REPORT R-1421

DATE January 25, 1938

FR-1421

S U B J E C T

Test of Model XTBR-1 Radio Equipment
(Contractor: General Electric Company)

by

R. B. Meyer

DECLASSIFIED by NRL Coolidge
Declassification Team
Date: 2 MAY 2016
Reviewer's name(s): H. Do, P. HANNA

Declassification authority: NAVY DECLASS MANUAL, 11 DEC 2012, 06 SERIES

DECLASSIFIED By authority of
5000A Dated: 1 Jan 1958

Entered By: E. Bliss Code 2027

Naval Research Laboratory

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25 January 1938

NRL Report No. R- 1421
BuEng Problem T5-25

FR-1421

NAVY DEPARTMENT

BUREAU OF ENGINEERING

Report on

Test of Model XTBR-1 Radio Equipment
(Contractor: General Electric Company)

sification changed
authority of Reference Bulletin
No. 2 Dated 3-31-49

(NEW CONSTRUCTION)

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D. C.

Number of Pages: Text - 71 Tables - 100 Plates - 35

Authorization: BuEng let.C-NOs-48078(12-1-W8) of 7 Dec.1936.

Date of Tests: October 11, 1937, to January 11, 1938.

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Table of Contents

Authorization of Tests	Page 1
Object of Tests	1
Abstract of Tests	1
Conclusions	2a
Recommendations	2b
Material under Test	3
Method of Test	3
Data Recorded	4
Probable Errors in Results	4
Results of Tests	5
Conclusions	70

Appendices

List of Weights	Table 1
Humidity Test, High Frequency Transmitter Unit	2
Humidity Test, Intermediate Frequency Transmitter Unit	3
List of Controls for Operation of High Frequency Unit	4
List of Controls for Operation of Intermediate Frequency Unit	5
List of Controls for Operation of Rectifier Unit	6
List of Indicating Instruments	7
Operation into Actual Antenna, H.F. Unit, 2000-7000 kc	8
Operation into Actual Antenna, H.F. Unit, 8000-18000 kc	9
Operation into Actual Antenna, H. F. Unit	10
Operation into Actual Antenna, I. F. Unit, 300-800 kc	11
Operation into Actual Antenna, I.F. Unit, 1000-2000 kc	12
Audio Frequency Characteristic from Line Input to Carrier	13
Signal to Noise Ratio and Percent Distortion	14
Range of Audio Gain Control	15
Determination of Limiting Frequencies and Overlap of MO Circuit	16
Determination of Overlap of 1st I.P.A. Circuit	17
Determination of Overlap of 2nd I.P.A. and P.A. Circuits	18
Determination of Limiting Frequencies and Overlap of MO Circuit	19
Determination of Overlap of I.P.A. Grid Circuit	20
Determination of Overlap of I.P.A. Plate Circuit	21
Determination of Overlap of P.A. Plate Circuit	22
Frequency Range of Master Oscillator Compensating Condenser, HF	23
Frequency Range of Master Oscillator Compensating Condenser, IF	24
Effect of MO Dial Lock upon Frequency, H.F. Unit	25
Effect of MO Dial Lock upon Fraquency, I.F. Unit	26
Variation of Resonant Frequency of Master Oscillator per division of Dial Marking, H. F. Unit	27
Variation of Resonant Frequency of Master Oscillator per division of Dial Marking, I.F. Unit	28
Measurement of Ripple Voltages	29
Regulation of Rectifiers	30
Power Required from Supply Lines	31
Effect of Line Voltage Variation on Rectifier and High Frequency Transmitter Units	32
Effect of Line Voltage Variation on Rectifier and Intermediate Frequency Transmitter Units	33
Determination of Power Output, H.F. Unit, 2000-3000 kc	34

DECLASSIFIED

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Table of Contents (continued)

Determination of Power Output, H.F. Unit, 4000-5000 kc	Table 35
Determination of Power Output, H.F. Unit, 6000-7000 kc	36
Determination of Power Output, H.F. Unit, 8000-10000 kc	37
Determination of Power Output, H.F. Unit, 12000-14000 kc	38
Determination of Power Output, H.F. Unit, 16000-18000 kc	39
Determination of Power Output, I.F. Unit, 300-400 kc	40
Determination of Power Output, I.F. Unit, 500-600 kc	41
Determination of Power Output, I.F. Unit, 700-800 kc	42
Determination of Power Output, I.F. Unit, 1000-1200 kc	43
Determination of Power Output, I.F. Unit, 1400-1600 kc	44
Determination of Power Output, I.F. Unit, 1800-2000 kc	45
Determination of Power Output, I.F. Unit, 300-400 kc (boat antenna)	46
Determination of Power Output, I.F. Unit, 500-600 kc (boat antenna)	47
Determination of Power Output, I.F. Unit, 700-800 kc (boat antenna)	48
Determination of Power Output, I.F. Unit, 1000-1200 kc (boat antenna)	49
Determination of Power Output, I.F. Unit, 1400-1600 kc (boat antenna)	50
Determination of Power Output, I.F. Unit, 1800-2000 kc (boat antenna)	51
Accuracy of Frequency Adjustment Using Calibration Curves, H.F.	52
Accuracy of Frequency Adjustment Using Calibration Curves, I.F. Unit	53
Accuracy of Reset to Previously Calibrated Frequencies, H.F. Unit	54
Accuracy of Reset to Previously Calibrated Frequencies, I.F. Unit	55
Test for Lost Motion, Back Lash and Torque Lash, H.F. Unit	56
Test for Lost Motion, Back Lash and Torque Lash, I.F. Unit	57
Variation of Frequency with Detuning of Circuits, H.F. Unit	58
Variation of Frequency with Detuning of Circuits	59
Control of Power Output, H.F. Unit	60
Control of Power Output, I.F. Unit	61
Change of Tubes, Master Oscillator Circuit, H. F. Unit	62
Change of Tubes, 1st I.P.A. Circuit, H.F. Unit	63
Change of Tubes, Master Oscillator Circuit, I.F. Unit	64
Change of Tubes, I.P.A. Circuit, I.F. Unit	65
Variation of Supply Line Voltage, H. F. Unit	66
Variation of Supply Line Voltage, I.F. Unit	67
Variations in Temperature, H. F. Unit, at specified frequency.	68
Variations in Temperature, H.F. Unit, at specified frequency.	69
Variations in Temperature, I.F. Unit, at specified frequency.	70
Variations in Temperature, I.F. Unit, at specified frequency.	71
Variation in Humidity, H.F. Unit, at specified frequency.	72
Variation in Humidity, H.F. Unit, at specified frequency.	73
Variation in Humidity, I.F. Unit, at specified frequency.	74
Variation in Humidity, I.F. Unit, at specified frequency.	75
Locked Key Operation for Two Hours, H.F. Unit, at 2000 kc	76
Locked Key Operation for Two Hours, H.F. Unit, at 4500 kc	77
Locked Key Operation for Two Hours, I.F. Unit, at 300 kc	78

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Table of Contents (continued)

Locked Key Operation for Two Hours, I.F. Unit, 1000 kc	Table 79
Change from Key Locked to Intermittently Keyed Condition, H.F. Unit	80
Change from Key Locked to Intermittently Keyed Condition, I.F. Unit	81
Change from Continuously Keyed Condition to Intermittently Keyed Condition, H.F. Unit	82
Change from Continuously Keyed Condition to Intermittently Keyed Condition, I.F. Unit	83
Inclination Due to Roll and Pitch of Ship, H.F. Unit, 2000 kc	84
Inclination Due to Roll and Pitch of Ship, H.F. Unit, 4500 kc	85
Inclination Due to Roll and Pitch of Ship, I.F. Unit, 300 kc	86
Inclination Due to Roll and Pitch of Ship, I.F. Unit, 1000 kc	87
Vibration Test, H.F. Unit	88
Vibration Test, I.F. Unit	89
Shock Test, H.F. Unit	90
Shock Test, I.F. Unit	91
Shock Test, Rectifier Unit	92
Endurance Test, Alternator Unit	93
Characteristics of Generator Unit	94
Characteristics of Generator Unit	95
Characteristics of Alternator Unit	96
Regulation of Engine Equipment	97
Regulation of Engine Equipment	98
Dimensions of Units	99
Cables for Operation of Equipment	100

Frequency Characteristic, H.F. Unit, 2000 kc	Plate 1
Frequency Characteristic, H.F. Unit, 4500 kc	2
Temperature Test, H.F. Unit, 2000 kc	3
Temperature Test, H.F. Unit, 4500 kc	4
Temperature Test, I.F. Unit, 300 kc	5
Temperature Test, I.F. Unit, 1000 kc	6
Humidity Test, H. F. Unit, 2000 kc	7
Humidity Test, H. F. Unit, 4500 kc	8
Humidity Test, I. F. Unit, 300 kc	9
Humidity Test, I. F. Unit, 1000 kc	10
Inclination Test, H. F. Unit, 2000 kc	11
Inclination Test, H. F. Unit, 4500 kc	12
Inclination Test, I. F. Unit, 300 kc	13
Inclination Test, I. F. Unit, 1000 kc	14
Vibration Test, H. F. Unit, 2000 kc	15
Vibration Test, H. F. Unit, 4500 kc	16
Vibration Test, I.F. Unit, 300 kc	17
Vibration Test, I.F. Unit, 1000 kc	18
Front oblique view of Intermediate Frequency Transmitter, in case	19
Back oblique view of I.F. Transmitter, in case	20
Right back view of I.F. Transmitter, case removed	21
Left back view of I.F. Transmitter, case removed	22

DECLASSIFIED

DECLASSIFIED

Table of Contents (continued)

Front oblique view of H.F. Transmitter, in case	Plate 23
Back oblique view of H.F. Transmitter, in case	24
Right back view of H.F. Transmitter, case removed	25
Left back view of H.F. Transmitter, case removed	26
Front oblique view of Rectifier Unit, in case	27
Back oblique view of Rectifier Unit, in case	28
Right back view of Rectifier Unit, case removed	29
Left back view of Roctifier Unit, case removed	30
Front oblique view of Engine-Generator Unit	31
Right back view of Engine-Generator Unit	32
Left back view of Engine-Generator Unit	33
View of Transportation Cart, assembled, without equipment in place	34
View of Combined Antenna System erected on Three Masts	35

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AUTHORIZATION OF TEST

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

Reference: (a) BuEng let.C-NOs-48078(12-1-W8) of 7 Dec.1936.
(b) BuEng let.C-NOs-48078(7-19-W8) of 27 July 1937.
(c) Contract NOs-48078 of 8 November 1935 with G.E.Co.
(d) BuEng Specifications RE 13A 518B
(e) BuEng Specifications RE 13A 506B
(f) G.E. Co. Descriptive Specifications RA-1460-A.
(g) G.E. Co. Descriptive Specifications RA-1461-A.
(h) G.E. Co. Type Test Report, October 1937.
(i) G.E. Co. Preliminary Instruction Book, Section I.
(j) G.E. Co. Preliminary Instruction Book, Section II.
(k) G.E. Co. Preliminary Instruction Book, Section III.
(l) NRL Report No. R-1566 (XTBR-1 Receiving Equipment)

OBJECT OF TEST

2. The object of the tests was to determine the following:

(a) The actual performance of the equipment with respect to contract requirements.
(b) Any departures from contract requirements.
(c) The nature of changes necessary to correct any departures from contract requirements.
(d) Recommendations regarding necessary or desirable improvements to meet service requirements.

ABSTRACT OF TESTS

3. The tests herein reported were conducted to determine the degree of compliance of the Model XTBR-1 Equipment with the mechanical and electrical requirements set forth in references (c), (d), and (e). Specifically tests were conducted to determine the following:

(a) Ability of the equipment to withstand shipment.
(b) Check of mechanical or physical construction and assembly; general workmanship; materials used; corrosion resisting measures employed and adequacy of electrical circuits to withstand operation under Naval service conditions.
(c) Power output; power input and overall efficiency.
(d) Quality of emitted signals; lilt; undesirable modulation and break-in operation.
(e) Check of dimensions and weights.
(f) Determination of frequency overlap, limiting frequencies of various circuits and cycles per division of master oscillator dials.
(g) Check of protective circuits.
(h) Determination of percentage modulation, MCW power output and frequency of audio oscillator.

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(i) Determination of the voice characteristics of the high frequency transmitter unit.
(j) Frequency stability and accuracy under following conditions:
  (1) Accuracy of reset.
  (2) Lost motion, back lash, and torque lash.
  (3) Detuning of circuits.
  (4) Operation of power output control.
  (5) Change of tubes.
  (6) Variation of supply line voltage.
  (7) Variations in ambient temperature.
  (8) Variations in humidity.
  (9) Locked key operation for two hours.
  (10) Key locked to intermittently keyed condition.
  (11) Continuously keyed to intermittently keyed condition.
  (12) Inclination due to roll and pitch.
  (13) Vibration.
  (14) Shock.
(k) Check of the gasoline engine driven power unit.
(l) Determination of the adequacy of the antenna structures submitted.
(m) Check of field transportation equipment.
(n) Adequacy of assembly and maintenance accessories.
(o) Determination of voltage regulation and percentage of voltage ripple.

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Conclusions

(a) The physical appearance of the units is uniform and pleasing although the finish of certain units must be modified to correspond to the color used on the major items. Controls are arranged in an orderly and symmetrical manner to afford maximum ease in operation. The rear panel of each major unit is provided with interlocked access door to provide for ease in changing tubes and making minor adjustments. The units may be completely removed from their cases for more extensive adjustments or repairs. The rear panel of each major unit and in addition, the front panel of the rectifier, are provided with ventilating louvers. Outer cases and covers are of stainless steel, adequately braced by channels welded to the inner surface. Rubber bumpers are provided to protect the equipment against shock. The handles provided for carrying purposes are of good design, although the weight of the larger units is excessive for two men when the footing is unsatisfactory. In general, the weights of the equipment exceed the specification tolerances.

(b) The power output obtained at all frequencies exceeds the specification requirements. Difficulty is experienced in properly adjusting the output circuits of the high frequency transmitter when operating into the present high frequency antenna system in the region of 2,000 kilocycles. The frequency stability of the equipment under varying temperatures and degrees of humidity is excellent considering the fact that no temperature control is employed. The compensating devices provided for this purpose perform very well.

(c) The tubes used in the equipments, particularly the 38837 and to a lesser degree the 38266A, have not provided reliable performance with respect to tube life. This condition results from inherent tube weaknesses and the fact that the tubes are being operated too close to the safe limit.

(d) Another serious defect in the operation of the equipment results from the poor starting characteristics of the gasoline engine, particularly at low temperatures. Starting difficulties seriously impair the usefulness of the remote start feature, except when the engine is warm.

(e) The antenna system is so constructed that it may be set up readily by a trained crew and is of light but rugged construction. Complete transportation equipment was not provided with the preliminary model and hence definite conclusion as to the suitability of the equipment which will be supplied cannot be arrived at. The limited equipment provided performed satisfactorily although certain modifications are required to improve performance.

(f) A number of changes, modifications, and corrections are indicated in order to provide greater safety factors, effect greater ease in handling by operating personnel and in a small degree to improve frequency stability.

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Recommendations

Note: The numerals enclosed by parentheses refer to the paragraphs in the body of this report wherein the items under discussion are covered in detail.

It is recommended:

(a) (23) That the securing of the various units by lashing them to the deck, bulkhead, or stanchions be considered as satisfactory.

(b) (25,80) That a complete review of all factors of weight be made with a view of deciding whether the interests of the Naval Service will be served by sacrificing, in varying degrees, strength, reliability and operational characteristics in order to permit a decrease in weight.

(c) (27) That, in view of the satisfactory operation of non-standard resistors during the period of test, the Bureau of Engineering consider the advisability of waiving the specification requirements in these instances.

(d) (30) That the items which became corroded during the course of these tests be replaced with non-corrosive materials.

(e) (31) That wherever possible iron and steel parts be replaced by non-ferrous materials.

(f) (33a,158a) That all tuning controls be designed with sufficient clearances to obviate possibility of galling or binding.

(g) (33b) That additional clearance, at least 1/4", be provided for fuse clips in rectifier unit.

(h) (33c) That an improved terminal panel be provided on the rear of the rectifier unit to prevent possibility of short circuits and accidental grounds.

(i) (33d) That external connections to rectifier unit be modified to prevent accidental interconnection of power supplies.

(j) (33f,44c,44d) That necessary steps be taken to prevent application of excessive potentials to 38266A rectifier tubes.

(k) (33g) That steps be taken to provide filter capacitors in rectifier unit of proper voltage rating.

(l) (33h) That adequate clearances be provided between tube sockets and ground to prevent short circuits.

(m) (33i) That additional protective measures be incorporated to prevent overloading of transformer supplying control and bias potentials (Item 682) in rectifier unit.

(n) (39) That the substitution of ceramic insulation for the phenolic insulation now used in 500 and 1500 volt plugs and receptacles of connecting cables be investigated.

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(o) (44e to 44i incl.) That necessary steps be taken to prevent failure of 38837 vacuum tubes.

(p) (48) That all controls be equipped with insulated bushings where the use of such bushings is necessary to insure uniformity of appearance.

(q) (49) That intermediate frequency transmitter "Antenna Coupling Switch" be modified so that increase of controlled effect is obtained by increase in numerical settings.

(r) (53) That the protective glass cover on the intermediate frequency transmitter antenna ammeter be of clear glass instead of anti-glare glass; that necessary precautions be taken to insure continued satisfactory operation of all meters in the equipment.

(s) (60, 33e, 41) That the use of "flamenol" insulated wire be prohibited and that care be exercised to provide adequate voltage clearances for all leads. That all soldered connections be made in a workmanlike manner without use of excessive solder.

(t) (61, 216) That all exterior surfaces of the various units be painted a uniform color.

(u) (66) That additional consideration be given to provide means to exclude falling rain and moisture from the major units.

(v) (69) That triangular rubber buffers be substituted for round rubber pads on cases of major units and that necessary changes be made in transportation cart to accommodate these pads.

(w) (74) That diagrams secured to inner surfaces of covers of major units be given a protective coating to increase resistance to moisture.

(x) (76) That means be provided whereby it will be possible to distribute the weight of the major units (rectifier and transmitters) between four men when these units are prepared for transportation.

(y) (87) That necessary rearrangement of parts be made to eliminate interference between knurled head securing screw and d.c. control cable plug (green and white) on rear panel of rectifier unit.

(z) (91) That necessary steps be taken to prevent failure of switches during vibration.

(aa) (92, 102) That the carbon resistor gain control on the high frequency transmitter unit be considered as satisfactory.

(bb) (112b, 131) That the antenna systems and equipment be modified as necessary to produce satisfactory operation in the frequency range at and adjacent to 2000 kilocycles.

(cc) (99) That the distortion characteristics of the high frequency transmitter be considered as satisfactory.

(dd) (112c) That the overlap characteristics of the intermediate frequency transmitter be considered suitable and satisfactory.

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(ee) (115) That the master oscillator compensating condensers in the high and intermediate frequency transmitter units be equipped with suitable stops to prevent shorting.

(ff) (133) That the reinforcing rings provided in the ends of mast sections be improved by employing solid rings of stainless steel.

(gg) (135) That the present method for erecting masts be considered suitable. (If rocky locations are encountered, improvised methods will be necessary.)

(hh) (136) That the guy insulators provided be replaced by insulators of more satisfactory design.

