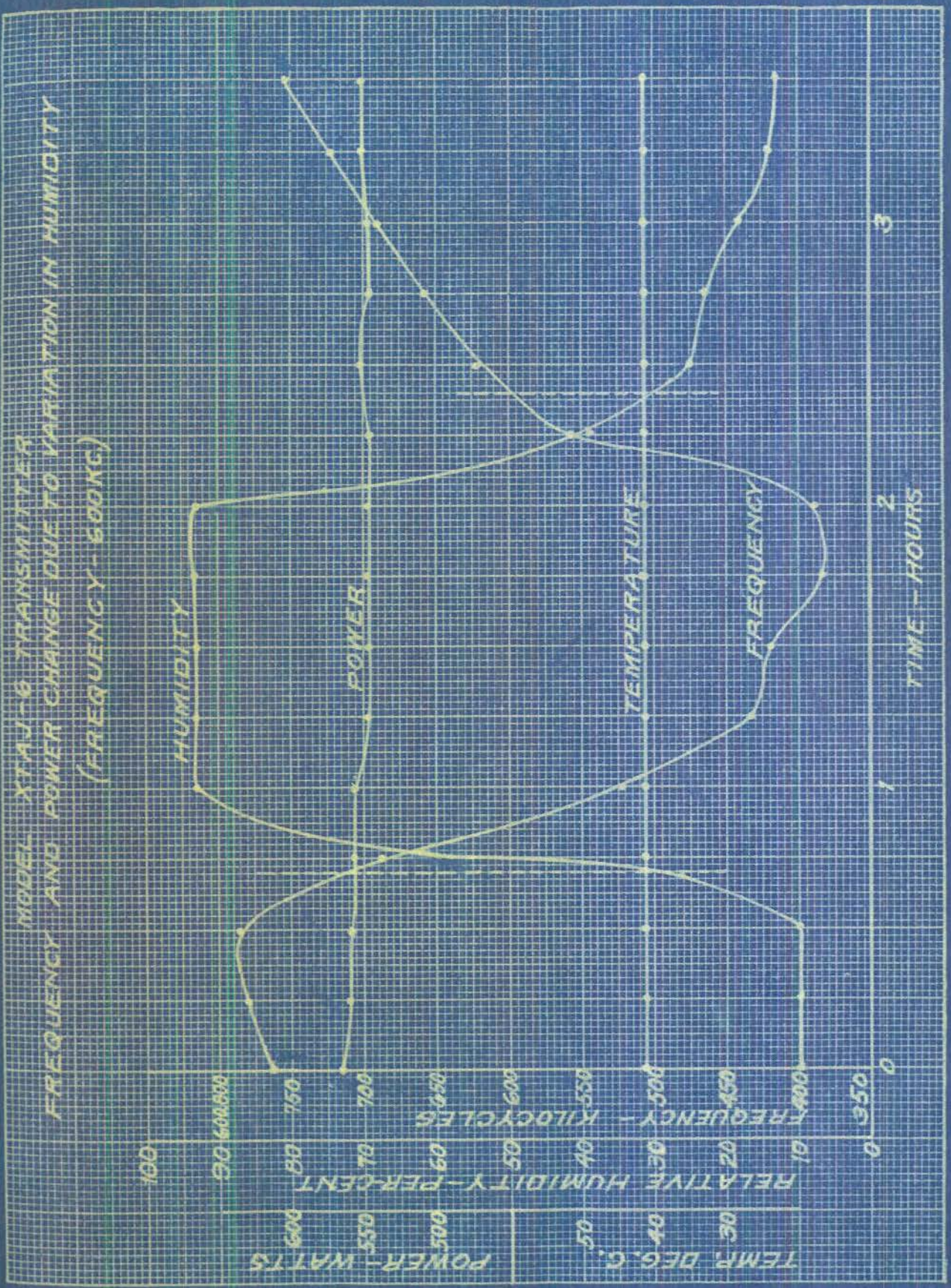
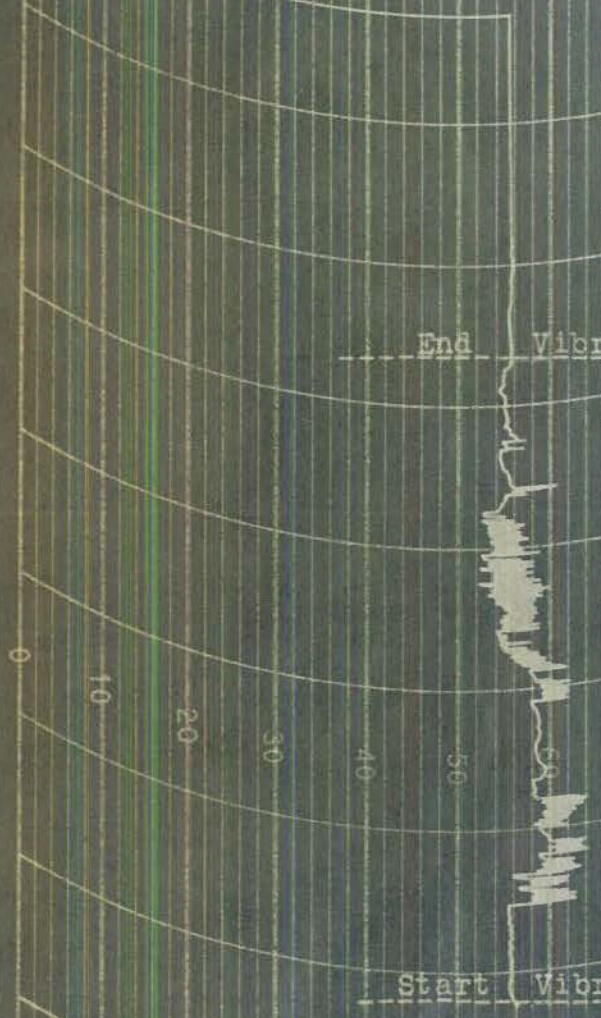


PLATE 4

MODEL XTAJ-3 TRANSMITTER
VIBRATION TEST AT 200 KILOCYCLES

TRANSMITTER SECURED RIGIDLY TO TEST STAND.