(ii) (139) That the use of guys for measurement purposes in place of marked counterpoise spans be considered as satisfactory.

(jj) (151a) That the modulation characteristics of the high frequency transmitter be considered as satisfactory.

(kk) (152) That the Bureau of Engineering consider the advisability of accepting operation requiring reduction of plate potentials when operating into "Boat Antennas" over the range of 1200 to 2000 kilocycles and that suitable instructions be provided to insure safe operation under these conditions.

(ll) (155) That the requirement of one-man-minute adjustment be interpreted to mean adjustment after the necessary data have been extracted from the calibration curves.

(mm) (160b) That efforts be made to reduce reactions due to detuning IPA grid circuit of the intermediate frequency transmitters, but that if no reasonable modification of circuits can accomplish this, that the present reactions be considered as not excessive.

(nn) (163a) That efforts be made to improve the frequency stability of the high frequency unit in the region of 4500 kilocycles with respect to variations in supply line voltage.

(oo) (169A) That efforts be made to improve the frequency stability of the high frequency unit when subjected to roll and pitch.

(pp) (171b) That, in view of the fact that the major portion of the frequency variation occurs during the first shock, the performance of the equipment be considered as satisfactory.

(qq) (178) That the rubber sleeves provided for waterproofing cable terminals be made more flexible.

(rr) (179) That the Bureau of Engineering consider the advisability of procuring additional accessories (as indicated) and that a heavier and larger mallet (with spare inserts) be provided.

(ss) (183) That consideration be given to obtaining microphone potentials from output of copper oxide rectifier instead of from the 1500 volt rectifier, as at present.

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(tt) (184) That consideration be given to inclusion of 6-volt trouble light with the accessories.

(uu) (187) That the hinges of the accessory box be modified and strengthened and that compartments be marked for identification of contents.

(vv) (188) That non-ferrous materials be used in construction of transportation carts wherever feasible and desirable.

(ww) (189, 190, 193, 195, 196, 197) That certain items of construction employed in transportation cart be modified as indicated.

(xx) (192) That further investigation be made with a view of improving stability of transportation cart during inclined operation.

(yy) (200) That efforts be made to bring the dimensions of the disassembled transportation cart within specification limits.

(zz) (207) That the necessary modifications be made to render the gasoline engine leak-proof when placed in condition for transportation.

(aaa) (210, 211, 217, 223, 224, 224, 227, 229, 230, 232, 235, 236, 238, 239, 242) That the necessary modifications be wrought in the design of the gasoline engine and starting motor to provide starting, operational, storage and servicing characteristics compatible with specification requirements.

(bbb) (246) That a stronger chain be furnished for securing protective end cover to generator.

(ccc) (249) That an improved fuse holder be provided for the exciter fuse in the engine control panel.

(ddd) (257) That a suitable partition be inserted above the cable stowage compartment in the engine control panel to prevent injury to electrical connections.

(eee) (258, 259, 260) That suitable modifications to various parts of the engine control panel be effected to produce a more satisfactory assembly.

(fff) That acceptance of the Model XTBR-1 equipment be held in abeyance until satisfactory modifications have been accomplished and assurances have been offered by the contractor that all of the items referred to above will be corrected in a manner which meets with the approval of the Bureau of Engineering.

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MATERIAL UNDER TEST

4. The material under test consisted of one Model XTBR-1 Transmitting and Receiving Equipment, minus certain auxiliary or accessory parts which were not required to be submitted under the terms of the contract governing preliminary models.

5. The equipment was manufactured by the General Electric Company, Schonectady, New York, and was received at the Naval Research Laboratory on October 11, 1937, via the Davidson Transfer Company.

6. The Model XTBR-1 equipment consists of the following major units:

1 - High Frequency Transmitter
Frequency Range: 2000 to 18100 kilocycles
Emission: CW; MCW; Phone
Nominal Rated Output: 100-150 watts

1 - Intermediate Frequency Transmitter
Frequency Range: 300 to 2000 kilocycles
Emission: CW and MCW
Nominal Rated Output: 100-150 watts

1 - Rectifier Unit
Input: 115 volts, 60 cycles

1 - Gasoline Engine Driven Generator Unit

1 - Receiver unit

1 - Receiver Power Unit

There is supplied, in addition, complete antenna equipment, transportation cart and accessory equipment.

METHOD OF TEST

7. The equipment, when received, was carefully examined to determine whether any breakage had occurred during transportation and whether adequate precautions had been observed in preparing the apparatus for shipment.

8. With the aid of the preliminary instructions furnished, the equipment was placed into commission.

9. Power output determinations in the high frequency range were accomplished through the medium of a 300 watt, 115 volt lamp and a calibrated photronic cell, the output of which was measured by a microammeter. The base of the lamp was removed in order to minimize capacity losses. At intermediate frequencies output measurements were made using dummy antennas of the proper characteristics and the I^2R method of determining power was employed.

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10. Frequency changes and drifts were checked by means of the Model LK-1 frequency drift indicator. Frequency range, overlap and kilocycles per division of marking were determined by means of the Model LD-2 Heterodyne Calibrator, Serial Number 1.

11. Ripple voltage measurements and the determination of harmonic content were made through the medium of the Model 636 wave analyzer.

12. Model RAA and RAB receivers were used in the tests for determining the quality of emission under the various conditions specified by the governing contract.

13. Audio frequency measurements and modulation investigations were conducted through the use of the Model OB Audio Analyzing Equipment and cathode ray oscillographs.

14. The ability of the equipment to withstand vibration and the roll and pitch of a vessel was determined by means of the test equipment designed for this purpose. The effect of temperature and humidity variations were studied in the test chamber, the design of which permits these characteristics to be varied over wide limits.

15. The behavior of the complete equipment was studied by actual field tests and the qualities of strength, flexibility and weight were determined by the usual methods. A special device was constructed for determining the ability of the interconnecting cables and plugs to withstand repeated flexing.

DATA RECORDED

16. Complete data were recorded on all tests conducted and this information is contained in Tables 1 to 100 and Plates 1 to 35 inclusive.

PROBABLE ERRORS IN RESULTS

17. Every effort was made to minimize errors in the results obtained through the selection of the proper measuring equipment of verified accuracy. Where single measurements might lead to doubtful results, repeat checks were made in order that a trustworthy average could be obtained.

18. Frequency drift measurements have been found to be accurate to within one or two cycles in one million, when employing the Model LK-1 equipment. The accuracy of the heterodyne calibrator is about 0.005%.

19. Power output measurements should be accurate to within 5%. The values of resistance used in the dummy antennas were accurately determined and care was exercised to provide sufficient overload margins to prevent undue heating of the resistive and capacitive elements.

20. The determination of percentage modulation is assumed to be accurate to within a plus or minus 2 to 3%.

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RESULTS OF TESTS

21. Upon receipt of the Model XTBR-1 equipment it was noted that satisfactory precautions had been taken to safeguard the material during shipment. The major units were enclosed in their regular carrying cases which in turn were protected by the special canvas slip covers. Each unit was then enclosed in a shipping case containing adequate packing material. No damage was incurred during shipment.

22. In the following paragraphs of this report reference is made to the governing specifications RE 13A 518B and RE 13A 506B under which this equipment was constructed. Since complete receiver tests were conducted and reported in reference (1) no further reference to the receiver will be made in this report other than its operation as a complementary portion of the complete installation. Where no specific reference is made to any particular paragraph of the specifications, it is to be understood that such paragraphs are essentially explanatory and require no specific tests, or that the paragraphs are general in scope and are covered in greater detail elsewhere.

Specification RE 13A 518 (Section I - Introductory)

23. Par. 1-4. This paragraph states that while the subject equipment is intended primarily for use ashore, it shall be suitably designed and constructed to permit the use of the equipment on various types of vessels - - -. In the case of equipment designed primarily for shipboard use means must be provided for securing the units to the deck through the medium of suitable fittings so that damage will not be incurred during heavy weather. No definite provision is made for securing the high frequency transmitter, intermediate frequency transmitter, rectifier, antenna loading coil, or gas engine unit of the XTBR-1 equipment to a deck or bulkhead. The receiver and receiver power unit can be secured to a table or similar horizontal surface through the medium of four flexible Lord mountings. The various units comprising the transmitting equipment could be lashed to suitable supports by means of lines or ropes. The intent of the specifications is not sufficiently clear to determine whether such lashing could be construed to indicate compliance with the terms of the specifications.

24. Par. 1-5. An external loading coil has been supplied for use in connection with the intermediate frequency transmitter unit in order to permit operation in a 40 foot motor launch equipped with an inverted "V" antenna. The load coil is enclosed in a waterproof case of the following dimensions:

Height: 12-1/2"
Width: 16"
Depth: 15-3/4"

The removal of the front cover exposes the panel of the unit which is fitted with the following:

Insulated antenna terminal
Insulated transmitter terminal
Ground binding post
10 position tap switch
Calibration chart

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As stated in paragraph 23 above, no definite provision is made for securing the loading unit. The electrical characteristics of this equipment are discussed under paragraph 7-8.

25. Par. 1-11. Reference to Table 1 attached hereto lists the weights of the various units and accessories which go to make up the Model XTBR-1 equipment. Due to the fact that the contractor was not required to submit the equipment in its entirety, certain of the weights listed in the table are derived from the contractor's estimates. The following comparison between actual weights and specification weights are given:

(a) Basic equipment complete (i.e., for high frequency operation:

Specifications:	1890 lbs.
Actual:	2268 lbs., 12 oz.

(b) Supplementary equipment complete (i.e., additional items necessary with (a) for intermediate frequency operation:

Specifications:	460 lbs.
Actual:	506 lbs., 3 oz.

(c) Complete basic and supplementary equipment (for high and intermediate frequency operation:

Specifications:	2052 lbs.
Actual:	2807 lbs., 3 oz.

(The latter figure includes weights of antenna loading coil.)

It will be noted that in all instances the specification weights have been exceeded.

26. Par. 1-12. This paragraph lists the contemplated weights of the various parts of the Model XTBR-1 equipment. Table 1 attached hereto lists the weights of the various parts of the equipment so that a comparison can be made.

Specifications RE 13A 518 (Section II - General)

27. Par. 2-2. Certain items of resistors used in the construction of this equipment fail to comply with the requirements of subspecification RE 13A 372G. These items are listed on pages 3 and 4 of reference (h). The resistors employed are of the pigtail or solder tab type, whereas the specifications require the ferrule type. During the course of these tests, no difficulties were encountered in connection with these resistors. Due to the nature of the equipment under consideration and the necessity for conserving weight and space, it is recommended that the Bureau of Engineering consider the advisability of waiving the specification requirements in these particular instances. The ability of this type of resistor to sustain severe overloads without permanent injury is illustrated in paragraph 33(h).

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28. Par. 2-3. The high frequency, intermediate frequency, and rectifier units are constructed of 1/8" x 3/4" angles (apparently Dural) reinforced at corners with 1/8" gusset plates which are riveted to the frame members. Further bracing and reinforcement is provided by sub-panel supporting angles which are secured to the main frame by 1/8" riveted gusset plates. The 1/8" front panel and sub-panel also reinforce the frame, thus providing a rigid assembly of adequate strength. The outer cases are constructed of stainless steel sheet. The corners are heavily reinforced by 1/8" x 2" stainless steel angles spot welded to the outer case. The side walls are further braced and reinforced by light gauge channels 1/2" x 1", spot welded horizontally at 7 inch intervals. 1/2" x 1/2" channels are placed at angles between the horizontal braces. All horizontal braces are faced with bakelite strips to prevent abrasion between cases and frame and to prevent intermittent contact. Sturdy phosphor bronze springs of "U" shaped construction are attached to the top and bottom of the cases to provide ground connections to the frame. Louvers are provided in back panels of all units for ventilation. These louvers are approximately 3" x 3/8" openings, spaced 1" apart. All louvers are backed by screening to prevent the entrance of foreign matter. The rectifier unit is provided with additional louvers on the lower front panel.

29. Par. 2-4. In general, the construction of the equipment reflects good workmanship and design. Such items which were found to require modification or correction are listed under appropriate paragraphs of the specifications.

30. Par. 2-5. During the course of the tests and at the conclusion of the tests herein described, the equipment was inspected for evidence of corrosion. The following items were noted:

(a) Spring clips on the power amplifier tube socket contacts; both intermediate frequency and high frequency units.

(b) Copper oxide rectifier bracket washers; rectifier unit.

(c) Voltmeter multiplier bolt; rectifier unit.

Certain other items entering into the construction of this equipment possess magnetic qualities where not required for electromagnetic purposes, and though no corrosion was in evidence at the conclusion of the tests, these items are listed in paragraph 31 below.

31. Par. 2-6. A list of the iron or steel (magnetic) items used in the construction of the various units is listed below. It is realized that many of these items may be fashioned from stainless steel and still possess magnetic properties. This could not be definitely determined without disassembly and probably destruction of parts. Hence all magnetic items are listed for consideration.

DECLASSIFIED

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Intermediate Frequency Transmitter Unit

(1) Key relay pivot screws (no finish)
(2) Filament rheostat contact arm (plated)
(3) Spring clips on P.A. tube socket contact prongs (corrosion started)
(4) Case of condenser Item 492 (tinned)
(5) Rear part of test key support bracket (plated) (Blue steel screws employed)
(6) Front panel handle screws (plated)
(7) All control shafts from knobs to coupling (not plated - obviously stainless steel)
(8) All "Allen" type set screws
(9) Switch plate securing screws, front panel (black)
(10) Handle assemblies on carrying case (painted)

High Frequency Transmitter Unit

(1) Key relay pivot screws (no finish)
(2) Spring clips on P.A. tube socket contact prongs (corroded)
(3) Rear part of test key support bracket (plated) (Blue steel screw employed)
(4) Front panel handle screws (plated)
(5) All control shafts from knobs to coupling (not plated - apparently stainless steel)
(6) All "Allen" type set screws
(7) Switch plate securing screws, front panel, (not plated)
(8) Condenser case (item 249)
(9) Handle assembly on carrying case (painted)

Rectifier Unit

(1) Handle assemblies on carrying case (painted)
(2) Terminals for remote controls and a.c. line (plated)
(3) Spring caps for covering cable receptacles (plated)
(4) Thumb screw bushings on back panel (also applies to h.f. and i.f. units)
(5) Door catch rivets (also applies to h.f. and i.f. units)
(6) Screws (miscellaneous)
(7) Copper oxide rectifier brackets
(8) Relay armature guide (plated)
(9) Voltmeter multiplier case and bolts.

32. Par. 2-7. The XTBR-1 equipment is so designed that it operates satisfactorily in any ambient temperature between the limits of -20° Centigrade to +50.5° Centigrade, and for any value of relative humidity up to 95% at 45° Centigrade. The specifications require a low limit of temperature of -32° Centigrade, but due to test facility restrictions, the minimum temperature obtainable during these tests was -20°. During the first humidity test to which the equipment was subjected, a voltage breakdown occurred in the high voltage wiring of the rectifier unit. The nature of this breakdown, which is discussed in greater detail under paragraph 2-45 (conductors) was such

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that it is impossible to state definitely that it was due entirely to high humidity conditions, although it is believed that the high humidity may have been a contributory factor. The effect of humidity upon frequency is discussed in detail under paragraph 7-13-9 and the effect of varying ambient temperatures is covered under paragraph 7-13-8. The effect of high humidity upon the entire equipment when idle is discussed under paragraph 2-13, while the effect of low temperatures upon the starting characteristics of the gasoline engine unit are detailed under paragraph 5-9 of Specifications RE 13A 506B. With respect to the requirements of the equipment covered by Specifications RE 13A 518B, it may be stated that the Model XTBR-1 complies with the intent of paragraph 2-7.

33. Par. 2-8. This paragraph requires that the design of the electrical circuits and controls must be liberal and that suitable protection be afforded to take care of overloads. The items listed below require further consideration and improvement in design.

(a) During tuning operations in connection with the high frequency transmitter unit, the master oscillator dial control galled and became practically immovable. Investigation revealed that the shaft had "frozen" in the bearing due to lack of sufficient clearance. This defect was remedied by a representative of the manufacturer and no further trouble was experienced on this score. That the greater clearance provided in this control had no ill effect upon the backlash characteristics of the equipment is illustrated in Table 56. Hence, it is recommended that in production equipment care be exercised to provide sufficient clearances in all controls to prevent failure due to binding or galling.

(b) The 3 ampere, 250 volt fuse clips in the rectifier unit are spaced for a clearance of only 1/32". Steps should be taken to increase this clearance to at least 1/4".

(c) The back panel of the rectifier unit is equipped with a bakelite terminal board which provides the following terminals:

3 - for extending the engine start stop wiring
2 - for a.c. line connections
2 - for rectifier start-stop.

This terminal board is so restricted in size and the terminals are spaced so closely that difficulty is encountered in making connections with wire sizes of No. 14 or larger. Unless extreme care is taken a short circuit to the metal panel of the equipment will develop. The size of this terminal panel should be increased to provide greater clearances and thus remove the possibility of accidental grounds.

(d) With the 115 volt a.c. line plugged from the control panel of the gas engine unit to the rectifier unit, if 115 volts a.c. from a line should be connected to the rectifier line terminals located on the bakelite terminal board, the two power sources would be interconnected with possibility of damage occurring. If the a.c line terminals on the rectifier and the plug receptacle terminals on the

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rectifier were connected to a D.P.D.T. switch, this situation would be avoided. Or, as an alternative, the a.c. line terminals could be eliminated and arrangements made to plug either the alternator supply or line supply into the same receptacle. A ten foot cable suitable for this purpose is provided with the equipment. This cable has a plug on one end only while the wires protruding from the opposite end are left bare for making connection to any type of suitable terminal.

(e) The high voltage wiring in the rectifier unit broke down during the course of the humidity tests. A detailed account of this failure will be found under paragraphs 2-7 and 2-45.

(f) The manufacturer's data covering the Type 836 Half Wave Rectifier Tube (38266A) state that the d.c. output voltage of a full wave, single phase circuit at no load shall not exceed 1590 volts. During adjustment of the circuits in the XTBR-1 equipment it was frequently observed that the d.c. output voltage of the main rectifier reached 1600 volts. By careful monitoring of the line voltage and power tap switch the voltage can be held to 1500 volts or less, but the fact remains that it is readily possible to obtain higher voltages. This must be construed as violating the requirement which specifies that the design of all electrical circuits must be liberal. It is recommended that in production equipments steps be taken to insure that safe operating potentials are not exceeded. This may result in a small reduction in power output under some circumstances but in the interests of safe and reliable operation it is deemed expedient to accept this reduction.

(g) The filter capacitors of the main rectifier are rated at 1500 volts. As stated in sub-paragraph (f) above, these capacitors are frequently subjected to 1600 volts. The filter capacitors in the auxiliary rectifier are stamped as being rated at 200 volts, while this circuit actually operates at potentials as high as 600 volts. It is understood that these condensers are actually rated at 600 volts but the marking is incorrect. From the foregoing it will be seen that no practical leeway has been provided. However, it must be stated that during the tests of this equipment no trouble was experienced with the filter condensers.

(h) The following 38837 tubes are mounted in the equipment in such a manner that the bottom portion of the tubes is shielded by a metallic cylinder rising above the tube socket:

Master oscillator, high frequency unit
1st I.P.A., high frequency unit
2nd I.P.A., high frequency unit
Master oscillator, intermediate frequency unit
I.P.A., intermediate frequency unit

These shields are so secured to the tube sockets that exceedingly small clearance exists between the shield and the rivets by which the socket prongs are secured to the Isolantite wafer which constitutes the tube socket insulation. During the vibration tests to which the intermediate frequency transmitter unit was subjected, this lack of clearance resulted in the destruction of the I.P.A. tube under the following circumstances. During vibration a small piece of stray

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solder was shaken into the tube socket and lodged on one of the rivets mentioned above. This piece of solder was of a size about twice that of the head of an ordinary pin. Yet it was sufficient to cause a ground to the shield. This ground removed the biasing potential developed across resistor item no. 508. Although the equipment was shut down as soon as possible, later tests revealed that the tube had lost its usefulness. Should the tube socket become loose during service, a small movement might result in a similar short circuit. Hence, it is recommended that steps be taken to increase the clearances in the five tube sockets mentioned above. It might be mentioned that although the biasing resistor was subjected to an excessive overload which resulted in extreme discoloration, subsequent tests revealed that it was still capable of satisfactory operation.

(i) During the course of the intermediate frequency transmitter unit vibration tests an incident occurred which revealed the fact that insufficient protection is afforded the transformer (Item 682) in the rectifier unit which supplies potential to the copper oxide rectifier item 692. This rectifier furnishes d.c. potential at about 60 to 70 volts for the operation of relays and also bias for the high frequency power amplifier tubes. Vibration caused the disintegration of the interlock mechanism which is attached to the intermediate frequency unit antenna coupling switch. A portion of this mechanism lodged across the 60 volt d.c. line causing a short circuit. The keying relay became inoperative but before the cause of the trouble was located smoke issued from the rectifier unit and inspection revealed that transformer Item 682 was overheating badly. The primary of this transformer is protected by a 3 ampere fuse (Item 698), which also is in series with the supply to the filament transformer, Item 683. This fuse failed to blow and hence cannot be considered as affording reliable protection. It is recommended that a more satisfactory means of protection be provided, either by reducing the size of fuse 698 or by inserting a suitable fuse in the d.c. output circuit of the copper oxide rectifier (Item 692).

(j) The high voltage fuses in the equipment, the main line circuit breaker and the remaining low voltage fuses gave adequate protection to the equipment during these tests, Several times overloads occurred in various portions of the equipment without damage other than the disruption of the fuses.

34. Par. 2-9. The equipment was subjected to numerous tests at ambient temperatures of 50° Centigrade without incurring damage due to overheating. Ventilation is provided by means of louvers in the rear panels of the various units and by direct radiation from the metallic enclosing case. The effect of continued running at high temperature of the gasoline engine will be discussed later in this report under Specifications RE 13A 506B.

35. Par. 2-10. Capacitors of the so-called "electrolytic" type have not been used in the construction of the XTBR-1 equipment.

36. Par. 2-11; 2-12. During the various tests conducted with the equipment, including key locked tests at high ambient temperatures (50° Centigrade) no evidence of undue heating was observed in connection with the filter condensers provided. The filter capacitors have apparently been dipped in wax with some of the wax remaining

DECLASSIFIED

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to coat the top surfaces. This wax became soft when operating in ambient temperatures of 45° C or higher, but did not flow or cause any apparent harm. The filter capacitors provided in the main rectifier consist of two 10 mfd units rated at 1500 volts. The filter capacitors of the auxiliary rectifier consist of two 10 mfd units stamped as being rated at 200 volts. (See paragraph 33 (g) above for a further discussion of these units.)

37. Par. 2-13. The moisture resisting characteristics of the various transformers, audio reactors, resistors and, in fact, all the component parts which form the complete assembly were checked by the following method. The equipment, including both high frequency and intermediate frequency units, was operated and checked at an ambient temperature of 30° C and a relative humidity of 26%. The equipment was then shut down and permitted to remain idle for a period of approximately one hour during which time the temperature was raised to and held at 45° C with a relative humidity of from 85% to 95%. The equipment was then started and the action observed. As illustrated in Table 2 covering the high frequency transmitter and Table 3 covering the intermediate frequency transmitter, normal operation was obtained without any signs of breakdown due to moisture. As reported in the foregoing tables, the only change of any importance observed was the difference in frequency between the low humidity at 30° C and the high humidity at 45° C.

38. Par. 2-19. During the course of numerous key locked full power runs at various temperatures ranging up to 51° C, no leakage of compounds or wax was observed other than the softening of the exterior wax on the filter capacitor units in the rectifier, as detailed in paragraph 36 above.

39. Par. 2-20. The radio frequency insulation employed in the construction of the equipment is of excellent quality. Phenolic insulation is not used for radio frequency purposes at frequencies above 2000 kilocycles. The intermediate frequency unit employs phenolic insulation coil forms in some locations but even in this unit liberal use of ceramic insulation is made. Phenolic insulation is not used for insulating d.c. potentials in excess of 500 volts except in the following instances:

Plugs and receptacles of the 1500 volt d.c. circuit.
Plugs and receptacles of the 500 (plus) volt d.c. circuits.

It is understood that the contractor intends to employ ceramic insulation for this purpose in production equipments.

40. Par. 2-21. The various units of the equipment were subjected to repeated handling and dismantling, vibration, shock and inclination up to 45° from the vertical while in operation without incurring damage other than the items mentioned under paragraph 33 above. Due to lack of suitable facilities the acceleration test called for under this paragraph was not conducted.

DECLASSIFIED

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41. Par. 2-22. In general, the equipment is proof against the effects of shock and vibration. However, as pointed out in paragraph 33 above, two failures occurred in the intermediate frequency unit which were directly traceable to the influence of vibration, lack of sufficient clearances and the careless use of solder. In this connection, it is pointed out that numerous soldered joints show evidence of poor workmanship. This condition should be corrected in production models.

42. Par. 2-23. No individual items or componont parts, such as tube sockets, are flexibly mounted within the transmitter or rectifier units. However, the entire unit is equipped with eight rubber mountings, four on the bottom and four on top, which protect the entire equipment against the effects of vibration. No tube failures occurred which could be directly ascribed to the effects of vibration.

43. Par. 2-24. All vacuum tube sockets are of the individual type, no gang sockets being employed in the construction.

44. Par. 2-25 and 2-26. Vacuum Tubes.

(a) The following vacuum tubes are employed in the Model XTBR-1 transmitting equipment.

Rectifier Unit

Main Rectifier - 2 - 38266A Tubes
Aux. Rectifier - 2 - 38266A Tubes

High Frequency Transmitter Unit

1 - 38837 tube; Master oscillator
1 - 38837 tube; 1st I.P.A.
1 - 38837 tube; 2nd I.P.A.
1 - 38837 tube; audio oscillator or modulator.
2 - 38803 tubes; Power amplifier

Intermediate Frequency Transmitter Unit

1 - 38837 tube; Master oscillator
1 - 38837 tube; I.P.A.
1 - 38837 tube; audio oscillator
2 - 38803 tubes; power amplifier

(b) All tubes received with the equipment were subjected to routine tests before any of the tubes were placed in operation in the Model XTBR-1. Of the eight 38266A rectifier tubes submitted, all passed the preliminary tests as satisfactory. Fourteen 38337 tubes were furnished with the equipment and all of these tubes tested as satisfactory with the exception that three tubes had loose bases and one tube had bent prongs. Eight 38803 tubes were received and all of these tubes passed the routine tests.

DECLASSIFIED

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(c) During the course of the tests outlined in this report and after the rectifier unit had been subjected to approximately 125 hours of operation, more than 50% of this time being consumed in full power output tests, two of the 38266A tubes failed. These tubes, Serial Numbers 5111 and 6831, had been installed in the main rectifier. The failure of these tubes caused the repeated blowing of the fuses which protect the primary of the high voltage rectifier transformer. Inspection revealed that No. 5111 was suffering from a loss of emission and that the cathode was defective while No. 6831 arced back after three minutes of operation. As stated in paragraph 33(f) above, the manufacturer's data covering the Type 836 tube (38266A) states that the d.c. output voltage of a full wave, single phase circuit at no load shall not exceed 1590 volts. The peak inverse voltage is limited to 5000 volts. Measurements were made to determine whether these values were likely to be exceeded in the XTBR-1 equipment. The following data were obtained:

Line volts - 115
Line tap - 3
A.C. volt, high voltage transformer: 3615 r.m.s.
Peak value: 5100
D.C. Output voltage: 1600

Line volts - 115
Line tap - 2
A.C. volts, high voltage transformer: 3300 r.m.s.
Peak value: 4660
D.C. output voltage: 1490

These measurements were made with a precision type voltmeter and in both cases the filament voltage was adjusted to the correct value. Hence it will be seen that the main rectifier tubes are likely to be subjected to over voltage. This may contribute to the tube failures encountered. During the course of this investigation, the Vacuum Tube Section selected two 38266A tubes from stock (not received with the Model XTBR-1) which tested normally. These tubes were subjected to a life test in accordance with standard specifications. After 442 hours of operation both tubes failed due to arc-back. During the course of the tests a representative of the manufacturer submitted two 38266A tubes to the Laboratory for investigation, the understanding being that these tubes were of later manufacture and of improved construction. These tubes were placed on life test (in Vacuum Tube Section) on December 21, 1937. At this writing no report is available on these tubes.

(d) It would appear, however, from the foregoing data, that the 38266A tubes in the Model XTBR-1 equipment are being operated too close to the safe limit and at times can be subjected to over voltage even though normal filament adjustments exist. It is recommended that the Bureau of Engineering consider the advisability of reducing the plate voltage to which these tubes can be subjected to such an extent that regardless of which line tap is used, when the filament potential is normal, the safe rating of the tube cannot be exceeded.

DECLASSIFIED

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(e) A considerable number of 38837 tubes failed during the course of the tests to which the Model XTBR-1 equipment was subjected. As noted above, three 38837 tubes as received had loose bases. As the tests progressed, the bases of several other tubes submitted with the equipment became loose. This did not cause the tubes to become inoperative, but extreme care had to be exercised in removing them from the sockets and when placing them in the sockets, a condition which would be extremely annoying if not dangerous under normal operating conditions. Early in the tests it was noted that while operating the high frequency transmitter unit, particularly at the high end of the frequency range, the plate current of the 2nd I.P.A. tube, and to a lesser degree, the plate current of the 1st I.P.A. tube, showed a tendency to creep upward. This upward creep of plate current continued until it was necessary to shut down the equipment. A total of three tubes were observed to suffer from this defect; namely Nos. 3, 5, and 14. (Note: Since the 38837 tubes are not assigned serial numbers, these designations are numbers given to the tubes for reference purposes.) The tubes in question were turned over to the Vacuum Tube Section for investigation and the results of the preliminary investigation are reported in Naval Research Laboratory letter S67/38 of 19 November 1937 to the Bureau of Engineering. From the evidence obtained, it appears that the cause of this abnormal operation is due to primary emission from the No. 1 grid.

(f) As the tests progressed, 38837 tube No. 8 failed due to a grid-cathode short circuit. During vibration tests of the intermediate frequency transmitter unit certain mechanical failures occurred as described in paragraphs 33(h) and 33(i) above. These mechanical failures resulted in momentary overloads being applied to the I.P.A. tube so that excessive plate current was drawn. Tubes No. 4 and No. 11 were in the I.P.A. socket when these two failures took place. Both tubes became inoperative and investigation revealed that both tubes were subject to excess grid currents. Another tube, No. 15, which was drawn from Navy stock for these tests, also failed due to a defective cathode. This failure apparently was due to incorrect manufacture.

(g) The various failures noted above were called to the attention of the contractor and on November 24, 1937, a representative of the manufacturer delivered two additional 38837 tubes to the Laboratory. These tubes are designated as Nos. 39 and 40. These tubes were placed in the 1st and 2nd I.P.A. circuits of the high frequency unit on November 24 and have continued to operate in those circuits to date; that is, for the remainder of the tests, without any evidence of failure or faulty operation.

(h) The maximum ratings and typical operating conditions assigned to the 837 tubes (38837) by the manufacturer, state that the maximum d.c. plate voltage to be employed is 500 volts. An investigation was conducted to determine the actual potentials applied to the various 38837 tubes employed in the XTBR-1 equipment. This data is tabulated below.

DECLASSIFIED

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High Frequency Transmitter Unit

	Key closed	Key closed
Line volts:	115	115
Line tap:	2	3
Aux. Rect. E.:	550	580
M.O. Ep:	420	455
1st IPA Ep:	518	555
2nd IPA Ep:	518	555
Audio Ep:	415	450

Intermediate Frequency Transmitter Unit

	Key closed	Key closed
Line volts:	115	115
Line tap:	2	3
Aux. Rect. E:	555	610
M.O. Ep:	498	530
I.P.A. Ep:	500	540
Audio Ep:	485	520

Filament voltages adjusted to correct value on all readings.

From the foregoing data it will be observed that the plate voltage applied to the intermediate amplifier tubes of both the intermediate frequency and high frequency transmitter units is in excess of the rated voltage.

(i) In order to obtain further information in connection with the Type 38837 tubes, a dozen of these tubes were purchased from the Radio Corporation of America. These tubes were purchased with the proviso that they be of the latest manufacture and hence incorporate all improvements accomplished to date. At this writing the tubes have been subjected to 600 hours in the life test racks of the Vacuum Tube Section (non-oscillating test). Three of the 12 tubes are beginning to show an appreciable increase in grid current. It is contemplated that more information will be available in connection with this test at a somewhat later date. This information will be submitted to the Bureau of Engineering in the form of a supplementary report.

(j) One 38803 tube failed during the course of the tests to which the Model XTBR-1 equipment was subjected. This failure was evidenced by reverse grid current and high plate current when operation was attempted from a cold start. The overload was sufficient to disrupt the protective fuses. Investigation revealed that Tube Serial No. 38436 had become gassy. All 38803 tubes supplied had been tested prior to being used in these tests and No. 38436 as well as all other 38803's had functioned normally. Since these tubes appear to be operating well within their normal ratings, the only conclusion which can be drawn indicates that this particular tube had some inherent weakness which was not revealed by the short routine test to which it was subjected prior to the tests in the intermediate frequency transmitter unit.

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(k) Summary. The information and data obtained during the tests of the XTBR-1 equipment indicate that the 38266 rectifier tubes are likely to be a source of trouble and failure and that these tubes are being operated too close, and in some instances above their safe rating. The 38837 tubes supplied suffer from a number of causes as evidenced by loose bases, primary grid emission, failure to resist momentary overloads and the indication that they are being subjected to excessive plate potentials. The general conclusion arrived at is that the 38837 tubes are being operated too close to their top limit and that even the normal ratings prescribed by the manufacturer are not conducive to long life and uninterrupted operation.

45. Par. 2-27. The various units of the equipment are completely shielded against external influences and the tests indicate that the internal shielding between circuits is adequate to prevent unwanted reactions. Ground terminals are provided by means of which all cases can be operated at ground potential when the equipment is in operation.

46. Par. 2-28. The nature of the equipment is such that extreme simplicity of controls cannot be obtained. However, the design is such that commensurate with the specification requirements the design is as simple as possible.

47. Par. 2-29. The design of the equipment is such that by the use of controls appearing on the front panel of the various units, adjustment to any frequency within the specified bands may be accomplished. The number of controls, their designations and the purpose of each is listed in the following tables:

High frequency transmitter - Table 4
Intermediate frequency transmitter - Table 5
Rectifier unit - Table 6

48. Par. 2-30. All metal control shafts are grounded to the frame of the equipment and all knobs and handles are insulated to prevent the possibility of radio frequency burns. Various control shafts are fitted with insulated washers or bushings between the knobs and the panel. These bushings tend to improve the appearance of the equipment. It was noted that several shafts were not equipped with these bushings. The controls in question are listed below:

High Frequency Transmitter Unit
M.O. Band Change Switch
P.A. Band Change Switch

Intermediate Frequency Transmitter Unit
Antenna Band Change Switch

Steps should be taken to insure that all controls are uniform in appearance and equipment in the production models.

49. Par. 2-31. The equipment is so designed that all controlled effects increase with nomerical settings with the exception of the intermediate frequency transmitter "antenna coupling switch." This switch permits a decrease of the controlled effect (coupling) with increase in numerical settings.

DECLASSIFIED

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50. Par. 2-32. All dials increase numerically in a clockwise direction and the design is such that all verniers and main dials move in the same direction.

51. Par. 2-33. All dials and verniers are marked on the basis of 10 or 100 and the marking is such as to provide continuity throughout the dial range.

52. Par. 2-34. All indicating instruments and other devices are located on the front panels and are suitably marked for identification. The arrangement is such, as far as space permits, that the various meters are arranged in a symmetrical manner. The antenna ammeters on the intermediate and high frequency units are mounted behind the front panels rather than on the front panel to insure adequate insulation. See Table 7.

53. Par. 2-35. All electrical indicating instruments included in the equipment are of the 2.5 inch flush mounting type, with the exception of the frequency meter mounted on the engine control panel, which is of 3.5 inch diameter. All meters are fitted with anti-glare glass with the exception of the frequency meter on the engine control panel. The glass cover over the recessed antenna ammeter in the high frequency unit is of plain glass while the cover in the intermediate frequency unit is anti-glare glass. It is recommended that both glass covers be of the plain glass type since visibility is extremely poor through two thicknesses of the anti-glare glass. During the course of these tests the antenna ammeters of both the high frequency and intermediate frequency units became inoperative. During vibration tests the line voltmeter in the rectifier unit became "sticky" due to the pointer making contact with the dial card.

54. Par. 2-36. All d.c. meters are provided with by-pass units in the form of 0.01 mfd capacitors rated at 600 volts d.c. The voltmeter multiplier is not provided with a by-pass unit.

55. Par. 2-37. Meter replacements can be accomplished from the front panels, the meter connections being made through the medium of flexible leads of sufficient length to permit withdrawal of the instrument. The external voltmeter multiplier has a sensitivity of 1000 ohms per volt and is protected by a perforated enclosing cover.

56. Par. 2-40. Resistor mountings are marked with type number and resistance values. Fuse mountings are marked to indicate voltage and current ratings. Tube mountings and other component parts are not marked with designating symbols. This type of marking is waived in the preliminary model under the terms of paragraph 2-38-2 of the specifications.

57. Par. 2-42. This paragraph requires "The equipment must be designed so that safe operation and satisfactory performance are assured." The various items entering into the construction of the equipment which are not in complete agreement with this requirement are discussed in detail under appropriate paragraphs of the governing specifications.

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58. Par. 2-43. In order to prevent accidental contact with potentials in excess of 150 volts, all access doors in the high frequency, intermediate frequency, and rectifier units are provided with interlocks. Opening of these doors removes all potentials in excess of the line potential. The interconnection cables are heavily insulated and the terminal board located on the rear panel of the rectifier unit is provided with a protective cover. Insulated lead-ins and counterpoise leads are provided in connection with the high frequency and intermediate frequency antenna systems. The counterpoise system itself is at high potential above ground and contact with this system, which is constructed from bare antenna wire, would result in radio frequency burns. However, any attempt to insulate the counterpoise wires sufficiently to prevent this condition would result in an extremely cumbersome system of increased weight and would increase the difficulties of stowage and handling.

59. Par. 2-44. Suitable reversed etched nameplates are provided on all units and the markings of the various controls are legible and satisfactory.