500 CYCLE RANGE OF LK EQUIPMENT USED
SCALE: 10 CYCLES PER DIVISION



MAXIMUM SET IN FREQUENCY BETWEEN BEGINNING AND END OF TEST: 3 CYCLES
0.0015%

Plate 5

PLATE 5

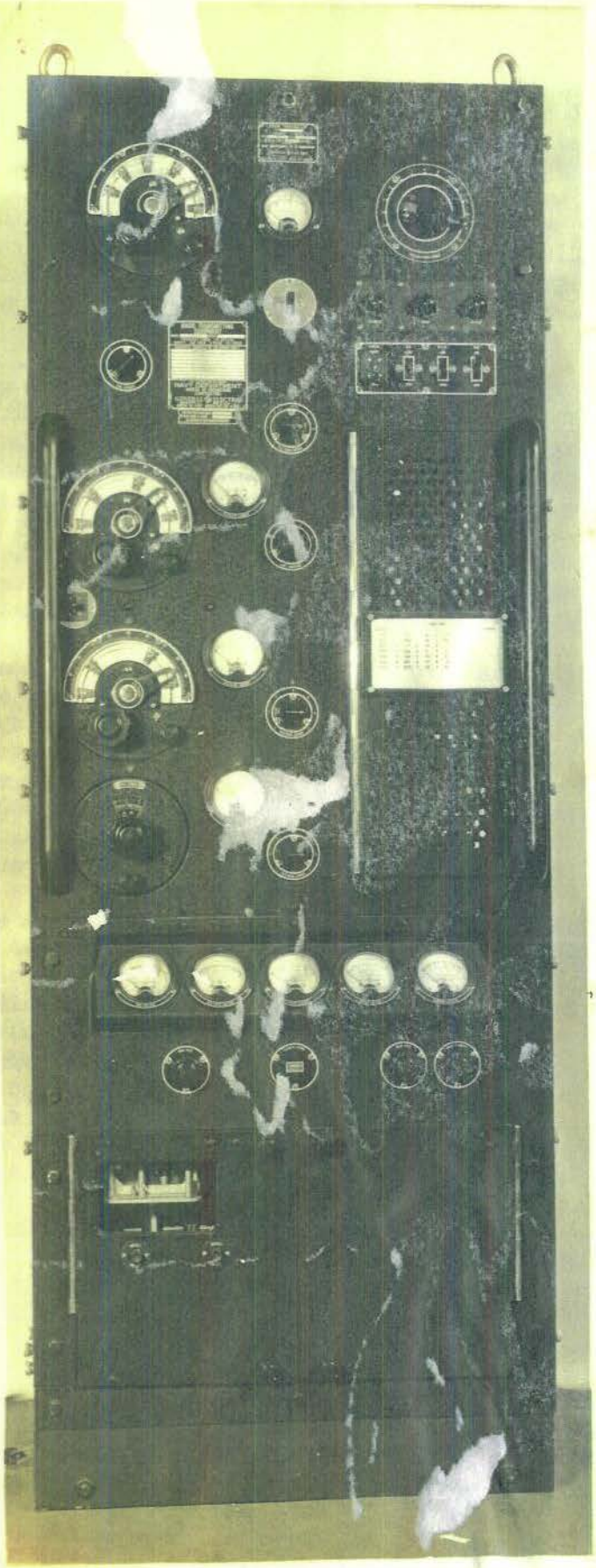


Plate 6

APPENDIX TO N.R.L. REPORT NO. R-1356

1. Subsequent to the conclusion of the tests of the Model XTAJ-6 transmitting Equipment, as reported in Naval Research Laboratory Report No. R-1356, the General Electric Company submitted and installed a redesigned tube cradle. The installation of the new tube cradle was accomplished on April 7, 1937, by Mr. J.J. Farrell, representative of the Contractor. The contractor's representative also provided and installed covers for the time delay relays, RL-3 and RL-6, in an effort to produce more quiet operation. During the period April 7th to April 9th, inclusive, vibration and inclination tests were conducted in accordance with the terms of specifications RE 13A 328J. This appendix to N.R.L. Report No. R-1356 covers the results of these additional tests.

2. Plate No. A-1 is a view showing the modified tube cradle installed in the Model XTAJ-6 transmitter unit. It will be noted that the ten watt lamps formerly employed as screen grid resistors, as illustrated in Plate 27 of NRL Report R-1328, have been replaced by four 100 watt vitreous enamelled resistors. This substitution has increased the reliability of the equipment to the extent that the screen grid circuits operated consistently and successfully during the entire course of the vibration tests conducted with the modified tube cradle. This feature of the equipment is now considered to be suitable for service requirements.

3. Table No. A-1 and Plate No. A-2 cover an inclination test conducted at 200 K.C. The equipment was subjected to inclination in a fore and aft direction through an angle of 45 degrees on either side of the vertical. The maximum frequency change noted during the half hour test from the frequency at the start of the test when the transmitter was in the vertical position, was 8 cycles, or 0.004%. The governing specifications (paragraph 2-7-13) permit a frequency change of 0.005%. Hence, the equipment successfully withstood the test when inclined in a fore and aft direction.

4. Table No. A-2 and Plate A-3 cover an inclination test conducted at 500 Kc. During this test the equipment was inclined from side to side through an angle of 45 degrees on either side of the vertical. The maximum frequency change noted during the half hour tests, from the frequency at the start of the test when the transmitter was in the vertical position, was 46 cycles, or 0.0092%. This frequency change occurred when the transmitter was inclined to the right hand side, looking at the front of the unit. At the conclusion of the test the equipment was subjected to a thorough examination in an effort to discover the cause of the frequency changes noted. The exact cause was not disclosed but it is believed that some element in the master oscillator compartment shifts its position sufficiently during inclination to cause the effects noted. During this test the equipment failed to meet the specification requirements and it is recommended that the manufacturer subject the entire master oscillator compartment to a thorough inspection with a view to discovering and eliminating the cause of the frequency shifts noted.

5. After the installation of the modified tube cradle the XTAJ-6 equipment was subjected to six 30 minute vibration tests at various frequencies. The contractor supplied five additional 38160 tubes on April 7th and three of these tubes were placed in the equipment prior to the vibration tests. A carbon anode 38161 tube (Ser. 16125) was placed in the power amplifier stage during two

thirty minute tests, after which a Tantalum anode tube (Ser. 16158) was substituted therefor for the remaining four thirty minute tests.

6. Table No. A-3 and Plate No. A-4 cover a vibration test conducted at 500 Kc. The maximum set in frequency between the beginning and the end of the test was 85 cycles, or 0.017%. The governing specifications, paragraph 3-7-14, permit a frequency difference of 0.005%. The second vibration test was conducted at 400 Kc and is covered by Table No. A-4 and Plate No. A-5. The maximum set in frequency noted during this test was 27 cycles, or 0.0067%. A third test was conducted at 200 Kc, resulting in a frequency variation of 22 cycles, or 0.011%, as shown in Table No. A-5 and Plate No. A-6. The fourth test conducted at 600 Kc is illustrated in Table No. A-6 and Plate No. A-7. The maximum change noted was 38 cycles, or 0.0063%. It will be seen that in all the foregoing tests the specification requirements were exceeded. However, during these tests no failures of tubes occurred and the entire equipment functioned safely and satisfactorily. It was further noted that the largest portion of the frequency shift occurred immediately after the vibration was applied. In an effort to determine the cause of this phenomenon a new tube was substituted in the master oscillator circuit. 38160 tube, Serial No. 700 was used to replace Serial No. 699.