60. Par. 2-45. All conductors used in the equipment are suitably anchored to prevent undue movement. Flexible stranded leads, color coded in order to facilitate testing and location of faults, have been employed in the construction of the equipment. Radio frequency wiring of the solid, self-supporting type is employed where necessary. The intermediate frequency and rectifier units employed wire insulated with a special compound called "Flamenol." The manufacturer states that this type of wiring will be replaced with rubber and lacquered cotton braid insulation in the production equipments. As stated in paragraphs 32 and 33(e) above, a voltage breakdown occurred in the rectifier unit during the course of a humidity test. The wiring,which was disrupted, was of the "Flamenol" type. This was replaced by the type of wiring used in the high frequency unit, rubber and cotton braid, and the remainder of the tests were conducted without any further breakdowns. It is recommended therefore that the use of "Flamenol" wiring be avoided. Furthermore, care should be exercised in the wiring of all equipments to provide adequate clearances between exposed wiring and the cases of the equipment, since evidence was found that too little clearance in this respect contributed to the breakdown in the rectifier unit. Care should also be exercised to prevent the use of excessive solder when making soldered connections, a condition which was noted in the preliminary model. Rigid inspection should be assured to prevent the presence of loose pellets of solder in the equipment and the consequent danger of short circuits developing from this condition. This criticism also applies to the presence of surplus loose nuts, washers, and screws.

61. Par. 2-49. This paragraph of the specifications requires all exterior surfaces of the transmitter cases, receiver cases, and power unit to be finished with a durable black wrinkle coating similar to samples held by the Inspector of Naval Material. The front and rear panels of the high frequency, intermediate frequency, and rectifier units are of black wrinkle finish (with covers removed). The receiver and receiver power unit are finished in black wrinkle. The exterior surfaces of the high frequency, intermediate frequency, and rectifier units and all auxiliary equipment including the transportation cart are finished in olive drab, with the exception of the gasoline engine

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which is painted a dark gray or blue gray. The interior surfaces of the equipment are of the natural aluminum of stainless steel finish. Page 5 of reference (h) states that the olive green finish was substituted for the black finish at the request of Captain Wallace, USMC. In the opinion of the Laboratory, the olive green finish is suitable for the type of equipment in question, if it meets with the approval of the Bureau of Engineering. However, steps should be taken to bring all items of the equipment into harmony by painting the gasoline engine, receiver unit, and receiver power unit the same color.

62. Par. 2-50. The front panels of the transmitters, receivers, and their power units are finished with a durable black wrinkle finish.

63. Par. 2-51. Stainless steel screws or bolts have been provided by means of which the covers are secured to the various units. Each of the major units; i.e., intermediate frequency, high frequency, and rectifier, are equipped with four phosphor bronze springs for the purpose of making grounding contact and intermittent contact is prevented at other points by the application of bakelite strips at frequent intervals to the inside surfaces of the enclosing covers.

64. Par. 2-52. Any single unit of the equipment, spare parts, etc., exclusive of the assembled carts, are capable of passing through a door 20 inches wide by 54 inches high, or through a hatch 48 inches long by 27 inches wide. The transportation cart, when dismantled for stowage is capable of passage through the door or hatch of the above mentioned dimensions. Table 99 appended hereto lists the dimensions of the various units of the XTBR-1 equipment.

Specifications RE 13A 518 (Section III - Constructional Requirements)

65. Par. 3-3. The enclosing cases are provided with removable front and rear covers. The covers are not interchangeable but have been stencilled to indicate their location; i.e., front or back. Interchangeability between cases is not considered advisable since it would tend to confuse the wiring diagrams which are secured to the inner surfaces.

66. Par. 3-4. The construction of the units is such that when prepared for transportation, enclosing covers in place, they are rain and spray proof. When set up for operation, covers removed, the major units are not proof against rain or spray. Various toggle switches are used in connection with these units and the openings in the panels through which the toggle handles protrude must necessarily be of greater dimensions than the handle itself. This will permit the entry of water. During the period of the field tests no rainfall was encountered and hence the equipment was not actually subjected to a test of this nature, but inspection is sufficient to reveal the fact that rain could gain access to the interior of the major units. When the front and rear covers are removed, openings are left in the front and rear panels approximately 1/4 inch in diameter by the withdrawal of the securing screws. This affords another means for the entrance of spray and rain. The openings in the microphone and key jacks fall in the same category.

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67. Par. 3-5. The cases of the various units are so designed that when closed for transportation complete protection is afforded to the interior parts. The cases are of rugged construction and present no sharp edges.

68. Par. 3-6. Frequent handling of the equipment in the field and in the Laboratory caused no derangement of parts and no faulty operation or breakage of parts was noted which could be attributed to this cause.

69. Par. 3-7. Buffer pads of resilient rubber have been attached to the top and bottom corners of the major units. These pads are of durable construction and greatly aid in protecting the cases against jars, shocks, and vibration. These pads extend 3/8" beyond the extremes of the cases. The front and rear covers of the units are fitted with round rubber pads about 7/8" in diameter and about 3/8" thick, secured with a single screw through the center. While these pads afford some protection to the equipment, they can easily be torn loose, especially while trying to arrange the equipment in the transportation carts. Greater protection would be afforded and a far more secure and durable arrangement would result if the circular pads were replaced by the triangular or wedge shaped pads now employed on the top and bottom surfaces of the units. If the triangular type pads are employed on the front and rear covers, some modification of the angle braces in the bottom of the transportation cart will be necessary in order to provide clearance for these pads.

70. Par. 3-8. The construction of the cases is covered in paragraph 28 of this report (par. 2-3 of the governing specifications).

71. Par. 3-9. The cases are designed in a manner which permits them to rest firmly and squarely on a flat deck or platform.

72. Par. 3-10. The front and back covers for the high frequency, intermediate frequency, and rectifier units are of stainless steel construction. Two reinforcing channels are spot welded on the inside of each cover running the full length. Each cover is secured to the unit by means of 20 slotted hexagonal head screws so that they may be tightened or loosened by means of an ordinary screw driver of convenient size (about 6"). The screws will remain anchored to the cover unless turned completely through.

73. Par. 3-11 and 3-12. The covers and their mating surfaces on the cases are designed to be spray proof. Live rubber gaskets are provided on these surfaces, the gaskets being cemented to the cover. The gaskets are fabricated from stock material, 1/8" thick and take the form of strips 5/8" wide.

74. Par. 3-13. The covers for each unit contain diagrams of that particular unit. One cover contains a wiring diagram and the other a schematic diagram. The diagrams are securely pasted into the covers. It is recommended that the diagrams be given a protective coating of clear lacquer to increase their resistance to moisture.

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75. Par. 3-14. Only one transportation cart was supplied with the preliminary model equipment. This cart is so arranged that it can be used as an operating table or support for the high frequency transmitter, the intermediate frequency transmitter, and the rectifier unit.

76. Par. 3-15. Each major unit is provided with a pair of carrying handles fitted in the sides of the unit. The handles are of ample dimensions and so fashioned as to provide a comfortable grip and their location is such as to provide a balanced load. The handles when not in use fold into a recess so that they do not protrude from the sides of the case and an internal spring or tension arrangement holds them securely in this position. When extended for use, the handles assume a carrying position of approximately right angles with the sides of the case. While the handles themselves are of suitable design and construction, the weights of the units are such, ranging from 193 pounds for the intermediate frequency unit to 273 pounds for the rectifier unit, that it is a difficult matter for two men of average strength and height to carry the latter unit. The difficulties encountered in carrying this heavy unit when the footing is insecure, as is the case in soft sand or mud or upon a platform subject to movement, such as the body of the transportation cart or a ship's gang plank, are almost prohibitive for two men. It is recommended, therefore, that serious consideration be given to some means for improving the portability of these heavy units. Arrangements should be made so that it would be possible for four men to distribute the load of a single unit among themselves. A consideration of this problem should include the possibility of securing four of the present type handles to each case in such a manner that the front panel of the equipment would be pointing upward during the carrying process, with a handle at each corner. Another method would be to provide extension handles or grips in connection with the present handles in the form of bars which would project in front of and to the rear of the case so that four men could be employed to carry a single case. This latter method has certain drawbacks, among which are the increased weight, the addition of the number of items and the necessity of providing suitable stowage space for the bars when not in use.

77. Par. 3-17. Reference to Table 99 shows that the high frequency and intermediate frequency transmitters are of essentially the same dimensions. The rectifier unit is of the same width and height as the transmitter units, but the depth of the rectifier is less than that of the transmitter units.

78. Par. 3-18. The transmitter units and the rectifier unit are of the same height.

79. Par. 3-19. The total cubical contents of the three major units; i.e., intermediate frequency, high frequency, and rectifier, total 36,000 cubic inches.

80. Par. 3-20. Reference to Table 1 reveals the fact that all three major units exceed the specification weights listed in this paragraph.

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81. Par. 3-21. The design and construction of each unit is such that the front panel is secured to the chassis of each unit with all integral parts attached thereto, so as to be removable from the case as a single unit.

82. Par. 3-22. The construction of the units is such that the chassis may be removed from the case without undue binding or chafing.

83. Par. 3-23. Each unit is fitted with four "U"-shaped metallic handles on the front panel for convenience in withdrawing the chassis from the case. This operation is most easily accomplished by laying the equipment on its face (front panel down) and then removing the enclosing case by withdrawing it upward. The four handles provide a secure rest and prevent damage to any of the controls.

84. Par. 3-24. The design of the chassis with respect to the mounting of integral parts is such that when removed from their cases the units may be placed flat on their base, top, front, or either side without damaging or deranging any component items. Placing the equipment flat on its back would tend to injure the various binding posts and sockets by means of which external connections are made.

85. Par. 3-25. Twelve knurled head screws are provided for securing the chassis of each unit in its respective case. Each screw is arranged to permit definite individual loosening prior to removal of the chassis and remains secured to the rear shield or panel.

86. Par. 3-27. The rear panels of the units are provided with interlocked access doors to permit the replacement of tubes. Ventilation louvers are also provided in the rear panels suitably screened to prevent the entrance of foreign material.

87. Par. 3-28. Receptacles are provided on all units for the interconnecting cables between units. These receptacles are of the reverse service type and are equipped with a grounded metal shell extending beyond the ends of the live pins. A positioning pin is provided which extends beyond the metal shell to facilitate making proper connections. In this connection it is pointed out that the socket for the d.c. control cable (green and white) is so positioned on the rectifier that interference exists between it and one of the knurled head securing screws. Once the plug is seated home in this socket, difficulty is experienced in withdrawing it due to the presence of the knurled head screw. Steps should be taken to eliminate this interference.

88. Par. 3-29. The receptacles for the transmitters and rectifier unit are located near the bottom on the rear inner cover or panel of the units.

89. Par. 3-30 to 3-34 incl. Each transmitter unit is provided with two panel lights and the rectifier unit is provided with a single panel light. These lights serve to illuminate the meters and important controls. The lights used are of General Electric type 64, 3C, 6-8 volts with bayonet type sockets. The lights are energized from the

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filament transformers. Each light is provided with a hinged semi-spherical cover or reflector which may be adjusted at will to prevent glare. The lights are finished in black wrinkle finish and each socket is equipped with a self-contained switch for turning the light on and off.

90. Par. 3-40. Each unit is provided with an indicator or warning light which indicates the presence of voltages in excess of 150 volts. These indicators, fitted with red jewels, are energized in parallel with the primary of the auxiliary voltage rectifier.

91. Par. 3-41 to 3-43 incl. During the course of vibration tests difficulties were encountered in connection with the following switches:

(a) Door interlock switch on high frequency unit
(b) Interlock switch on intermediate frequency unit antenna coupling switch.

The details of these failures are discussed under paragraphs 33(i) and 170 of this report.

92. Par. 3-44. This paragraph requires that all variable resistors be of the wire wound type. The gain control in the high frequency transmitter unit is of the carbon type. No difficulty was experienced with this control during the course of the tests.

93. Par. 3-47 to 3-51 incl. All vacuum tube filaments are lighted from alternating current and the filament transformers are provided with center tapped secondaries, with the exception of the rectifier filament transformer. All transformers are of adequate design, no undue heating being observed during the course of numerous full power key locked tests at high ambient temperatures. The transformer supplying the power to the Rectox rectifier suffered an overload due to a short circuit in the output of the Rectox unit but suffered no apparent ill effects in spite of the failure of the fuse to provide protection. (See par. 33(i).) Each unit; i.e., high frequency, intermediate frequency, and rectifier, is equipped with individual filament transformers the output voltage of which is controlled by means of an individual rheostat in the primary. The primary circuits of all power transformers are tapped for operation at approximately 95, 105, 115, and 125 volts.

Specifications RE 13A 518B (Section IV - Transmitter Units)

94. Par. 4-3. Operation into Actual Antenna Systems.

(a) High Frequency. The combined high frequency and intermediate frequency antenna-counterpoise system was erected according to instructions in a flat grassy field, clear of immediate obstructions. Tables 8, 9, and 10 appended hereto list the data obtained during the power output tests of the high frequency transmitter unit. The primary source of power employed in these tests was the gasoline engine driven generator which is an integral part of the XTBR-1 equipment. No difficulty was experienced in obtaining full power

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operation at any frequency within the range of 2000 to 18000 kilocycles, with the exception of 2000 kilocycles. Using the 85 foot long antenna plus its 10 foot insulated lead in conjunction with the triangular counterpoise system, it was found impossible to resonate the power amplifier circuit. Some power output was obtained, as illustrated in column 1 of Table 8. However, it will be observed that it was necessary to reduce the plate voltage to 1000 volts and even at this low potential excessive plate current was drawn by the P.A. tubes (340 ma). The lowest frequency at which resonance could be obtained was found to be 2056kilocycles. Operation under this condition is illustrated in column 2 of Table 10. An attempt was made to operate the high frequency transmitter on 2000 kilocycles into the intermediate frequency antenna system. Good operation was obtained under these conditions as is illustrated in column 1 of Table 10. Another test was conducted wherein the high frequency antenna system was lengthened to 100 feet; i.e., the antenna was 100 feet long plus the 10 foot insulated lead. In order to use the extended high frequency antenna it was necessary to move the transmitting equipment out from its original position. The additional 15 feet permitted the high frequency transmitter to operate successfully at 2000 kilocycles as is illustrated in column 3 of Table 10. In order to determine whether this additional length of antenna influenced operation at the high end of the frequency range, the high frequency transmitter was tuned up to 18000 kilocycles. Successful operation was obtained at this frequency as is illustrated in column 4 of Table 10. There proved to be ample leeway in the output circuits and the P.A. tuning circuits; that is, the high frequency transmitter is capable of operating over the entire frequency range of 2000 to 18000 kilocycles with the 100 foot antenna (plus 10 foot insulated lead). However, since it was necessary to move the entire transmitting equipment out 15 feet from its original location, it was necessary to increase the length of the intermediate frequency lead-in and counterpoise lead. The additional 15 feet required resulted in a sufficient increase in inductance and capacitance to prevent resonance being obtained at 2000 kilocycles with the intermediate frequency transmitter.

(b) Intermediate Frequency. Tables 11 and 12 cover intermediate frequency tests conducted with the intermediate frequency antenna system as supplied by the contractor. Successful operation was obtained over the band from 300 to 2000 kilocycles. However, as mentioned in the preceding paragraph (94a), when the equipment was moved out 15 feet to accommodate the 100 foot high frequency antenna, unsatisfactory operation was obtained at 2000 kilocycles. With optimum adjustment of the output circuits the maximum plate current drawn by the P.A. tubes at 2000 kilocycles was 110 milliamperes which resulted in an antenna current of 2.5 amperes.

(c) From the foregoing discussion it will be seen that with the high frequency antenna system as supplied by the contractor, unsatisfactory operation results at 2000 kilocycles when employing the high frequency transmitter unit. When the high frequency antenna is lengthened to 100 feet, satisfactory operation over the entire range of the high frequency transmitter results. Lengthening the high frequency antenna causes the intermediate frequency antenna

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lead-in and counterpoise lead to increase approximately 15 feet in length, which results in unsatisfactory operation at 2000 kilocycles on the intermediate frequency transmitter. Hence it will be necessary for the manufacturer to effect some modification in the intermediate frequency antenna system which will permit the intermediate frequency transmitter to function satisfactorily with an additional 15 feet of lead-in, or it will be necessary to modify the output circuits of the high frequency transmitter unit to enable satisfactory tuning adjustments to be arrived at with the 85 foot high frequency antenna system.

95. Par. 4-4. The limited time available and the fact that the Naval Research Laboratory motor sailer had been removed from the water for the winter, prevented actual operation on the specified boat antenna when using the external load coil. The operation of the equipment when using the load coil in connection with a dummy antenna is covered under paragraph 7-8 of the specifications.

96. Par. 4-5. The equipment is so designed and constructed that it covers the specified frequency bands without resorting to the use of plug-in coils or external loading units other than the loading coil definitely specified for boat operation, with the exception of operation in the immediate neighborhood of 2000 kilocycles. (See paragraph 94 above.) When both transmitters are involved in a single installation, the change from the lower band to the upper band, or vice versa, is accomplished by shifting interconnecting plugs and cables.

97. Par. 4-6. No actual power output measurements were attempted when operating into actual antenna systems. While equipment is available at the Naval Research Laboratory by means of which radio frequency power measurements in this frequency range can be accomplished, the methods employed require considerable time. In view of the fact that reference (b) limited the time for making all tests and reporting them to three calendar months, it was necessary to forego such power measurements. It may be stated, however, that the equipments were loaded to full power conditions and that no undue heating of tubes or other parts was noted. Hence it may be safely assumed that satisfactory output was being obtained. That the equipment is capable of producing power output far in excess of the required 100 to 150 watts over the range of 300 to 18000 kilocycles is illustrated by the power output determinations made in dummy antennas and reported under paragraph 7-7 of the governing specifications.

98. Par. 4-7. Suitable means have been incorporated into both the intermediate frequency and high frequency transmitter units whereby it is possible to obtain MCW transmission. The frequency of modulation was measured as follows:

High frequency unit - 1002 cycles
Intermediate frequency unit - 984 cycles

Specifications require a modulation frequency of 1000 cycles, ± 5%.

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99. Par. 4-8. Means have been provided in the high frequency transmitter unit to permit voice modulation of the transmitter output over the audio frequency range of 200 to 3000 cycles. The specifications require that the audio frequency characteristic be flat within ± 2 decibels over this frequency range. The response characteristic was determined at two output frequencies; i.e., 4500 kilocycles and 2000 kilocycles. Table 13 and Plates 1 and 2 illustrate the results of these tests which show that the specification requirements have been met. This paragraph of the specifications states further that the distortion due to all harmonics shall not exceed 10 per cent r.m.s. at 90% modulation. The data listed in Table 14 appended hereto shows distortion measurement made at two output frequencies. At approximately 90% modulation the distortion is slightly in excess of the specified value of 10%. Since the distortion measurement equipment used has a guaranteed accuracy of ± 5% in this range, the excess distortion may be considered negligible. Furthermore, listening tests revealed no unsatisfactory conditions which could be attributed to distortion. It is recommended, therefore, that the equipment be considered as satisfactory with respect to the distortion characteristics.

100. Par. 4-9. The design of the equipment is such that when using a carrier output equivalent to 25% of the required CW power and employing a suitable microphone, the output can be modulated to 95% by speaking in a normal tone of voice.

101. Par. 4-10. The input circuits are such that the equipment may be modulated from either the microphone jack or from a special jack which permits operation from an external 500 ohm, 6 milliwatt source. This is accomplished by providing the microphone transformer with dual primary windings. The data listed in Table 15 was obtained while using the 500 ohm input circuit.

102. Par. 4-11. All necessary audio amplification has been included in the transmitter unit. A suitable, continuously adjustable attenuator or gain control has been provided by means of which it is possible to obtain a smooth adjustment of gain control of input levels from 15 decibels below 6 milliwatts to 10 decibels above. From the data listed in Table 15 it will be observed that the gain control permits a wider range and smoother variation than required by the governing specifications. As mentioned previously, however, in paragraph 92, the gain control is a carbon type rheostat whereas specifications require the use of wire wound resistors.

103. Par. 4-12. A modulation indicator is provided on the front panel of the high frequency unit. This indicator serves to indicate relative percentage of modulation on MCW or phone operation. The indicator is an a.c. voltmeter calibrated from 0 to 150 volts. It is connected across the secondary of the modulation transformer 358. This winding impresses an audio voltage produced by the audio oscillator or phone amplifier upon the P.A. suppressor grids. The meter indicates the magnitude of audio voltage across the secondary winding but does not indicate exact percentage modulation. However, it may be calibrated under a particular condition of operation of the transmitter. Under ordinary operating conditions an audio voltage swing of 75 to 100 volts produces from 75% to 90% modulation. The phone modulation is controlled by gain control 280.

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104. Par. 4-17. Both the high frequency and intermediate frequency transmitter units employ an electron coupled master oscillator and the design of the circuits is such as not to require the use of constant temperature control.

105. Par. 4-23. The high frequency and intermediate frequency units were keyed at rates of 20 and 40 words per minute. The keying was observed by means of a cathode ray oscillograph on both CW and MCW emission. Satisfactory operation was secured. Keying speeds considerably higher than 40 w.p.m. were observed and very little faulty operation in the way of relay "bounce" was noted as the speed approached 100 w.p.m.

106. Par. 4-24. The keying circuits of both transmitters are so arranged that all tubes, with the exception of the audio tubes, cease oscillating when the key is open.

107. Par. 4-25. The emitted output of both transmitters was examined while operating in the Laboratory and under field conditions while employing actual antennas. CW and MCW emission was observed on both units and additionally phone operation in the case of the high frequency unit. Operation from a line supply was investigated and also operation while employing the gasoline engine driven generator. A slight amount of lilt is present, particularly at the higher frequencies when employing the high frequency unit. However, the lilt is of small magnitude and not sufficient to be objectionable. More lilt is observable from a line supply than when using the gasoline engine drive. This is due to the fact that the supply voltage has a rising characteristic when employing the compensated gasoline engine driven generator supply. Key clicks are present to the extent usually found in circuits where special vacuum tube keying is not provided.

108. Par. 4-26 to 4-29 incl. Break-in operation was investigated with the equipment set up in the field, operating into the actual antenna systems. With the receiver adjusted to a normal 60 microwatt noise level, a signal was picked up at approximately 8790 kilocycles, with a signal output of 6 milliwatts. The high frequency transmitter unit was then adjusted to resonance with the receiver at this frequency. No pick-up from the transmitter was observed with the transmitter key open, but a receiver output of 17 volts across 600 ohms was obtained with the key depressed. This, however, did not interfere with hearing the signal during keying when the key was in the open position. In this test the receiver was placed alongside and close to the high frequency transmitter. With the receiver about 3 feet from the intermediate frequency transmitter, the transmitter was adjusted to 400 kilocycles and resonated with the receiver. No pick-up from the transmitter was observed with the key open and with the key depressed the receiver output was less than 6 milliwatts. As in the case of the high frequency unit, signals could be heard during keying in the intervals while the key was open. Signals were then picked up in the highest frequency bands and no noise interference was observed from the gasoline engine unit, with the unit placed at either 100 or 50 feet distance from the receiver. During the latter part of the test a very high noise level developed in the receiver of sufficient intensity to

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destroy reception. This was more or less intermittent and it was found that it could be eliminated by cutting off the filament supply of the transmitter. This trouble was overcome by moving the cable plug connecting to the rectifier. Apparently one connection was making poor contact, although the exact connector could not be determined. Once the cables were securely seated home all noise ceased and further movement of the cables failed to produce any interference. It should be stated that the Model XTBR-1 receiver was operated from the a.c. line (engine driven alternator) and also from the receiver power unit operated from d.c. battery supply.

109. Par. 4-30. When operating the transmitting equipments from the engine driven alternator, it was found that if the alternator voltage was manually adjusted between the limits of 115 and 120 volts, the regulation between key closed and key open was within 5%. Should the alternator voltage be adjusted to a low value, such as 105 to 110 volts key open, closing the key causes a rise of approximately 10 volts due to the compensating circuits included in the engine driven unit.

110. Par. 4-31. A start-stop control is located on the panel of the rectifier unit. In order to place a transmitter in operating condition it is necessary to manipulate three switches on the rectifier unit. First, the main line switch must be closed, then the start-stop switch is closed which energizes the filaments and also actuates the time delay relay. In order to obtain plate voltage the plate switch must be closed, although plate voltage will not be available until the time delay relay has had sufficient time to operate.

111. Par. 4-32. Provision is made for safely tuning the equipment and for varying the power output between maximum and a minimum of 25%. In order to obtain safe tuning potentials the power tap switch is set to tap 1 or tap 2.

112. Par. 4-33. Frequency range and overlap.

(a) The frequency range of each transmitter is divided into several bands controlled by range selector switches. Table 4 lists the controls provided on the high frequency unit while Table 5 lists the controls on the intermediate frequency unit. The band change switches are designated together with the number of taps or bands on each. On the high frequency unit the master oscillator and 1st I.P.A. are not provided with interlocks and on the intermediate frequency unit the master oscillator and I.P.A. band change switches are not provided with interlocks. The remaining band change switches are interlocked. The range switches which are not interlocked may be moved with power on the transmitter without destructive arcing.

(b) The limiting frequencies and overlap of the various circuits in the high frequency transmitter are listed in the following tables:

Table 16 - Master oscillator circuit
Table 17 - 1st I.P.A. circuit
Table 18 - 2nd I.P.A. and P.A. circuits

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It will be noted that the specification requirement of 5% overlap is complied with in all cases. Attention is invited, however, to the discussion contained in paragraph 94 of this report which indicates the need of more liberal coverage in the P.A. and output circuits of the high frequency unit to enable satisfactory operation to be obtained at 2000 kilocycles when operating into the 85 foot high frequency antenna system.

(c) The limiting frequencies and overlap of the various circuits in the intermediate frequency transmitter are listed in the following tables:

Table 19 - Master oscillator circuit
Table 20 - I.P.A. grid circuit
Table 21 - I.P.A. plate circuit
Table 22 - P.A. plate circuit

It will be noted that the master oscillator circuit fails to meet the requirement of 5% overlap, although in all cases the overlap is 2.5% or greater. The I.P.A. grid circuit meets the requirements of 5% overlap. The I.P.A. plate circuit complies with the 5% requirement except between taps 4 and 5 where the overlap is 3.91%. The overlap of the power amplifier plate circuit is in essential agreement with the 5% requirement.

(d) In general, it may be stated that no difficulties were experienced in connection with overlap frequencies except in the case of the high frequency unit output circuits when operating into the aforementioned 85 foot antenna system.

113. Par. 4-34. Both transmitters are equipped with calibration card holders mounted on the front panel. These holders are waterproof in design and provision is made for recording reset data for ten frequencies. Five additional cards are mounted behind the marked card in use.

114. Par. 4-35. The instruction books furnished with the preliminary models contained calibration tuning curves to permit the adjustment of the transmitters to any frequency within the specified bands to an accuracy greater than the required 0.15%. Naturally, calibration curves cannot be provided for any circuits beyond the power amplifier.

115. Par. 4-36. In order that the calibration of the frequency determining circuits may be kept substantially constant when changing master oscillator tubes, both the high frequency and intermediate frequency units have been equipped with master oscillator compensating condensers of the screw driver adjustable type. The range of these condensers is illustrated in Tables 23 and 24. Attention is invited to the fact that no stops are provided to prevent short circuiting these condensers. Adequate stops should be provided.

116. Par. 4-37. See comments under paragraph 7-13-1 of the governing specifications.

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117. Par. 4-38. Friction type locking devices have been provided in connection with all continuously variable controls. The effect of these locking devices upon the frequency of the high frequency master circuit is shown in Table 25. Similar data for the intermediate frequency transmitter are logged in Table 26.

118. Par. 4-39. The emission selector switch on each transmitter is so designed that this single switch offects all necessary changes in circuits, potentials, etc., required for changing from one type of emission to another.

119. Par. 4-40. Each transmitter unit is equipped with a suitable type test key of the lever operated type arranged for key open, momentary key closed and key locked positions. The key is so mounted that the momentary position is down.

120. Par. 4-41. The variation of resonant frequency per division of master oscillator dial marking is shown in Table 27 for the high frequency transmitter unit. Similar data covering the intermediate frequency unit is listed in Table 28. Both transmitters comply with the requirement that the maximum change per one division shall not exceed 0.02%. The width of the smallest scale division measures 0.094", which is well within the specification requirement of 0.05". The vernier ratios of the remaining circuit controls are so designed as to provide for the non-critical adjustment of the various circuits which they govern.

121. Par. 4-42. For a discussion of back-lash characteristics, see comments under paragraph 7-13-2 of the governing specifications.

Specifications RE 13A 518B (Section V - Rectifier Unit)

122. Par. 5-3. The rectifier unit is so constructed that it produces satisfactory operation over a range of line voltage variation of -15% and +10% of 115 volts.

123. Par. 5-5. The various rectifiers contained in the rectifier unit are so designed as to produce the required d.c. potentials. Certain elements in the design of these circuits require further consideration as indicated in paragraphs 30(b), 30(c), 33(f), and 33(g) of this report.

124. Par. 5-6. As illustrated in Table 29 appended hereto the total ripple voltage noted in the main and auxiliary rectifier is approximately 0.25% or less, whereas the specifications permit a value of 1%.

125. Par. 5-7. Table 30 covers the voltage regulation of the various rectifiers contained in the rectifier unit when employing either the high frequency or intermediate frequency transmitters. The requirements of the governing specifications, as amended by Contract Notes, have been met.

126. Par. 5-24. The power required from the line, or from the engine driven alternator unit, under various conditions of operation, both high and intermediate frequency, is illustrated in Table 31.

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It will be noted that the specification requirement of a maximum input of 1.4 kilowatts has been complied with.

Specifications RE 13A 518B (Section VI - Antenna Counterpoise System)

127. Par. 6-1. The antenna-counterpoise system supplied with the Model XTBR-1 equipment meets the general requirements of this paragraph. Certain details of construction and operation which require modification to produce more satisfactory operation will be discussed in detail under appropriate paragraphs of this section of the specifications.

128. Par. 6-3. The combined intermediate frequency and high frequency antenna system employs three masts 45 feet high located 110 feet apart at the vertices of an equilateral triangle. The intermediate frequency antenna consists of a triangular flat top formed by single conductor spans equivalent to Model"J" aircraft antenna wire. Each 100 foot span terminates in a metal triangular connection plate by means of which the individual spans are electrically connected together. Two downleads are provided with the intermediate frequency antenna, one each connected to the end of a single span and then running downward at an angle to a central point from which the insulated lead which connects to the transmitter is taken. The high frequency antenna consists of a single 85 foot length of Model "J" antenna wire supported at the high end by the mast opposite the span from which the intermediate frequency antenna downleads are taken. The downleads of both antennas and the counterpoise lead are secured by means of snap lines to the transportation cart in which the equipment is erected.

129. Par. 6-4. The counterpoise system for the combined intermediate frequency and high frequency antenna system consists of a triangular assembly similar to the triangular antenna supported from the base of the masts approximately five feet above the earth. No additional stakes are required to support the counterpoise.

130. Par. 6-8. The design and construction of the complete antenna system is such that it may readily be erected by a crew of eight trained men. Sufficient time was not available to train a crew of men and practice erecting the system, but when once familiar with the system and given a suitable location trained personnel should be capable of effecting a complete installation in one and one half to two hours' time.

131. Par. 6-9. The antenna counterpoise system as supplied fails to function satisfactorily in the region of 2000 kilocycles as described in paragraph 94 above.

132. Par. 6-10. The maximum length of any span of the antenna or counterpoise, including the five foot separation between conductors and masts, does not exceed 110 feet. Sufficient tension may safely be applied to the antenna and counterpoise spans to prevent a sag in excess of 10%.

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133. Par. 6-11. Each mast is made up of five 9-foot sections of 4" diameter dural tubing of 1/16" wall. Split rings are riveted inside the ends of the tubes to afford additional strength in order to avoid distortion or deformation of the ends of the tubes. The ends of several tubes were slightly deformed when received but not sufficiently to interfere with the ready assembly of the masts. However, it is believed that these reinforcing rings should be solid; i.e., not split and should be constructed from stainless steel in order to provide greater strength.

134. Par. 6-12. The masts, while erected in the field, were subjected to rain and light snow falls without any signs of corrosion becoming visible. When first received, one complete mast assembly (partially assembled) was placed in an exposed location on the roof of a building in order that the effects of exposure to weather might be studied. This mast remained in this location during the period from October 12, 1937 to December 20, 1937, without evidencing any signs of corrosion or other deleterious effects. A section of the mast was supported at the extreme ends and a hundred pound weight was suspended from the center. The maximum sag measured under these conditions was 5/32". When the weight was removed after one hour the sag disappeared and no signs of permanent distortion were visible.

135. Par. 6-13. The bottom section of the mast is fitted with a pin which rests in grooves provided in the base plate. When the mast is raised it pivots on this pin facilitating the work of installation. The base plate is secured to the ground by means of a pointed stake of rugged design. Like sections of the different masts are interchangeable. Eye bands are secured to the center section and the top section of each mast for securing the six guys. The method employed for securing the base to the earth works well in soft earth or even in ground of considerable density or hardness. However, this method would be unsuitable if the masts were to be erected upon rocky locations. It is difficult to see how any one method could be made applicable to all types of ground conditions and hence it appears that under certain conditions the attending personnel will be forced to improvise means for securing the base plates.

136. Par. 6-15. This paragraph of the specifications, as modified by the "Contract Notes" calls for the use of six guys to each mast, the guys to be of the flexible wire type broken at intervals of 15 feet or less by ceramic insulators. These provisions have been complied with in the Model XTBR-1 equipment. The guy assemblies and fittings are satisfactory with one exception. The strain insulators furnished are the equivalent of Isolantite Aircraft Antenna Strain Insulators No. 801. The insulator is egg-shaped with rounded ends and after the guy wires pass through the insulator openings they are secured by means of steel clamps. When the guys are alternately subjected to and released from strains the insulator has a tendency to rotate within the bights causing the two wire loops to make metallic contact and thus eliminate the insulator effectively from the circuit. This condition persists whether the insulators are loosely coupled or tightly coupled into the guy wire. Experiments were conducted with several different types of small strain insulators available at the Naval Research Laboratory and the most satisfactory insulator

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was found to be Isolantite No. 803 Compression Type Strain Insulator. This insulator is larger than the Type 801 and weighs approximately 2-1/2 ounces whereas the 801 weighs about 3/4 ounce. Thus since the total number of insulators used in a complete installation is 63, the total increase in weight incurred by the substitution of the Type 803 would total approximately 7 pounds. The Type 803 insulator is of far greater physical strength than is required in this connection and it may prove feasible to obtain smaller insulators of this type and thus effect a reduction in weight.

137. Par. 6-16. Dural stakes of cruciform cross section 18 inches in length are provided for anchoring the guys. Each stake is fitted with a shackle near the top for attaching a snap line. A total of 18 stakes are furnished.

138. Par. 6-17. Suitable flexible rope halyards are furnished with the equipment. A total of four 100 foot halyards are provided for the combined antenna systems. Provision is made to form the halyards in an endless chain and it is possible to connect the halyard in such a manner that it can be employed for hauling the antenna down should the weight of the antenna prove insufficient for gravity to accomplish this act.

139. Par. 6-19. The counterpoise spans are not marked to serve as measuring lines to facilitate erection of the antenna system. This provision is unnecessary. The hundred foot length can be used as a tape line for locating mast positions and the flexible guy wires which are broken at intervals by insulators can be used as measuring devices for locating guy stakes. This is the method proposed by the manufacturer in the instruction books and the method worked satisfactorily in actual practice.

140. Par. 6-20. Snap hooks have been provided at the ends of all conductors and lines where their use is feasible. Electrical connections are made by means of clamps and clamp plates which require the use of a screw driver to make satisfactory electrical contacts.

141. Par. 6-21. Ceramic insulators of suitable design and in sufficient number have been provided for the complete installation. (Note: See paragraph 136 for a discussion of the deficiencies of the guy insulators.)

142. Par. 6-22. All metallic parts are fabricated from corrosion resisting materials or have been coated to prevent corrosion and rust. No signs of undue corrosion were observed during and after the tests to which the antenna equipment was subjected.

143. Par. 6-23. Suitable hand reels of light construction and weight have been provided to facilitate stowage of antenna and counterpoise spans.

144. Par. 6-24 to 6-27 incl. No antenna accessory stowage box or boxes were provided with the preliminary model. However, each item was plainly marked with a metal tag designating its use and dimensions.

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Specifications RE 13A 518B (Section VII - Performance)

145. Par. 7-1. The degree of compliance of the various units with the requirements of the governing contract is indicated in the preceding paragraphs of this report and also in the following paragraphs.

146. Par. 7-2. The complete radio equipment is capable of operating continuously at full power at any ambient temperature between the limits of -32° C to +50° C and at relative humidities up to 90%.

147. Par. 7-3. The equipment operates satisfactorily when energized from a line supply whose voltage varies from -15% to +10% of 115 volts. No line supply was available which permitted a frequency variation between the limits of 50 and 62 cycles. However, when operating from the engine driven alternator the frequency of the supply was varied essentially over the above range and the equipment was found to operate satisfactorily.

148. Par. 7-4. The design of the equipment is such that no damage results when the line voltage is varied between the limits of ± 10% of normal for short periods of time. Such tests are illustrated in Table 32 covering operation of the high frequency equipment and Table 33 covering operation of the intermediate frequency equipment. In these tests no voltage controls were readjusted. The foregoing tables cover additional tests wherein the line voltage was varied from -15% to +10% of normal during which time the voltage controls were readjusted. Under these conditions the equipment is capable of continuous operation and sufficient flexibility of voltage controls is provided to obtain normal operating potentials.

149. Par. 7-5. This paragraph states that the complete equipment using the engine driven alternator as a source of power shall be capable of meeting the performance requirements of this specification. Due to the length of time required to conduct the performance tests and the conditions surrounding some of the tests it was impracticable and in some cases impossible, to employ the gas engine as the primary source of power. Hence, the majority of the performance tests were conducted using a line supply. However, the data obtained indicates that the equipment functions equally satisfactorily on either a line supply or when using the alternator forming a part of the equipment.