7. Table No. A-7 and Plate No. A-8 cover a tests conducted at 600 Kc wherein tube Serial No. 700 was employed in the master oscillator circuit. It will be noted that the specification requirements are complied with, the maximum frequency set being 14 cycles or 0.0023%. In order to definitely demonstrate that the original M.O. tube, serial 699, had been the cause of unsatisfactory operation, an additional test was conducted at 200 Kc. This test is illustrated in Table No. A-8 and Plate No. A-9. The maximum frequency change noted was 8 cycles, or 0.004%. Thus it is demonstrated that a faulty tube was employed during the first four vibration tests and that the XTAJ-6 equipment fitted with the improved tube cradle and when supplied with suitable tubes is capable of safe and satisfactory operation complying with the requirements of the governing specifications.

8. After the completion of the vibration and inclination tests, time delay relays RL-3 and RL-6 were fitted with the covers provided by the contractor's representative. These covers produced only a very slight dimunition of the noise during keying operations and it is recommended that the contractor be required to still further modify the action of these relays to produce more quiet operation.

9. Recommendations. As a result of the tests conducted in connection with the Model XTAJ-6 equipment during the period of April 7th, 8th and 9th, certain of the recommendations listed on pages 2-b to 2-d inclusive, of NRL Report No. R-1356 must be revised, or modified, as follows:

(a) Reference par. (a) on page 2-b.

It is recommended that the use of 10 watt lamps as screen grid resistors be disapproved and that suitable 100 watt vitreous enamelled resistors, complying with the latest revision of Bureau of Engineering specifications, be substituted therefor.

(b) Reference Par. (m) on page 2-b.

It is recommended that the latest revision of the Model XTAJ-6 equipment, as improved by the substitution of a modified tube cradle, be

considered as satisfactory to meet the needs of the Naval Service in so far as the factor of vibration is concerned.

(c) Reference Par. (x) on page 2-c.
It is recommended that the frequency stability of the equipment with respect to inclined operation be further improved by preventing the shifting of any vital parts in the master oscillator circuit.

(d) Reference:Par. (y) on page 2-c.
It is recommended that the frequency stability of the equipment with respect to operation when subjected to vibration be approved.

(e) Reference Par. (kk) on page 2-d.
It is recommended that further precautions, over and beyond the placing of enclosing covers on the relays, be required to reduce the noise of operation of relays RL-3 and RL-6.

10. Conclusions. As a result of the modifications and improvements wrought in the Model XTAJ-6 transmitting equipment during the period of April 7th to April 9th, 1937, inclusive, and as a result of the tests conducted during the same period of time, it is concluded that:

(a) The Model XTAJ-6 equipment should be capable of providing safe and satisfactory operation when subjected to severe vibration.

(b) With some slight modification of the master oscillator circuit, the Model XTAJ-6 equipment should be capable of satisfactory operation complying with the frequency stability requirements of the governing specifications, when installed and operating on a Naval vessel subject to roll and pitch.

(c) The use of vitreous enamelled resistors should eliminate the difficulties encountered when employing small 10 watt lamps as screen grid resistors.

(d) The noise engendered during keying operations which is caused by the intermittent action of relays RL-3 and RL-6 is not sufficiently eliminated by the mere placement of covers over the operating parts. Further re-adjustment of movable parts or the application of suitable buffers is deemed necessary.

Table No. A-2

Model XTAJ-6 Transmitting Equipment

INCLINATION DUE TO ROLL AND PATCH OF SHIP

Test as per paragraph 3-17-13 of Specifications RE 13A 328J

Transmitter inclined from side to side

Time	Maximum Frequency	Minimum Frequency
12:35	500.296	Stationary
12:40	290	500.330
12:45	291	333
12:50	293	335
12:55	293	341
13:00	293	342
13:05	293	342 (end)

Maximum frequency change during test from frequency at start of test: 46 cycles; 0.0092%

Permitted by Specifications: 0.005%

Table No. A-3

Model XTAJ-6 Transmitting Equipment

VIBRATION

Test as per paragraph 3-7-14 of Specifications RE 13A 328J

Transmitter rigidly secured to Test Stand

Time	Frequency
16:05	500.377
16:10	286
16:15	285
16:20	277
16:25	275
16:30	288
16:35	287
End	292

Maximum set in frequency between beginning and end of test: 85 cycles; 0.017%

Permitted by Specifications: 0.005%

Tubes used during test:

Circuit	Mfgr	Serial No.
M.O.	CG38160	699
IPA	CG38160	697
Audio	CG38160	698
P.A.	CG38161	16125 (Carbon Anode)

Table No. A-4

Model XTAJ-6 Transmitting Equipment

VIBRATION

Test as per paragraph 3-7-14 of Specifications RE 13A 328J

Transmitter rigidly secured to Test Stand

Time	Frequency
09:00	400.381
09:05	369
09:10	377
09:15	381
09:20	395
09:25	406
09:30	416
End	408

Maximum set in frequency between beginning and end of test:
27 cycles; 0.0067%

Permitted by Specifications: 0.005%

Tubes used during test:

Circuit	Mfgr	Serial No.
M.O.	CG38160	699
IPA	CG38160	697
Audio	CG38160	698
P.A.	CG38161	12125 (carbon Anode)

Table No. A-5

Model XTAJ-6 Transmitting Equipment

VIBRATION

Test as per paragraph 3-7-14 of Specifications RE 13A 328J

Transmitter rigidly secured to Test Stand

Time	Frequency
10:45	200.312
10:50	277
10:55	280
11:00	280
11:05	280
11:10	280
11:15	284
End	290

Maximum set in frequency between beginning and end of test:
22 cycles; 0.011%

Permitted by Specifications: 0.005%

Tubes used during test:

Circuit	Mfgr	Serial No.
M.O.	CG38160	699
IPA	CG38160	697
Audio	CG38160	698
P.A.	CG38161	16158 (Tantalum Anode)

Table No. A-6

Model XTAJ-6 Transmitting Equipment

VIBRATION

Test as per paragraph 3-7-14 of Specifications RE 13A 328J

Transmitter rigidly secured to Test Stand

Time	Frequency
13:45	600.325
13:50	286
13:55	288
14:00	287
14:05	286
14:10	284
14:15	280
End	287

Maximum set in frequency between beginning and end of test: 38 cycles; 0.0063%

Permitted by Specifications: 0.005%

Tubes used during test:

Circuit	Mfgr	Serial No.
M.O.	CG38160	699
IPA	CG38160	697
Audio	CG38160	698
P.A.	CG38161	16158 (Tantalum Anode)

Table No. A-7

Model ATAJ-6 Transmitting Equipment

VIBRATION

Test as per paragraph 3-7-14 of Specifications RE 13A 328J

Transmitter rigidly secured to Test Stand

Time	Frequency
16:00	600.319
16:05	312
16:10	307
16:15	325
16:20	302
16:25	312
16:30	305
End	305

Maximum set in frequency between beginning and end of test:
14 cycles; 0.0023%

Permitted by specifications: 0.005%

Tubes used during test:

Circuit	Mfgr	Serial No.
M.O.	CG38160	700
IPA	CG38160	697
Audio	CG38160	698
P.A.	CG38161	16158 (Tantalum Anode)

Table No. A-8

Model XTAJ-6 Transmitting Equipment

VIBRATION

Test as per paragraph 3-7-14 of Specifications RE 13A 328J

Transmitter rigidly secured to Test Stand

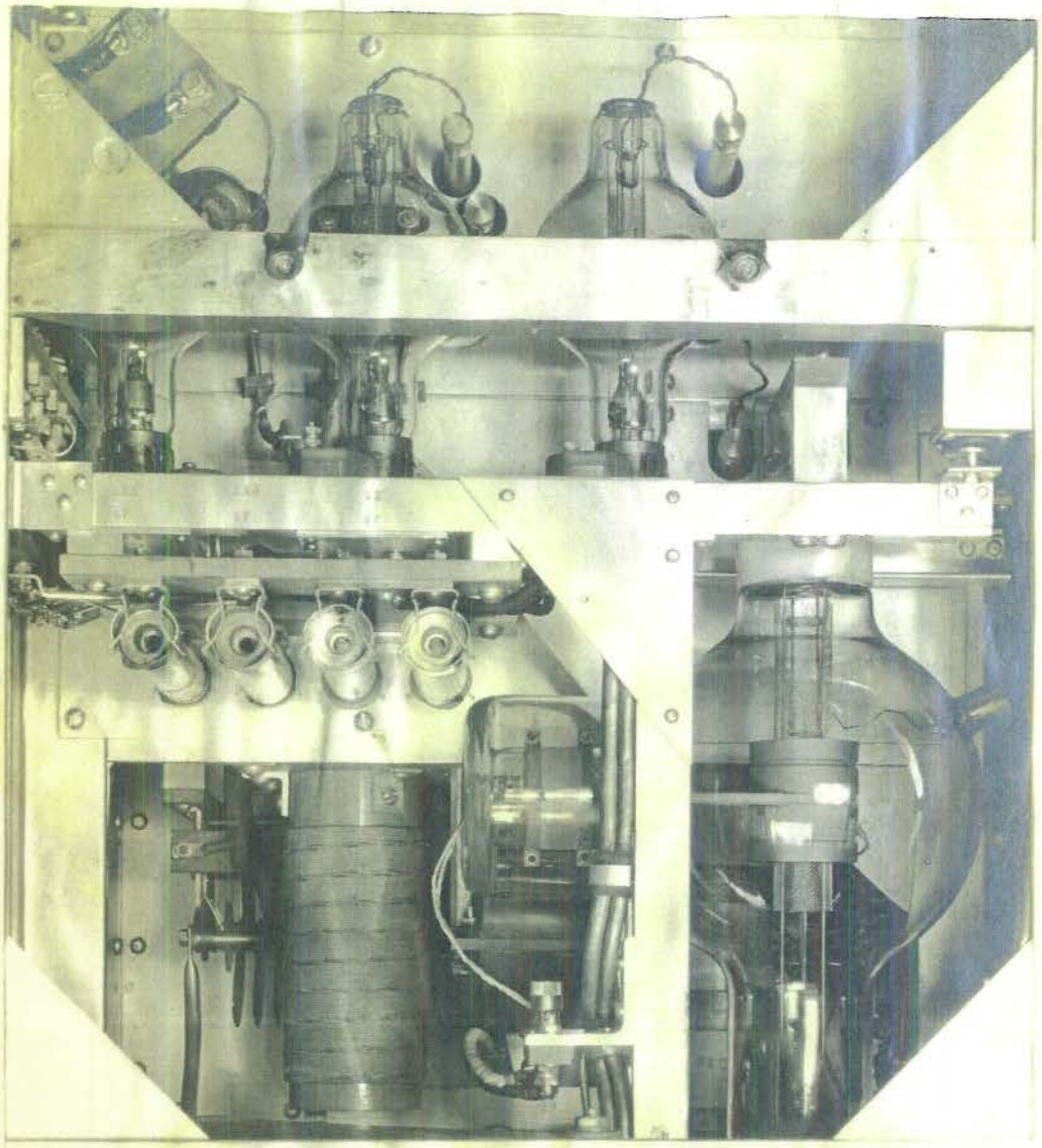
Time	Frequency
08:55	200.361
09:00	359
09:05	361
09:10	365
09:15	366
09:20	364
09:25	369
End	369

Maximum set in frequency between beginning and end of test:
8 cycles; 0.004%

Permitted by Specifications: 0.005%

Tubes used during test:

Circuit	Mfgr	Serial No.
M.O.	CG38160	700
IPA	CG38160	697
Audio	CG38160	698
P.A.	CG38161	16158 (Tantalum Anode)