150. Par. 7-6. The complete equipment is capable of operation as a complete radio transmitting and receiving station for CW, MCW (tone) and voice transmission and reception. The performance of the receiving equipment is outlined in reference (1) while the performance of the transmitting and power equipment is described in thepreceding and succeeding paragraphs of this report.

151. Par. 7-7. Both the high frequency and intermediate frequency transmitter units were subjected to complete tests to determine the power output at various frequencies. Antenna constants simulating those of the actual antenna systems were employed during these tests. In the case of the high frequency unit the output

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power was determined through the medium of a calibrated lamp load while at intermediate frequencies dummy antennas consisting of high grade capacitors and non-inductive resistive elements were employed.

(a) High Frequency. Tables 34 to 39 cover tests conducted with the high frequency unit over the range of 2000 to 18000 kilocycles. It will be noted that in every case the power output obtained, either CW, MCW, or phone, is in excess of that required by the governing specifications. In the majority of cases this excess is of the order of 100%. It will be noted that the percentage modulation falls within the limits of 80% to 90%. The specifications require a modulation of 95%. It may be pointed out, however, that the actual side band power is in excess of that required by the specifications due to the fact that the carrier power is in excess of that required. Therefore, the equipment,as submitted, may be considered as complying completely with this provision of the governing specifications.

(b) Intermediate Frequency. Tables 40 to 45 cover tests conducted with the intermediate frequency unit over the range of 300 to 2000 kilocycles. Reference to the foregoing tables reveals that in every instance power in excess of that required by the specifications was obtained, in a number of cases this excess ranging to 100% or more. In all cases the percentage of modulation when operating in MCW condition is practically 100%, thus complying with the specification requirement of 95%.

(c) The equipment is so designed that the liberal power outputs reported above may be obtained without overloading the actual equipment. The tuning adjustments to obtain these outputs are simple and direct once the operator becomes somewhat familiar with the equipment in question. As reported previously under paragraph 2-26 of Specifications RE 13A 518B tube failures were encountered and evidence of overloaded tubes is indicated.

152. Par. 7-8. This paragraph states that "When operating into the antenna system erected in a 40 foot boat (see par. 1-5 and 6-7 and sheet 85B) the output shall be a maximum consistent with the performance indicated above and the limitations on dimension of the external load coil unit for the intermediate frequency transmitter." The contractor submitted information indicating that the constants of such an antenna would be approximately as follows:

Antenna Resistance: 10 ohms
Antenna Capacity : 220 micromicrofarads

Employing these approximate values power output tests were conducted on both CW and MCW emission. The results of these tests are listed in Tables 46 to 51 inclusive. It will be noted that the CW power output range between the limits of 116 watts at 2000 kilocycles and 225 watts at 800 kilocycles. In all cases the MCW power was 28%, or more, of the CW power. From the above tables it will be noted that in the range of 1200 to 2000 kilocycles it was necessary to reduce the plate voltage to prevent overloading the P.A. tubes. Full voltage may be used if the I.P.A. grid is detuned.

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The boat antenna loading coil is fitted with 10 taps and it will be noted that the loading inductance was actually used only at 300 kilocycles. From 400 kilocycles and above, no loading coil is necessary when operating into the antenna constants indicated above. That the loading coil device when used on tap 10 (no inductance in the circuit) produces no measurable losses at the higher frequencies was demonstrated at 1600 and 2000 kilocycles. The intermediate frequency transmitter unit was loaded into the same antenna with and without the load coil connected into the circuit and no appreciable differences in settings or power output were observed. The operation of the antenna loading coil is considered to comply with the requirements of the governing specifications.

153. Par. 7-9. The audio characteristics of the XTBR-1 equipment were discussed under paragraph 4-8 of Specifications RE 13A 518B. See also Tables 13, 14, and 15, and Plates 1 and 2.

154. Par. 7-10. The design of the equipment is such that when using a suitable frequency standard it is possible for an operator to adjust the high frequency unit with a greater degree of accuracy than the 0.001% required by the specifications. See Note appended to Table 54. With respect to intermediate frequency operation, wherein an accuracy of 0.005% is specified, reference to Table 55 reveals that this degree of accuracy may be obtained without the use of a frequency standard. That is, the reset accuracy to previously calibrated settings is of the order of 0.005% or less. The equipment complies with the requirements of this paragraph of the specifications.

155. Par. 7-11. This paragraph requires that through the use of the tuning curves supplied with the equipment it shall be possible for an operator to adjust the equipment within one man minute to any desired frequency for which it has not been previously calibrated within 0.2%. Reference to Tables 52 and 53 reveals that the equipment, both high frequency and intermediate frequency, can be set to an accuracy greater than 0.2% by use of the tuning curves. However, it would require more than one minute for an operator to extract the necessary information from the tuning charts. Once this information is obtained, however, the transmitters may be adjusted in less than one man minute. Therefore, in the opinion of the Laboratory the XTBR-1 equipment meets the requirements of the governing specifications.

156. Par. 7-12. The frequency range and other characteristics of the master oscillator compensating condensers is discussed in detail under paragraph 4-36 of Specifications RE 13A 518B.

157. Par. 7-13-1. Accuracy of Reset to Previously Calibrated Frequencies.

(a) High Frequency. Table 54 appended hereto covers tests conducted at 2000 and 4500 kilocycles to determine reset accuracy. The accuracy of reset at 2000 kilocycles was found to be 0.0024% and 0.0018% at 4500 kilocycles. Specifications require an accuracy of 0.08%.

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(b) Intermediate Frequency. Table 55 appended hereto covers tests conducted at 300, 1000, and 2000 kilocycles. The average frequency deviation at these settings was 0.0016%, 0.00072%, and 0.0052% respectively, whereas the specification limitation is 0.08%.

158. Par. 7-13-2. Lost Motion, Back Lash, and Torque Lash.

(a) High Frequency. The frequency difference due to lost motion or back lash is illustrated in Table 56. During the course of the various tests to which the equipment was subjected subsequent to the back lash test, the master oscillator control became inoperative due to galling of the shaft. This galling was so intense that the control became practically immovable. A representative of the contractor remedied this defect by providing greater clearances in the dial assembly. After this modification had been effected the tests were repeated to determine whether back lash characteristics had been affected. The second series of tests contained in Table 56 reveal that no essential differences were detected. In both series of tests the results obtained complied with the specification requirements. It is recommended that in production equipments sufficient clearances be provided on all controls to prevent the possibility of galling or "freezing", since the foregoing tests show that greater clearances can be provided without adversely affecting the accuracy of the controls.

(b) Intermediate Frequency. Back lash tests were conducted at 300, 1000, and 2000 kilocycles as detailed in Table 57 appended hereto. The average deviation due to back lash was found to be in the range of 0.0172 to 0.0207%, whereas the specifications permit a deviation of 0.05%.

159. Par. 7-13-3. The Model XTBR-1 equipment is not provided with a "Tune-Operate" control and hence this paragraph does not apply.

160. Par. 7-13-4. Detuning of Circuits.

(a) High Frequency. The various circuits of the high frequency unit were detuned from resonance to determine the effect upon frequency of the master oscillator. The degree of detuning was such as to cause a 25% change in current of the circuit affected. Table 58 appended hereto shows that the detuning of any circuit including and subsequent to the 1st I.P.A. circuit produces an almost negligible effect upon the frequency.

(b) Intermediate Frequency. Table 59 covers tests conducted with the intermediate frequency unit at 300, 1000, and 2000 kilocycles. It will be noted that the detuning of the I.P.A. grid tuning control, "D", causes frequency shifts of 0.004% whereas the specifications limit the shift to 0.003%. The effect of all subsequent controls is less than that permitted by the specifications.

161. Par. 7-13-5. Operation of Power Output Control.

(a) High Frequency. Table 60 appended hereto shows that the power output may be varied between the limits of approximately 20% and 100%, in three steps, and that such variation in power has a

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negligible effect upon the emitted frequency. Specifications permit a frequency change of 0.005%. Tests were conducted at 2000 and 4500 kilocycles.

(b) Intermediate Frequency. Tests covering the control of power output of the intermediate frequency transmitter are listed in Table 61 appended hereto. The power may be varied in three steps between the approximate limits of 25% and 100% and such variation causes a negligible change in frequency. Specifications permit a frequency change of 0.01%.

162. Par. 7-13-6. Change of Tubes.

(a) High Frequency. The deviation from the average frequency when changing tubes in the master oscillator circuit was found to be 0.036% at 2000 kilocycles and 0.0197% at 4500 kilocycles. Ten tubes selected at random from tubes which fell within the limitations imposed by Navy Tube Specifications were used in these tests. Table 62 attached hereto tabulates the results of these tests. Specifications permit a deviation of 0.2%. Table 63 shows the effect of changing tubes in the 1st I.P.A. circuit. Here again the average deviation is less than that permitted by specifications. Permissible variation is 0.001%.

(b) Intermediate Frequency. Table 64 shows that the deviation encountered when changing tubes in the master circuit is less than the 0.1% permitted by specifications. Table 65 covers a similar test wherein tubes were changed in the intermediate power amplifier circuit. Here again the changes encountered are less than the 0.002% permitted by the governing specifications.

163. Par. 7-13-7. Variation of Supply Line Voltages.

(a) High Frequency. Table 66 illustrates tests conducted to determine the frequency variation resulting from changes of +5% to -5% in supply line voltage. Tests were conducted wherein this variation occurred in one minute and additionally in five minutes. It will be noted that the specification requirements are complied with in all cases except at the output frequency of 4500 kilocycles. When employing this output frequency, the master circuit is at half frequency, or 2250 kilocycles. Reference to the wiring diagram of the high frequency unit shows that the plate circuit of the master oscillator contains a tapped inductor, Item 301. This inductor was designed to give a flat characteristic over the operating frequency range. According to information from the contractor this circuit is essentially flat except for the region around 2200 to 2250 kilocycles. Hence in this region the transmitter is somewhat sensitive to voltage variations. Apparently efforts to overcome this condition have resulted in transferring the resonance point to a different place in the frequency range, rather than eliminating it. If further study on the part of the contractor fails to evolve a method for overcoming this difficulty it is recommended that the Bureau of Engineering consider the advisability of accepting the present type of operation since the specifications are exceeded by a matter of approximately 0.001% over a small portion of the frequency range.

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(b) Intermediate Frequency. Table 67 covers tests conducted at 300, 1000, and 2000 kilocycles wherein the supply line voltage was varied between the specified limits in a period of one minute and again in a period of 5 minutes. In all instances the specification tolerance of 0.005% was not exceeded.

164. Par. 7-13-8. Variations in Ambient Temperature.

(a) High Frequency. In order to facilitate the work and to conserve the time required for the tests, paragraph 5 of reference (b) authorized the temperature changes to be made in steps of 10° instead of 5° as called for by this paragraph of the specifications. In some instances, as will be noted by reference to the attached Tables 68 to 71 and Plates 3 to 6, the stabilization periods were reduced from one hour to forty-five minutes. The above tables contain a complete record of transmitter circuit voltages and currents together with the power output observed during the course of the tests. Reference to Table 68 reveals that the temperature coefficient of the circuit at 2000 kilocycles varies between the limits of 0.00002% and 0.00067%. At 4500 kilocycles, Table 69 reveals that the largest temperature coefficient is 0.0011%. This is considered excellent performance for equipment of this type, considering its semi-portable nature and the fact that temperature control of the master circuit is not resorted to. This desirable condition is undoubtedly due to the employment of Invar condensers and the use of a compensated inductor in the master circuit coupled with the use of high grade materials, rigid construction, and general circuit design. Specifications permit a temperature change of 0.006% per one degree change in temperature.

(b) Intermediate Frequency. The intermediate frequency transmitter unit was subjected to temperature changes over the range of $+50^{\circ}$ C to -15° C as shown in Tables 70 and 71, and Plates 5 and 6. The temperature coefficient at 300 kilocycles was found to fall within the range of 0.0054% and 0.0003%, while at 1000 kilocycles the frequency change per one degree was found to fall between the limits of 0.0014% and 0.0001%. Specifications permit a frequency change of 0.008% per degree change in ambient temperature. Throughout these tests no signs of overheating, loss of power or other breakdowns occurred and the operation of the equipment at the end of the test was essentially the same as at the start of the test.

165. Par. 7-13-9. Variations in Humidity.

(a) High Frequency. Tables 72 and 73 cover tests conducted to determine the frequency changes incident to variation of humidity and further to determine the effect of humidity upon the power output of the high frequency transmitter unit. These data are also shown, in graphic form, in Plates 7 and 8 appended hereto. Tests were conducted at 2000 and 4500 kilocycles. The greatest frequency variations noted were approximately 0.05% whereas the specifications permit a variation of 0.2%. The maximum power reduction encountered during these two tests was 3% whereas the governing specifications permit a reduction of 25%. Hence it will be observed that the equipment is in complete compliance with the contractural requirements.

DECLASSIFIED

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(b) Intermediate Frequency. The intermediate frequency unit was subjected to the specified variations in humidity as illustrated in Tables 74 and 75. Plates 9 and 10 present these data in graphic form. Maximum frequency changes of 0.052% and 0.072% were encountered at 300 and 1000 kilocycles respectively. Specification requirements limit this value to 0.2% The maximum power reduction encountered during these tests was 10% whereas specifications permit a 25% reduction.

166. Par. 7-13-10. Locked Key Operation for Two Hours.

(a) High Frequency. Tables 76 and 77 cover two hour locked key tests conducted at 2000 and 4500 kilocycles. During these tests the maximum change in frequency during the run from the frequency at the end of the first 20 minutes was found to be 0.002% at 2000 kilocycles and 0.0039% at 4500 kilocycles. Specifications permit a change of 0.005%.

(b) Intermediate Frequency. The results of two hour locked key tests conducted with the intermediate frequency unit are shown in Tables 78 and 79. At 300 kilocycles the maximum variation in frequency was found to be 0.004% while at 1000 kilocycles a change of 0.01% was noted. Specifications permit a frequency change of 0.025% for the intermediate frequency unit.

167. Par. 7-13-11. Change from Key Locked to Intermittently Keyed Condition.

(a) High Frequency. Table 80 covers tests conducted with the high frequency unit at 2000 and 4500 kilocycles to determine the frequency change encountered under the conditions outlined in paragraph 7-13-11. With the filament lighted the frequency change was found to be 0.004% at 2000 kilocycles and 0.0024% at 4500 kilocycles. Specifications permit a change of 0.01% under these conditions. With the filaments not lighted the frequency changes noted were 0.0097 and 0.0106% at 2000 kilocycles and 4500 kilocycles respectively. These figures are well within the specification requirement of 0.05%.

(b) Intermediate Frequency. Reference to Table 81 reveals that the intermediate frequency unit complies with the specification requirements of this paragraph. Where the specifications permit a frequency change of 0.02% with the filaments lighted the equipment under test produced figures of 0.0033% and 0.002% at 2000 and 300 kilocycles respectively. With the filaments unlighted the maximum frequency changes observed at 2000 kilocycles and 300 kilocycles respectively, were 0.0081% and 0.0065%, whereas the specifications permit a change of 0.05%.

168. Par. 7-13-12. Change from Continuously Keyed to Intermittently Keyed Condition.

(a) High Frequency. During this test the equipment was found to be subject to frequency variations of 0.0017% at 2000 kilocycles and 0.0022% at 4500 kilocycles. Specifications permit a frequency change of 0.005%. See Table 82.

DECLASSIFIED

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(b) Intermediate Frequency. Table 83 covers tests conducted with the intermediate frequency unit. The maximum frequency changes observed were 0.0016% at 300 kilocycles and 0.002% at 2000 kilocycles. Specifications require that the changes in frequency shall not exceed 0.01%.

169. Par. 7-13-13. Inclination Due to Roll and Pitch of Ship.

(a) High Frequency. The high frequency transmitter unit together with the rectifier unit were secured to the test stand employed to simulate the roll and pitch of a vessel by means of ropes and loosely fitting angle brackets at the bottom of the units to prevent slipping. Each test was of 30 minutes duration during which the equipment was inclined up to 45° on either side of the vertical at a rate of 7 cycles per minute. Table 84 and Plate 11 show the results of the test conducted at 2000 kilocycles. It will be noted that the maximum frequency change during the test as compared with the frequency at the start of the test is 51 cycles or 0.0025%, while the maximum change in frequency as compared with the frequency at the end of the test with the transmitting equipment vertical and stationary was 24 cycles or 0.0012%. Specifications permit a maximum variation of 0.001% and hence the equipment fails to comply with this requirement at 2000 kilocycles. Table 85 and Plate 12 cover test conducted at 4500 kilocycles. During this test the maximum frequency change noted was 52 cycles or 0.0011% which is considered as being in agreement with the specification requirement of 0.001%. During these tests no mechanical failures resulted and no discernible difference could be noted in the emitted signal when the equipment was at rest as compared to the signal when the equipment was in motion. Listening tests embraced CW, MCW, and phone emission.

(b) Intermediate Frequency. The methods employed for securing the intermediate frequency unit and rectifier were identical with those described for the high frequency unit and the tests were conducted in a similar manner. Tables 86 and 87 and Plates 13 and 14 cover tests conducted at 300 and 1000 kilocycles. The maximum frequency shift noted during these tests was 0.0066% whereas the specifications permit a value of 0.05%. Listening tests on CW and MCW revealed no noticeable difference between the equipment at rest as compared to the equipment when in motion. The intermediate frequency equipment is in complete accord with the specification requirements.

170. Par. 7-13-14. Vibration.

(a) High Frequency. The units were secured to the test stand in the same manner as described in the above paragraph. Table 88 and Plates 15 and 16 appended hereto cover the vibration tests conducted at 2000 and 4500 kilocycles. The maximum frequency change noted at 2000 kilocycles was 15 cycles, or 0.0007%, while at 4500 kilocycles a change of 70 cycles or 0.0015% was noted. Specifications permit a change of 0.01%. When the high frequency unit was first subjected to vibration it was discovered that the interlock switch on the rear panel was making intermittent contact. This was remedied by a slight readjustment. In production models, care should be observed that all interlock switches are accurately aligned in order to prevent occurrences of this nature. Table 88 also lists the carrier noise while adjusted for phone emission with the equip-

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ment at rest and with the equipment subjected to vibration. The increase in noise level was very slight. Actual listening tests on MCW and phone revealed no appreciable spurious modulations. When listening to the CW emission it was found that the signal lost its clarity although no difficulty was experienced in making solid copy. The high frequency unit complies with the requirements of the governing specifications with regard to frequency stability.

(b) Intermediate Frequency. Table 89 and Plates 17 and 18 cover tests conducted with the intermediate frequency unit. Specifications permit a frequency change of 0.02%. It will be noted that the frequency change observed during the test of 300 kilocycles was 68 cycles or 0.022%, or an excess of 8 cycles. This value of excess is considered to be negligible and with respect to frequency stability the intermediate frequency unit may be considered as complying with the specification requirements. During the vibration tests of this unit, however, two mechanical and electrical failures occurred which require further consideration in design. A short circuit of the keying rectifier occurred due to disintegration of the interlock switch on the antenna coupling control and another short circuit occurred in the tube socket of the I.P.A. stage, caused by a stray bit of solder. These failures are discussed in detail under paragraph 33(h) and 33(i) of this report. Listening tests during the course of the vibration tests revealed no detectable influence upon MCW emission and only a very slight modulation of the CW note was observed.