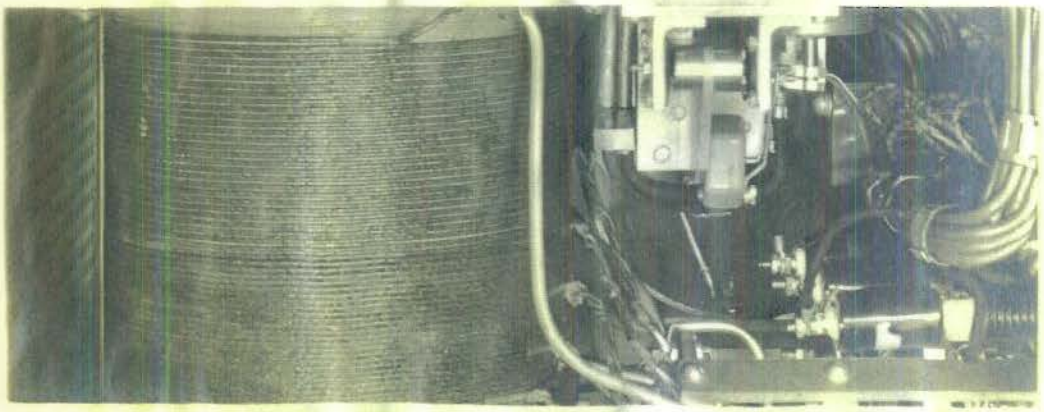
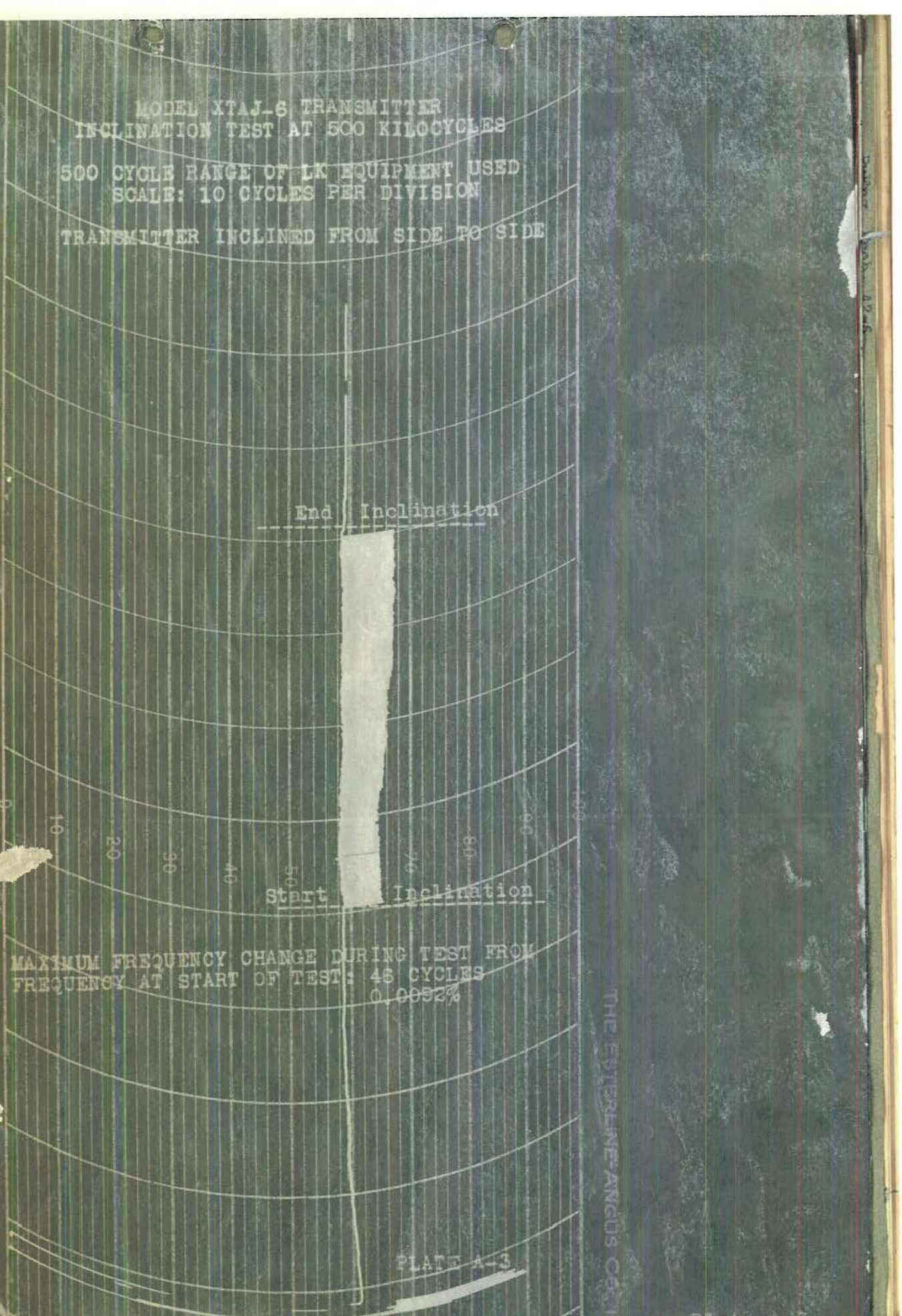


Plate A-1

MODEL XTAJ-6 TRANSMITTER
INCLINATION TEST AT 500 KILOCYCLES

500 CYCLE RANGE OF LK EQUIPMENT USED
SCALE: 10 CYCLES PER DIVISION

TRANSMITTER INCLINED FROM SIDE TO SIDE

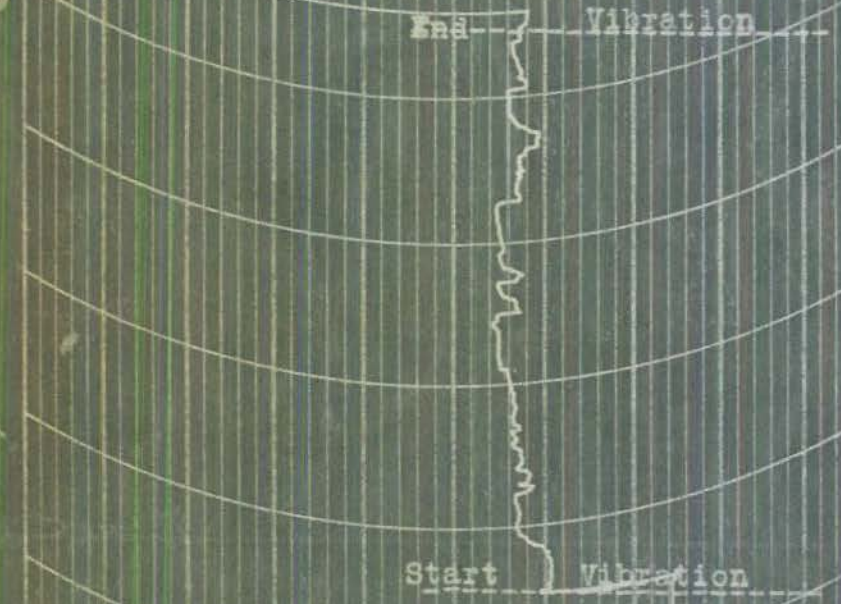


MAXIMUM FREQUENCY CHANGE DURING TEST FROM
FREQUENCY AT START OF TEST: 46 CYCLES
0.0092%

PLATE A-3

Plate A-3

MODEL XTAJ-6 TRANSMITTER
VIBRATION TEST AT 500 KILOCYCLES
TRANSMITTER SECURED RIGIDLY TO TEST STAND
500 CYCLE RANGE OF LK EQUIPMENT USED
SCALE: 10 CYCLES PER DIVISION



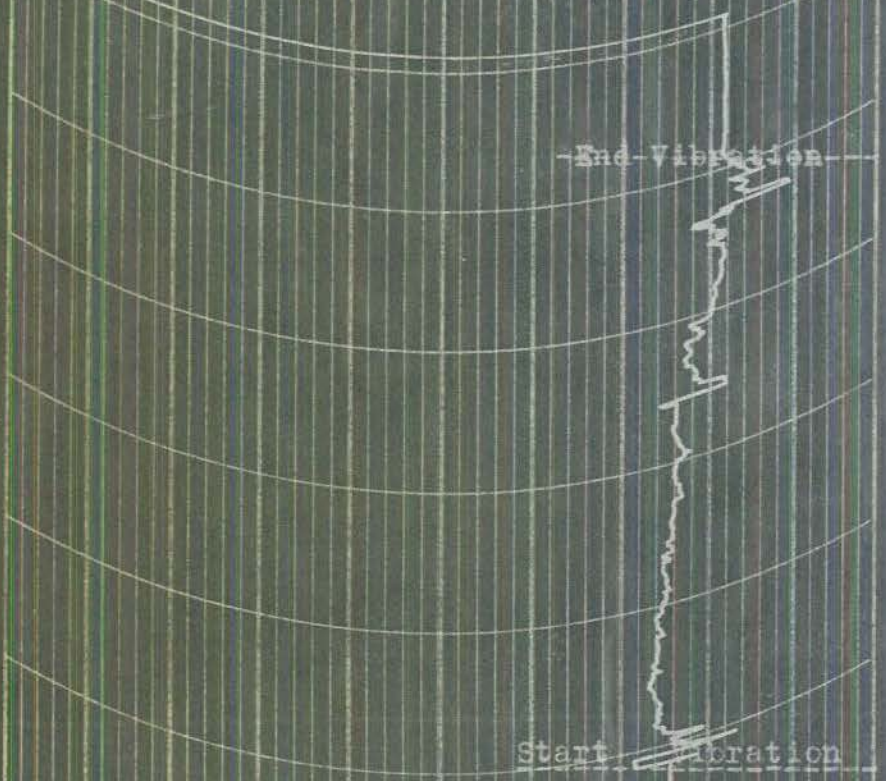
MAXIMUM SET IN FREQUENCY BETWEEN BEGINNING AND END OF TEST: 85 CYCLES
0.017%

PLATE A-4

MODEL XTAJ-6 TRANSMITTER
VIBRATION TEST AT 400 KILOCYCLES

TRANSMITTER SECURED RIGIDLY TO TEST STAND

500 CYCLE RANGE OF LX EQUIPMENT USED
SCALE: 10 CYCLES PER DIVISION



MAXIMUM SET IN FREQUENCY BETWEEN BEGINNING AND END OF TEST: 27 CYCLES
0.0067%

0 10 20 30 40 50 60 70 80 90 100

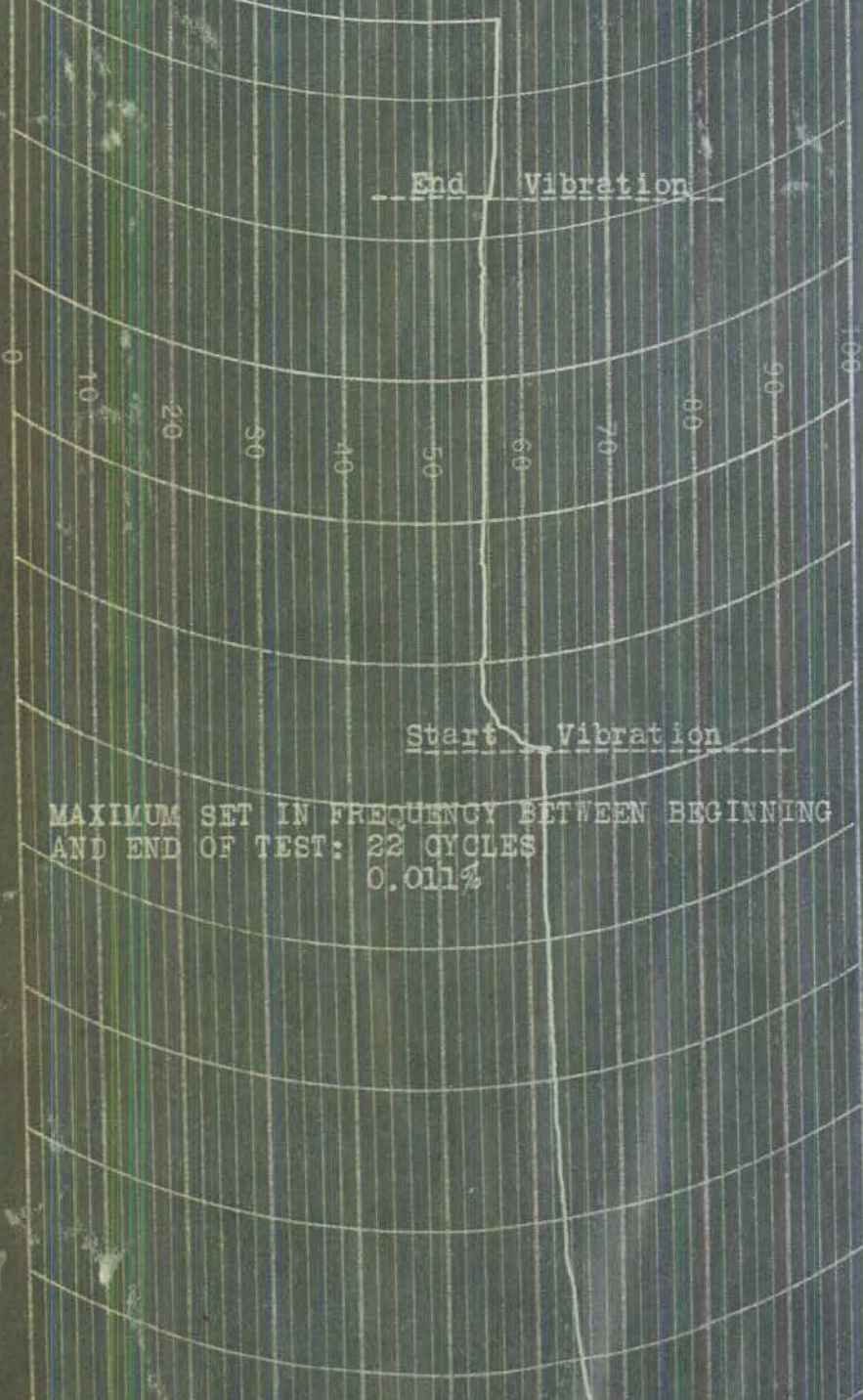
PLATE A-5

Plate A-5

MODEL XTAJ-6 TRANSMITTER
VIBRATION TEST AT 200 KILOCYCLES

TRANSMITTER SECURED RIGIDLY TO TEST STAND

500 CYCLE RANGE OF LK EQUIPMENT USED