171. Par. 7-13-15. Shock.

(a) High Frequency. Table 90 covers the data obtained during the shock tests to which the high frequency unit was subjected. In all cases the frequency stability falls within the limits of 0.002% required by the specifications.

(b) Intermediate Frequency. Table 91 covers the data obtained during the shock tests to which the intermediate frequency unit was subjected. It will be noted that during the tests at both 300 kilocycles and 1000 kilocycles, the specification limit of 0.002% has been exceeded. It will be noted that the first shock always produces the maximum frequency shift and after two or three shocks have been applied the change becomes negligible. Apparently the back lash in controls is removed during the first few shocks after which the equipment is practically impervious to further shock.

(c) Rectifier Unit. The rectifier unit was also subjected to the shock test prescribed for the transmitter units. The results of this test are shown in Table 92. It will be noted that no observable changes occurred and the equipment functioned normally during and after the test.

172. Par. 7-14. The various units, with tubes mounted in the sockets, were subjected to the usual handling encountered in field transportation, movement in and out of the temperature test room and lowering and lifting by means of cranes from one level to another, without any derangement or damage to parts.

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Specifications RE 13A 518B (Section VIII - Accessories)

173. Par. 8-2 to 8-6 incl. The governing contract does not require the submission of storage batteries with the preliminary model equipment. In order to conduct the necessary tests two 100 ampere hour storage batteries in accordance with Specifications 17-B-4f were obtained. Each battery, complete with electrolyte weighs 80 pounds 4 ounces.

174. Par. 8-8 and 8-9. The requisite number of adequate interconnection cables have been furnished with the equipment. Table 100 appended hereto lists these cables indicating the color code employed, the lengths of the cables, number of conductors employed and the purpose of each cable. While the cable arrangement is not in complete accordance with the details outlined in these paragraphs, the intent of the specifications is complied with and the system of connections submitted by the manufacturer is complete and satisfactory.

175. Par. 8-10. The cables supplied are of the multi-conductor type where this type of construction is necessary while the remaining cables are single conductor.(See Table 100) Where necessary the cables are shielded with metal braid electrically connected to the grounded conductor and the metallic enclosing shell. This braid appears to be tinned copper. The external covering is live rubber of an extremely tough and durable nature.

176. Par. 8-12. One of the multi-conductor cables, No. 6 as listed on Table 100, was subjected to special tests to determine its flexibility and resistance to the strains encountered under repeated flexing. A testing device was constructed by means of which it was possible to flex the cable through an angle of 180°. The cable was secured to the device so that it was moved through the arc of 180° on approximately a 2 inch radius. All conductors in the cable were connected in series and the driving potential for running the motor and electric counter was fed through these cables so that all operations would cease if any cable opened and the counter would register the number of operations up to the time of failure. After 1180 flexes it was found that two conductors (salmon and blue) had fractured within the cable at the point of flexure. None of the other conductors showed any signs of wear or breakage and only a few strands of the shielding wires were broken. Each cable consists of 26 strands of 0.01 diameter wire, single cotton covered over which approximately 0.04" of rubber covering is laid. The conductors are laid up and covered with single cotton braid, then braided shielding and approximately 1/8" rubber over all. After the first test, the cable was repaired and subjected to a second test. After 7016 flexes one conductor broke (green). No damage to any of the other conductors could be noted. The nature of the flexing produced by the flexing machine is considered to be far more violent than any handling which the cables will receive in the course of routine use. It is of interest to note that no failures occurred within the plug or receptable itself. Apparently the reason why one or two conductors failed and not the others is due to the fact that these conductors were slightly shorter and hence were subjected to more stress. While no standard

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exists to determine the number of flexes a cable of this nature should withstand to be considered of high quality, it is believed that the cables submitted may be considered as being of excellent quality and workmanship.

177. Par. 8-13. All plugs and receptacles are polarized and color coded in order to prevent accidental interchange. It is possible to insert the plug of the 500 volt cable into the 1500 volt receptacle but this error would be plainly evident since the plug is much smaller and the color coding is different. Furthermore, since the 1500 volt cable cannot be inserted in the 500 volt socket the equipment could not be placed into commission if this error were made.

178. Par. 8-14 to 8-18 incl. The plugs supplied comply with the requirements of these paragraphs. One of the connection plugs was subjected to a pressure test. It was intended to apply a pressure of 200 pounds but inadvertently the pressure applied equalled 340 pounds. It was discovered, however, that the plug withstood this pressure without breakage or permanent distortion. Water proofing is obtained by supplying thin rubber sleeves over the cables which should be drawn tightly over the plug after it is inserted in the socket. It is believed that rubber of greater flexibility should be furnished for this purpose since it is extremely difficult to stretch the present sleeves sufficiently.

179. Par. 8-19. Tools and tool roll as called for by this paragraph have been supplied with the equipment. The items furnished are of good quality. However, in order to maintain the equipment properly the following accessories are necessary:

(a) Small funnel for gasoline.
(b) Lead funnel for battery use.
(c) Small oil can for oiling magneto.
(d) Oil can to be used for priming engine.

In addition, the rawhide stake mallet now provided should be heavier and equipped with a longer handle in order that guy stakes and antenna stakes may be driven in hard earth. Since this eventually deforms the rawhide head, spare rawhide inserts should be provided. In the interests of safety it is recommended that the addition of a fire extinguisher of suitable type be considered. No provision is made for transporting spare oil. A suitable container should be provided for this purpose.

180. Par. 8-20. The tape, solder, and hook-up wire specified under this paragraph are provided with the equipment and are stowed with the hand tools in the accessory case.

181. Par. 8-22. Suitable jacks have been provided for extending the telegraph key and the microphone. The key can be secured to the tail gate of the transportation cart when the latter is in position to form an operating table.

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182. Par. 8-23 to 8-25 incl. A suitable hand type of microphone in accordance with the requirements of these paragraphs has been provided. Since this microphone is identical with the microphone furnished with the Model TBO equipments, submergence tests, and humidity and temperature tests were not conducted. Complete tests of this nature were reported in paragraph 89 (page 17) of Naval Research Laboratory Report R-1307 of 21 September 1936 covering the Model TBO portable equipments. Additional tests were conducted to determine the ability of the microphone to withstand hard usage. The microphone was dropped repeatedly upon a hard wood surface from a height of approximately 2 inches. After each shock the microphone was tested. It was found to function satisfactorily after this operation had been repeated 25 to 30 times.

183. Par. 8-26 to 8-34 incl. Microphone Characteristics.

(a) The insulation of each microphone was tested by applying 110 volts, 60 cycles for 10 seconds between the various parts and the conductors. These potentials were applied as follows:

(1) Ground lead and each conductor.
(2) Key lead and microphone lead.
(3) Chest switch and all leads.
(4) Securing ring and all leads.

All tests were successfully concluded without damage resulting to any part.

(b) In this connection attention is invited to the method employed for supplying microphone potentials. The microphone is connected to the transmitter by means of Jack 426. One terminal is grounded directly. The other terminal goes to the microphone transformer (terminal 2 of item 356). Voltage for the microphone is provided by resistor 628 in the main rectifier circuit. This voltage is produced by the return current of the rectifier flowing in resistor 628 (25 ohms 20 watts). Negative potential is supplied by a connection between item 628 and 686 through conductor 34 in the interconnecting cable to the filter choke item 335 to No. 1 terminal of transformer 356. Positive potential comes from the other end of resistor 628, which is grounded. The amount of voltage applied to the microphone is dependent upon the current flowing in the main rectifier. This voltage is greater when the transmitter is on CW emission due to the increased plate current of the P.A. tubes. It is to be noted that if Resistor 628 opens, the full voltage of the main rectifier will be present on cable conductor 34, across filter condensers 248 and 251 and in the microphone. If no voltage breakdowns occurred, the microphone could be subjected to potentials as high as 1500 volts. Thus an exceedingly dangerous condition would result. In order to avoid the possibility of this condition arising it is recommended that the manufacturer consider the advisability of obtaining microphone potential from the copper oxide rectifier which now supplies control or relay potentials and bias potentials.

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(c) The following voltage measurements were made in connection with the microphone circuit.

Potentials measured across Resistor 628
CW - key open: 2 volts
CW - key closed:-9.6 volts
Phone - key open: 2 volts
Phone - key closed: 3.4 volts

Potentials measured across microphone
CW - key open: 0.6 volt
CW - key closed: 2.6 volts
Phone - key open: 0
Phone - key closed: 1.5 volts

(d) The physical and electrical design of the microphones supplied are in accordance with the specification requirements and tests showed that satisfactory voice communication is obtained with both the hand type and chest type instruments.

184. Par. 8-36. One 40 watt lamp fitted with a suitable guard was provided in conjunction with the portable cord called for under paragraph 8-8-4. In this connection attention is invited to the fact that this portable lamp is useful only when 110 volts is available. Should the equipment be operating from the gasoline engine driven unit and should trouble develop in this unit the 110 volt trouble light would be useless. Hence, it is suggested that the Bureau of Engineering consider the advisability of equipping the apparatus with a 6 volt light which could be operated from the storage batteries for emergency use.

185. Par. 8-37. A five gallon capacity safety type gasoline container of rugged construction is supplied with the equipment.

Specifications RE 13A 518B (Section IX - Transportation Material Canvas Covers, Boxes, Carts.

186. Par. 9-1 to 9-8 incl. Canvas covers of waterproofed material (yellow in color) have been provided for the various units and boxes as called for by the specifications. No mobile or station spares were supplied with the preliminary model, hence the design of the carrying cases for this material is not known. Carrying facilities or stowage facilities were not furnished for antenna and counterpoise system, halyards, cables, or masts. The canvas covers for the rectifier and transmitter units do not enclose the bottom of these units, draw strings being provided to secure the covers along the bottom edge. These covers are satisfactory with the present arrangement of carrying handles. However, attention is invited to paragraph 76 of this report which discusses the difficulty of handling the major units with the present arrangement of handles. Should a rearrangement of the carrying handles be provided, modifications to the canvas covers will also be necessary.

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187. Par. 9-9 to 9-17 incl. The accessory box (the only box furnished with the preliminary equipment) is constructed of stainless steel and is of strong construction. The box is provided with a hinged lid of the overlapping type. The hinges permit the lid to rest against the back of the box when open. The hinges are not entirely satisfactory. They should be constructed of somewhat heavier stock and the hinge pins should be headed over to prevent working loose and eventual loss. One hinge pin in the present design is sufficiently loose so that it works out of place readily. The box is fitted with the same type handles provided on the major units. A tray is fitted into the box, divided into compartments for the stowage of small items. No markings were stencilled in the box to indicate the position of the various items and no list of parts was attached to the inner surface of the cover. The total weight of the accessory box, with contents, is 121 pounds 8 ounces, as listed in Table 1. Specifications limit the weight to 110 pounds.

188. Par. 9-20. The cart as originally supplied was equipped with a dural draw bar or handle. The contractor, however, delivered a seamless steel bar as a substitute in order to provide increased strength. The following items used in the construction of the cart are of steel. Certain of these items may be of stainless steel construction but this fact could not be determined. Other items have been coated or painted to protect against corrosion. However, consideration should be given to the substitution of non-ferrous metals for such items where the use of such metals is feasible.

Key mounting studs on tail gate.
Cotter pins in tail gate hinge pins.
Tail gate extension hinges.
Lower tail gate bracket pins.
Lower nuts and springs on antenna mast supporting racks.
Springs and spring shackle assembly.
Wheels.
Wheel spindles.
Bottom axle supporting plate and retaining bolts.
Spindle retaining wing stud and axle band.
Webbing loops.
Webbing buckles.
Tool compartment hinges.

189. Par. 9-21. Test of Transportation Cart.

(a) The cart fully loaded was drawn by four men. The weight is such that four men of average strength have no difficulty in propelling the cart over hard surfaces with slight grades. However, with a soft and yielding road surface difficulty is experienced on the level and it would require more than four men to pull the cart over such a surface with a 2% grade. Continued exertion under such conditions would undoubtedly result in undue fatigue. This condition arises from no defect in cart design and construction since the load is evenly balanced and no undue resistance or friction is present in the wheels.

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(b) The cart, fully loaded with the specified radio equipment, was attached to a light truck and subjected to a road test. Improved and unimproved roads were encountered during this test. Speeds up to 18 miles an hour were employed during this test. The cart shows a tendency to oscillate about the axle when bumps and depressions are encountered at just the right speed and sequence. No failures were encountered during this test but it was decided not to increase the speed up to 30 miles per hour using the radio equipment as a load. In the absence of specific authority it was believed desirable not to subject the equipment to the chance of serious injury and the remainder of the test was conducted with a dummy load.

(c) The center of gravity of the loaded cart was calculated and a dummy load was designed and the cart so loaded as to approximate this same center of gravity. The dummy load consisted of 40 pound sand bags to a total weight of 1120 pounds. The cart was then attached to the rear of a light truck and drawn over average roads at speeds up to 30 miles per hour for a distance of 20 miles.

(d) The cart as originally received was equipped with a dural draw bar. The contractor submitted a steel draw bar to take its place and to increase the strength of this member. The original fittings were transferred to the new draw bar and secured in the same manner. This construction employed brass pins of 1/4" diameter for securing the end fittings in the tubular draw bar. The fitting by means of which the draw bar is attached to the towing truck is a brass casting, cadmium plated.

(e) The design of the towing mechanism is such that the tubular draw bar must flex and twist to compensate for any changes in the relative positions of the towing truck and transportation cart since no flexible knuckle or universal joint member is supplied. During the test the cart showed good towing characteristics in most respects. The trailer consistently maintained its position behind the truck without undue side sway. It was again noted that the cart oscillated about the axle and this action places a particularly heavy strain on the brass fitting used for attachment to the truck. Turns were made over rough inclined ground at slow speeds without accident and in general satisfactory performance was demonstrated.

(f) The following recommendations are submitted for improving the transportation cart:

(1) Substitute steel, adequately protected against corrosion for the present brass casting used for attaching the cart to the towing truck.

(2) Employ tempered steel, corrosion proof pins for securing the fittings to the draw bar in place of the present pins of brass.

(3) Insert a flexible knuckle or universal joint fitting in the draw bar near the outboard end in order to compensate for road shocks and relieve the draw bar and end fitting from excessive strain.

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(g) Since only one transportation cart was submitted and since two carts are required to transport the complete XTBR-1 equipment, it is impossible to submit final and conclusive opinions as to the suitability of the transportation equipment. In order to complete the tests it will be necessary to await the time when two complete carts fully loaded can be tested under the specified conditions.

190. Par. 9-24. Lubrication means is provided in wheel hub but the oil retaining ball is so small that a typewriter oil can would have to be used for this purpose. No such oil can is furnished with the equipment. Tapor roller bearings are furnished. The wheel spindles are of 1-9/32" diameter steel 9-5/8" long, tapered at wheel end. Over these spindles a hollow steel sleeve 1-5/8" diameter by 6-1/8" long is fitted and held in place by 5/16" Allen set screw into hole in spindle. These sleeves have a 3/16" deep by 5/16" wide groove turned 1-3/8" from inboard end. They are retained in hollow axle by 5/16" diameter wing-stud which is screwed through axle band axle into sleeve groove. The distance from the inner side of the wheel hub to center of groove is 5-1/4" and the distance from end of axle to wing stud is 4-3/4". Thus it is possible to push the sleeve groove 1/2" past the axle wing stud. This condition makes the proper alignment of groove and stud somewhat difficult. Should the stud fail to seat home properly it might result in the loss of a wheel when the equipment was in motion. It is recommended that the following construction be considered for the wheel assembly. Wheel shaft to be in one piece, hollow if necessary, and provided with turned groove as at present. Provide spring actuated stud (similar to that provided to hold cross bar handle on draw bar) which will automatically enter the groove in shaft when in alignment. Taper inboard end of shaft sufficiently to clear stud so that wheel assembly can be pushed into proper place without delay.

191. Par. 9-26. The minimum road clearance of the chassis is 12-1/2 inches.

192. Par. 9-27. The transportation cart was loaded with the following units:

Rectifier
High frequency transmitter
Intermediate frequency transmitter
Accessory box
Receiver
Antenna load coil.

A ramp was constructed to give the necessary inclination of 35° to the cart. The tires were fully inflated. The cart was then positioned so that one wheel could be drawn over the ramp while the other remained on the floor. Preventer lines were rigged to prevent damage should the cart show a tendency to overturn. When the inclination reached a point between 30 and 35° normal equilibrium was destroyed and the cart started to overturn. Actual overturning was prevented by means of the preventer lines. When inclined at this angle, the tire in contact with the floor showed a decided tendency to roll off of the rim so that the outer edge of rim almost made contact with the floor. The test demonstrated that even in a static

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condition the cart will overturn when inclined at an angle of 35°. The loading chart submitted is such that the weight of the equipment is as evenly distributed as possible. Very little or no improvement along this line can be obtained. With the various dimensional restrictions placed on the construction of the cart and the units comprising the load together with the load clearance specified, little if any improvement can be accomplished in order to improve the stability of the loaded cart.

193. Par. 9-28. The cart is provided with a T-handle type of tongue or draw bar of the detachable type and adjustable as to height above the ground. The front end of the draw bar is provided with a towing eye. The cross member is readily removable being held in place in draw bar end fitting by means of a spring stud. However, this stud enters hole in cross member only if cross bar is entered in end fitting from right hand side. This pin or stud should be centrally located in end fitting so that cross member can be inserted from either side.

194. Par. 9-29 to 9-31 incl. The rear of the cart is equipped with a suitable tow hook for use in tandem hook-up and a suitable eye is provided at each corner of the cart body for attaching drag ropes. Two 15 foot drag ropes of suitable design are provided.

195. Par. 9-32. A telescopic leg is provided at each corner of the cart. These are of such length, however, that they are fully extended when the cart is horizontal on a level floor. It is recommended that these legs be capable of at least three inches further extension to provide for adequate support on uneven or hilly ground.

196. Par. 9-33. The cart submitted is equipped with fittings by means of which the load may be secured in place. These fittings take the form of angles secured to the floor of the cart body and canvas web straps. In this connection attention is invited to paragraph 69. Should triangular type rubber pads be substituted for the round pads now furnished, the supporting angles fastened to the floor of the cart would have to be modified to provide clearance for the triangular type pads. Four mast supporting brackets are furnished with the cart. Each set of two brackets is capable of securing four sections of mast, or eight sections to the cart. The total number of mast sections to be divided between the two carts is fifteen. The left hand rear bracket is positioned 9-1/4" from the end of the cart while the right hand rear bracket is set back 11" from the end of the cart. It is recommended that both sets of brackets be spaced 11" from the end of the cart. With the spacing only 9-1/4", the securing fitting for the tail gate interferes with the bracket and hence it is impossible to lower the tail gate when the bracket is in place. The additional spacing of 1-3/4", making a total of 11" permits the manipulation of the tail gate securing device with the bracket in place.

197. Par. 9-34. The cart is fitted with a tool compartment near the front end. This compartment measures 4-1/2" x 6-3/8" x 32", with a partition 18" from one end. This partition is pierced to permit passage of draw bar member. The two end doors which are fitted to the compartment are held closed by means of spring clips. A tire

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iron, tube patching outfit and tire pump were furnished after the delivery of the main equipment. The pump, however, is too large to be housed in the tool compartment and hence the compartment must be modified to accommodate this pump.

198. Par. 9-35. The rear of the cart body is equipped with a hinged tail gate which may be used as an operating table when lowered.