SCALE; 10 CYCLES PER DIVISION



MAXIMUM SET IN FREQUENCY BETWEEN BEGINNING AND END OF TEST: 22 CYCLES
0.011%

MADE IN U.S.A. THE SOUTHERLINE-ANGUS CO. INDIANAPOLIS

Plate A-6

PLATE A-6

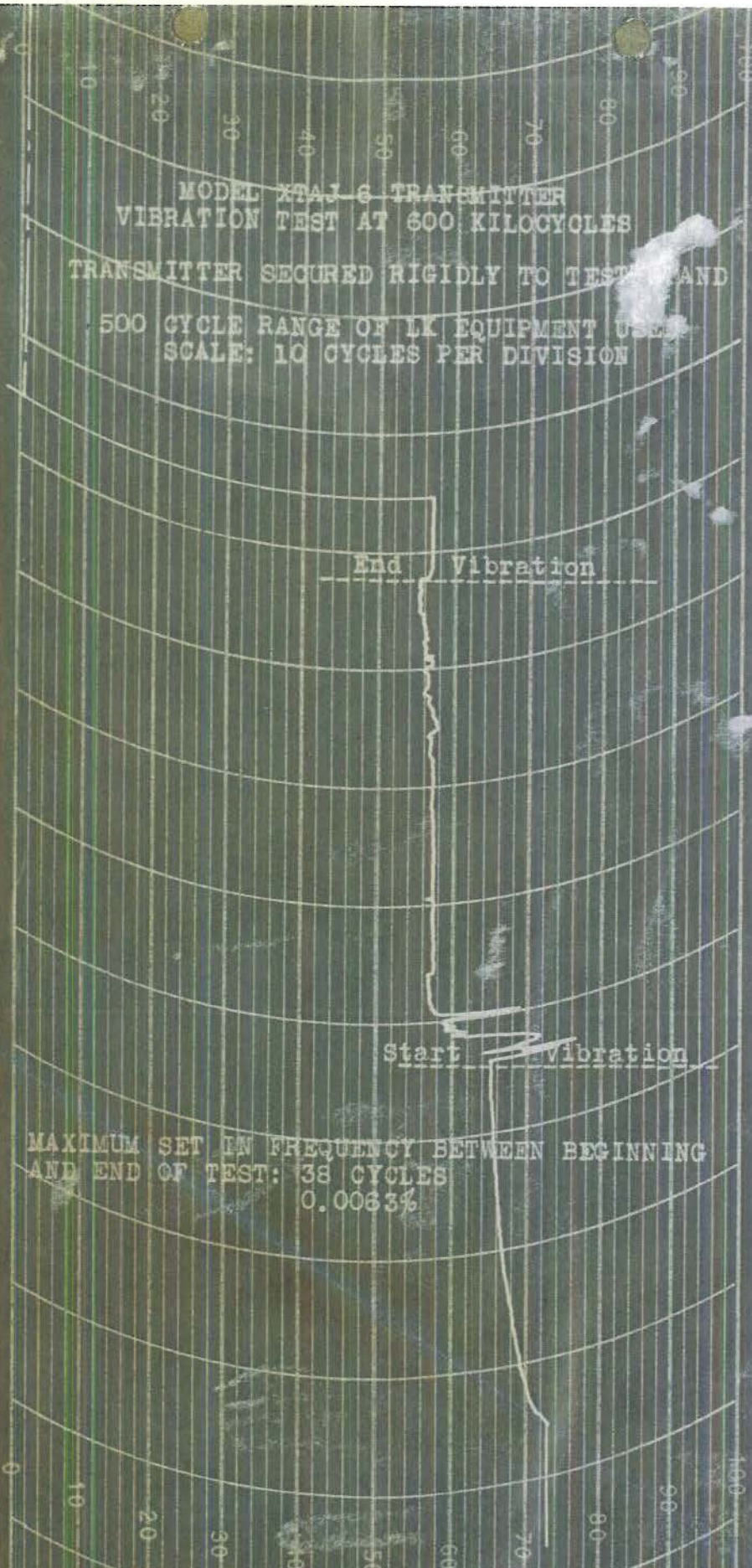

MODEL XTAJ-6 TRANSMITTER
VIBRATION TEST AT 600 KILOCYCLES
TRANSMITTER SECURED RIGIDLY TO TEST STAND
500 CYCLE RANGE OF LX EQUIPMENT USED
SCALE: 10 CYCLES PER DIVISION
End Vibration
Start Vibration
MAXIMUM SET IN FREQUENCY BETWEEN BEGINNING AND END OF TEST: 38 CYCLES
0.0063%
PLATE A-7
MADE IN U.S.A. THE ESTERLINE-ANGUS CO., INDIANAPOLIS, IND. U.S.A.

Plate A-7

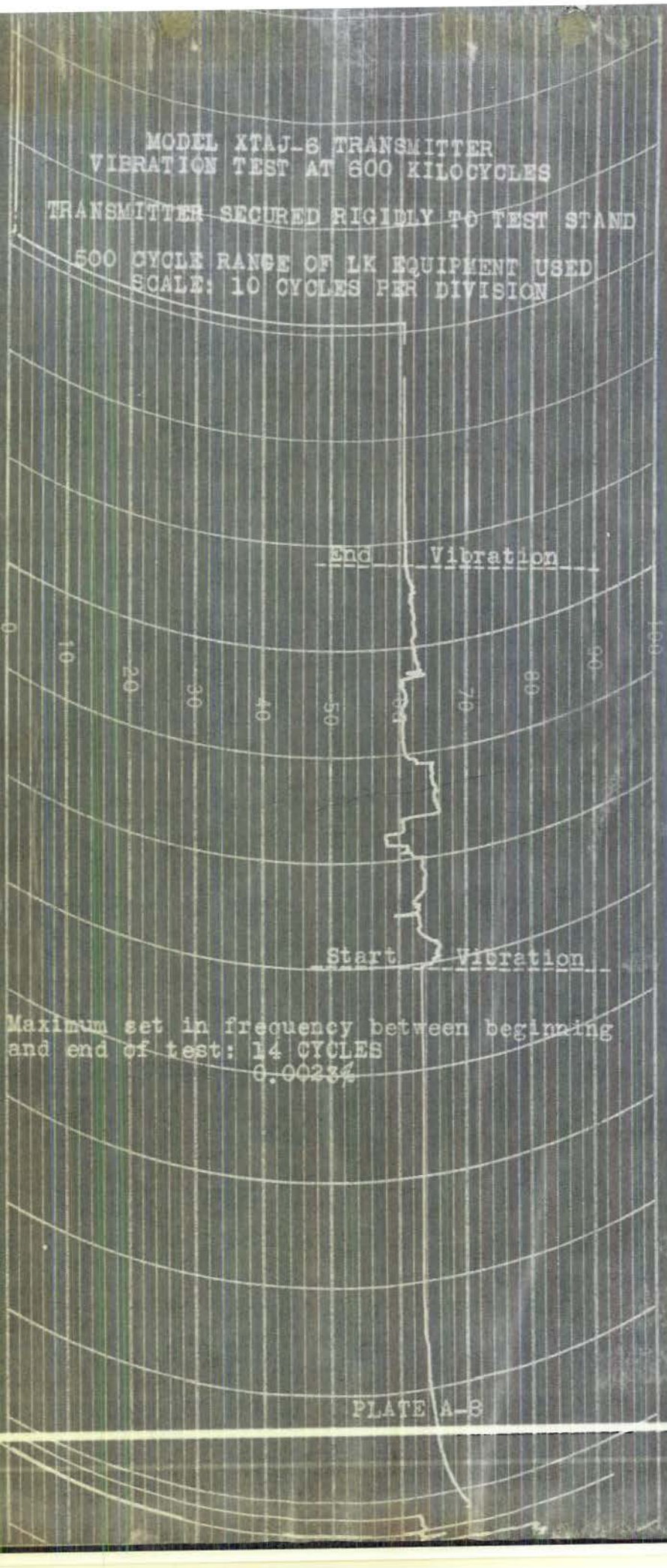

MODEL XTAJ-6 TRANSMITTER
VIBRATION TEST AT 600 KILOCYCLES
TRANSMITTER SECURED RIGIDLY TO TEST STAND
500 CYCLE RANGE OF LK EQUIPMENT USED
SCALE: 10 CYCLES PER DIVISION
End Vibration
0
10
20
30
40
50
60
70
80
90
100
Start Vibration
Maximum set in frequency between beginning and end of test: 14 CYCLES
0.00234
THE STERLING-ANGUS CO., INDIANAPOLIS, IND., U.S.A.

PLATE A-8

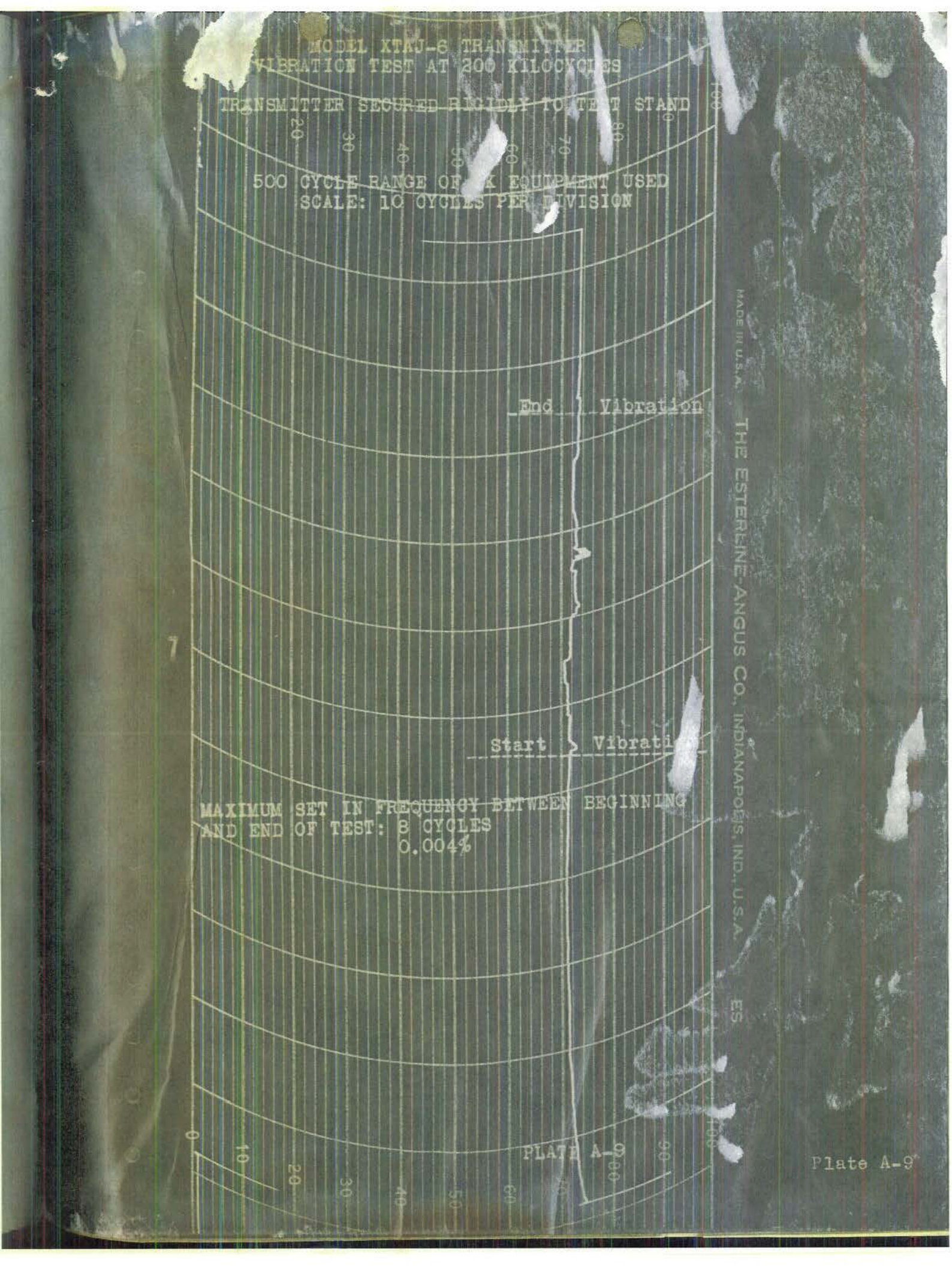

MODEL XTAJ-6 TRANSMITTER
VIBRATION TEST AT 200 KILOCYCLES
TRANSMITTER SECURED RIGIDLY TO TEST STAND
500 CYCLE RANGE OF [illegible] EQUIPMENT USED
SCALE: 10 CYCLES PER DIVISION
End } Vibration
Start } Vibration
MAXIMUM SET IN FREQUENCY BETWEEN BEGINNING
AND END OF TEST: 8 CYCLES
0.004%
MADE IN U.S.A. THE ESTERLINE-ANGUS CO. INDIANAPOLIS, IND., U.S.A.
PLATE A-9

Plate A-9