199. Par. 9-36 to 9-38 incl. Since only one cart was furnished with the preliminary model, the exact distribution of the entire load between the two carts could not be checked.

200. Par. 9-39 and 9-40. The overall dimensions of the cart, assembled and disassembled, are listed in Table 99 appended hereto. It will be noted that in its assembled condition the cart complies with the requirements of the governing specifications. When disassembled for storage the cart exceeds the specification requirements in all dimensions by the following amounts:

Length - 4-3/8"
Width - 1-1/2"
Depth - 1-1/2"

201. Par. 9-41. The cart body is equipped with a suitable name plate and the floor of the cart body is stencilled to designate the loading position of the various units which go to make up the complete load.

Specifications RE 13A 518B (Section X - Spares)

202. Paragraph 12-2 of Specifications RE 13A 518B states that spare parts shall not be supplied with the preliminary model equipment.

Specifications RE 13A 518B (Section XII - Tests)

203. The tests to which the Model XTBR-1 equipment was subjected are discussed in detail in the foregoing paragraphs of this report. A discussion of the engine driven power unit is contained in the succeeding portion of this report under Specifications RE 13A 506B.

Specifications RE 13A 518B (Section XIII - Data Required)

204. The descriptive specifications submitted by the contractor were checked during the conduct of the tests reported herein and such points of disagreement as exist have been noted. A type test report covering the Model XTBR-1 equipment was submitted by the contractor and proved to be of great assistance in the conduct of the tests herein reported.

Specifications RE 13A 506B (Section I - Introduction

205. The degree of compliance, or non-compliance, of the equipment submitted with the requirements of this introductory section of the specifications is discussed in detail in the succeeding paragraphs of this report.

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Specifications RE 13A 506B (Section II - General Requirements)

206. Par. 2-2 and 2-3. The gasoline engine driven generator unit consists fundamentally of a gasoline engine directly driving a combined a.c./d.c. generator, all mounted, when operating, on a common bed plate. In addition, a control unit is provided, secured to the common bed plate, which contains all necessary control and terminal devices. The equipment is so designed and fabricated that it may be disassembled into three units for storage or transportation.

207. Par. 2-3. Each unit is designed to be rain or spray proof, but not submergence proof. The gasoline engine was suspended upside down to determine oil and gas tightness. The gasoline tank was found to leak badly. The cap on the gasoline tank is provided with about 1-1/2 useful threads for securing purposes. This was insufficient to prevent gasoline leakage. Greater thread area should be provided for safety. The gasoline tank was then drained and the engine left in the inverted position for about 12 hours. At the end of this period it was found that about a teaspoon of oil had leaked out of the governor tension spring shaft bearing on the outboard end. No other leaks were noted. From the foregoing it will be observed that the engine fails to comply with the leak-proof requirements of the specifications.

208. Par. 2-5. The weights of the respective units, housed for stowage and transportation are as follows:

	Actual Weight	Contract Requirements	Notes
Engine unit	141 lb. 4 oz.	155 lb.	
Generator unit	127 8	145	
Bed plate; control panel	74 8	60	
Totals	343 lbs. 4 oz.	360 lbs.	

From the foregoing it will be seen that both the engine and generator units weigh less than the requirements permit while the bed plate and control panel are somewhat in excess of contract requirements. The total weight is less than the contract requirement.

209. Par. 2-6. A number of tests were conducted, utilizing resistive loads as well as the load supplied by full power operation of the rectifier and transmitter units, plus storage battery charging, and in all cases the equipment demonstrated its capability in supplying 1.6 kva at 115 volts, 60 cycles and 150 watts at approximately 8 volts, d.c. (exclusive of alternator excitation) at 1800 r.p.m. without undue heating. The power output characteristics of the gasoline engine and the generator unit are satisfactory and in accord with the governing specifications.

210. Par. 2-7. The direct current output is suitable for storage battery charging purposes. The d.c. generator is equipped with special windings to permit its use as a 6 volt motor for starting the prime mover. The equipment fails to function satisfactorily in this connection however. See comments under paragraph 2-8 below. (Par. 211 of this report.)

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211. Par. 2-8. Starting Characteristics.

(a) Numerous tests were conducted to determine the efficacy of the starting motor under various conditions of ambient temperature. During each test care was exercised to insure that the correct grade of lubricating oil was used as outlined in the contractor's instructions, i.e.:

Temperatures above freezing:	SAE-50
Temperatures below freezing:	SAE-20-W
Extremely low temperatures:	SAE-10-W

During the tests conducted, SAE-10-W lubricant was used whenever the temperature was appreciably below zero degrees Centigrade. Two types of gasoline were used in the tests, a regular grade of vehicular gasoline and special aviation fuel of high octane rating.

(b) Tests at room temperature (25° C). In attempting to start the engine at this temperature after it had been idle for a considerable period of time, it was generally found that the starting motor failed to spin the engine through the compression stroke, particularly if the engine was at rest at an unfavorable position with respect to the compression stroke. Under these conditions the motor would actually stall or would creep slowly through compression in a period of time ranging from 10 to 20 seconds. Furthermore, it was generally found necessary to choke the engine when starting after an extended idle period, which requires the services of two men. The engine is equipped for hand or rope starting. This method generally proved to be more effective at room temperatures, but frequently required at least two or three attempts and also required manipulation of the choker. After the engine had operated for a sufficient length of time to become thoroughly warmed up, the engine would usually start at the first attempt, either by push button control or rope starting.

(c) The engine was permitted to remain out in the open over night. Temperature at time of starting was -1° C. A single 6-volt storage battery was used for starting. Engine would not spin with cylinder pet cock closed. With pet cock open, but no priming, engine started after being turned over for about 80 seconds. The engine was then permitted to remain outdoors for four hours additional. At this time the temperature had risen to +4° C. Rope starting was employed, pet cock closed. Engine started with first spin of rope starter.

(d) Field Tests. During the time field tests were conducted the temperature ranged between the limits of approximately -5° C to +6° C. At various times rope starting, 6-volt battery starting and also 12-volt battery starting were employed. After the engine had been idle for any considerable length of time (2 hours or more) 6 volt push button starting was ineffective without resorting to choking and opening the cylinder pet cock. When 12-volt starting batteries were used, the engine would start in less than 30 seconds. Rope starting with a cold engine was effective only if the choker was used and the pet cock opened. Battery voltage tests showed the following results. Fully charged batteries used.

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Single battery
No load voltage: 6.55 volts
Voltage under load: 4.5 volts

Two batteries in series
No load voltage: 13.1 volts
Voltage under load: 8 to 9 volts

After the engine had been in operation so that it had warmed up, starting and stopping could be accomplished from the remote control position without changing adjustments at the engine, i.e., operating the choker and pet cock. During the field tests SAE-10-W lubricant was employed and both high test and regular vehicular gasoline were used.

(e) Low temperature tests (Range -10 to -28°C). The engine unit was placed in the temperature test room and the temperature reduced to -20° C. SAE-10-W oil was used. For a period of one-half hour, during which the temperature rose from -20 to -10° C repeated attempts were made to start the engine by means of rope starting alone, 6 volt battery starting alone and combined rope starting and 6-volt battery starting. Approximately 15 attempts were made during which the choker was manipulated and cylinder priming of various degrees was resorted to. The engine would hang on the compression stroke, creep through, give a half revolution and again practically stall on compression. No signs of firing were noted and the engine failed to start. Later a second test was conducted in the temperature controlled test chamber. The temperature was reduced to -28° C. SAE-10-W oil was used. Previous to reducing the temperature the engine was run for a short time to insure that the SAE-10-W oil had reached all bearing surfaces. The gasoline tank was filled with gasoline at room temperature (+25° C). 6-volt battery would not rotate the engine with pet cock open. Hand or rope starting was ineffective with and without priming and choke manipulation. With 12-volt starting battery the engine would spin between compression strokes, but on compression it would stop and then barely crawl through. Priming and choking failed to result in starting the engine. As a last resort rope starting combined with 12 volt push button starting was tried and although it was possible to spin the engine no explosion was obtained and finally the test was abandoned without starting the engine.

(f) During the field tests mentioned above the engine stalled due to air lock after having been in operation for approximately 2 hours. The air lock was cleared and the engine restarted. After running less than one hour air lock again stalled the engine. Temperature was approximately 5° above 0 Centigrade. During a test run at +25° C, the motor stalled after 1-1/2 hours of operation due to air lock.

(g) During the course of the various tests to which the gasoline engine was subjected it was frequently noted that even though satisfactory running adjustments of the carburetor had been arrived at, these adjustments appeared to change and a readjustment of the carburetor was necessary to produce smooth operation, after periods of operation and changes in ambient temperature.

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(h) Summary. The evidence collected during the tests in connection with the gasoline engine unit indicates that remote starting (i.e., push-button control) using a 6 volt battery will be effective only after the equipment has been in operation sufficiently long to thoroughly warm up the engine. Push-button control with a cold engine, even at temperatures as high as +25° C will be unsatisfactory unless an attendant is present at the engine to manipulate the choker and the pet cock in the engine cylinder. Tests at sub-freezing temperatures reveal that the present equipment will not start under any conditions. With the present design of engine wherein the gasoline feed line is positioned directly above the muffler and exhaust pipe, air locks in the feed line occur which stall the engine. This phenomenon will occur after approximately two hours of operation at temperatures of approximately +5° C and within 1-1/2 hours at a temperature of +25° Contigrade. At higher temperatures the air lock condition will undoubtedly assert itself in shorter periods of time.

(i) Conclusions. From the foregoing it must be concluded that the gasoline engine in its present state is unsatisfactory for use under the conditions specified in the governing contract and that a modified design must be developed before the desired operation will be obtained.

(j) Addendum. Subsequent to the tests outlined above and after the above data had been compiled, a representative of the General Electric Company and a representative of the Indian Motocycle Company visited the Naval Research Laboratory for the purpose of conducting further tests. These tests to determine the starting ability of the equipment at sub-zero temperatures were conducted under different conditions than those previously reported. The essential differences consisted of diluting the SAE-10-W lubricating oil with 10% kerosene and manually holding the throttle closed during cranking operations. The engine was placed within the temperature room and the temperature lowered to -25° C. Rope starting was used. The engine cranked readily and started on the first attempt. On successive attempts the engine did not always start with one spin from the rope starter but two or three attempts were generally successful. Priming was necessary on all of those attempts. 6-volt push button starting was not successful. With two 6-volt batteries in series the engine could be turned over at high speed and could be started without priming. Further attempts to start the engine without manually closing the throttle were all unsuccessful. The results of this test indicate that the use of 10% kerosene greatly reduces the drag on the engine and permits a sufficiently high speed to be obtained to insure starting by the rope method. It further demonstrates that the position of the throttle is an important factor in starting. For 6-volt starting even with 10% kerosene in the crank case lubricant, the need for an impulse magneto or coupling is indicated. In general, it may be concluded that if the manufacturer takes the necessary steps to correct and modify certain elements and if the use of kerosene is permissible in the Naval Service, the equipment can be improved to the point that sub-zero starting can be accomplished. It should be pointed out that the use of kerosene requires that another item be added to the accessories and that suitable means must be provided for storing and transporting the kerosene.

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212. Par. 2-9. The prime mover, or gasoline engine, drives the generator through a suitable flexible coupling. This unit is so designed that it is capable of ready engagement or disengagement. The coupling remains affixed to the generator unit during transportation and is protected from damage by means of a detachable end bell. Proper positioning marks appear on the coupling and shaft to indicate the proper method of assembly.

213. Par. 2-10. A tool roll housed within the engine cover is supplied. The tools furnished are of good quality and consist of the following:

1 - Socket wrench with 7/16", 1/2", 9/16", 5/8" and 3/4" sockets.
1 - Extension handle and universal joint for above.
1 - 7" Bicycle wrench.
1 - 3" screw driver.
Open end wrenches, 7/16", 1/2", 9/16", 5/8"
2 - Pressed steel wrenches, 7/16", 27/32"
Spark plug wrench.
1 - Pair pliers

214. Par. 2-11. The design of the engine driven generator unit is such that when assembled on the bed plate for operation the equipment will not creep on a level floor or deck. The equipment was installed on a level iron platform and after eight hours of operation, including operation at various speeds and loads, no measurable creepage was noted. While it is believed that the equipment would operate at an angle of 30° without overturning, an actual test to determine this was not conducted. The platform available for such tests has a smooth steel surface and before an angle of 30° was reached there was danger of the equipment sliding off the platform, although not overturning. Hence, when tests were conducted which required the equipment to be tilted up to 45°, the bed plate was securely bolted to the test platform.

215. Par. 2-12. As reported under paragraph 208 of this report, the combined weight of the various units comprising the engine driven generator is 343 pounds 4 ounces, which is within the contract requirement of 360 pounds.

216. Par. 2-15. Reference to paragraph 61 of this report is invited. As stated in this paragraph all external surfaces of the equipment are painted olive drab or green color with the exception of the gasoline engine driven unit which is painted a dark gray, and the receiver unit and power unit which are finished in black wrinkle. It is again recommended that all units be painted the same color.

217. Par. 2-17. This paragraph requires that satisfactory provision shall be made for protection of personnel against injury when starting or operating this equipment.

(a) The equipment is so designed that rotating parts are unlikely to injure the operator since they are well protected.

(b) During the course of these tests the gasoline engine kicked violently during rope starting operations. This causes the engine to

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reverse its rotation and tends to draw the operator's arm down into the starting pulley. While no injury occurred from this cause, the possibility of injury does exist. In order to overcome this condition it is recommended that the addition of an automatic spark advance be considered.

(c) The construction of the carburetor is such that a small amount of gas leakage occurs from this point even when the engine is on a level base. If the engine is operated when inclined at an angle from the horizontal considerably more leakage occurs. When first received, the engine was left idle over the week-end and approximately two quarts of gasoline escaped from the carburetor. The float needle valve was reground and leakage was reduced to a large extent. Any leakage from the carburetor falls directly upon the muffler and exhaust pipe. When in operation these parts become exceedingly hot and thus gasoline leakage presents a fire hazard, with the possibility of an explosion occurring. In order to eliminate this hazard the following recommendations are submitted:

(1) Provide a leak-proof carburetor.
(2) To guard against accidental leakage provide a drip pan with flame arrester beneath the carburetor.
(3) Re-position the muffler and exhaust pipe so that it does not lie directly beneath the carburetor.

218. Par. 2-18. The gasoline engine driven generator was subjected to a momentary overspeed of 25% (2250 r.p.m.) without injury to any part.

219. Par. 2-19. The various component parts of the engine driven equipment have been provided with suitable nameplates.

Specifications RE 13A 506B (Section III - Prime Mover)

220. Par. 3-1. The prime mover is a single cylinder four stroke cycle gasoline engine manufactured by the Indian Motorcycle Company. It is of the L-head type.

221. Par. 3-2 to 3-6 incl. The engine is of the air cooled type. The rated operating speed is 1800 r.p.m. Power take off is accomplished by means of crankshaft extension. The gasoline engine is rated at 3.5 h.p. at 1800 r.p.m. During the tests herein conducted no evidence of overheating was noted, with the exception of the "air-lock" condition which is discussed under paragraph 211 of this report. No engine operational tests were conducted at 50° C since in order to obtain this temperature it would have been necessary to operate the equipment in the temperature control room. Operation of a gasoline engine in this room is considered unsafe. Continuous or intermittent operation of the gasoline engine for a period of 250 hours in order to determine the necessity of overhaul could not be accomplished during the course of these tests.

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222. Par. 3-7. Engine lubrication is accomplished by means of dry sump pressure feed system. No oil cups, grease cups or similar hand oiling devices are necessary except in the case of the magneto which is provided with an oil cup. This oil cup is necessary and its use unavoidable since the magneto is not an integral part of the engine.

223. Par. 3-9. Inclined Operation of Gasoline Engine.

(a) While no signs of lubrication failure were noted with the engine operating at an angle of 30° from the horizontal, operation of the equipment was not feasible under these conditions for other reasons. Prior to this test the complete engine equipment was securely clamped to the test stand. With the engine in horizontal position the equipment was adjusted to give smooth operation at 1800 r.p.m. The platform was then inclined to an angle of 30°, with the gas engine end of the equipment at the lower level. In this position engine operation became erratic and failed to operate at the proper speed. Power output also fell off. Gasoline spilled from the carburetor onto the hot exhaust. Carburetor was readjusted in this position (30° tilt) and engine ran normally except for gasoline leakage. When engine was returned to the horizontal irregular operation resulted until a richer mixture was provided by carburetor adjustment. Engine was then subjected to 45° roll at rate of 7 r.p.m. Gasoline spillage was excessive. Engine operated very erratically and power output fell to useless level. In general, operation was entirely unsatisfactory and fire hazard so great that test was abandoned. Previous to the above tests the carburetor float level was carefully adjusted to 11/32" from top edge of bowl as directed in instruction book.

(b) Subsequent to the above tests a representative of the contractor inspected and adjusted the gasoline engine in an effort to improve its operation. During this inspection it was finally determined that the high speed jet in the carburetor had been inserted upside down. The design of this part is such that to one unfamiliar with this particular type of construction the upside down position appears to be the logical one. Since this jet falls out every time the carburetor bowl is disassembled this error is very likely to occur. Hence some definite means should be evolved to prevent a mistake being made in the assembly of the carburetor.

(c) After the above adjustments had been completed the engine was again subjected to tilted operation. The engine operated smoothly up to 30° tilt but gasoline drippage from the carburetor was very pronounced. The engine continued to function during 45° roll test but due to excessive leakage of gasoline upon the hot muffler and the consequent fire hazard this test was not prolonged. In general, however, the operational characteristics of the engine had been improved by correcting the jet assembly.

(d) The starting battery was also included in the tilt test. Previous to the test the electrolyte level had been checked and adjusted to the proper level. During the tilt test, both at 30° and 45°, electrolyte spilled from the filler tubes. The leakage was particularly severe when the equipment was subjected to the 45° roll,

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224. Par. 3-10 to 3-12 incl. Since it was found impossible to start the gasoline engine at temperatures of -10° C or lower, the effectiveness of the lubricating system at these temperatures could not be observed. During the remainder of the tests conducted in the range of temperature between -5° and +25° C the lubricating system functioned satisfactorily. The oil tank of the engine is fitted with a gauge of the bayonet type for readily ascertaining the amount of lubricating oil in the system. Navy standard lubricants in conformity with the types specified in the instructions were used during the tests with satisfactory results. It is recommended that a nameplate be attached to the gasoline engine specifying the correct grades of lubricant to be used at various temperatures.

225. Par. 3-13. The engine is provided with a magneto of the rotary type. In view of the fact that the starting characteristics of the equipment are unsatisfactory, particularly at low temperatures, as discussed in paragraph 211 of this report, it is recommended that a magneto of the impulse type be considered as a substitute.

226. Par. 3-14 and 3-15. The complete ignition system is protected against rain and moisture and the electrical disturbances produced by the system are insufficient to interfere with radio reception at distances of 50 feet and 100 feet. (See paragraph 108 of this report.)

227. Par. 3-16. No manual spark adjustment is provided. However, as recommended in paragraph 217(b) of this report, the addition of an automatic spark advance should be considered in order to protect operating personnel during hand starting.

228. Par. 3-17. The engine as received is equipped with a 14 mm spark plug mounted in a 7/8" adapter. The reasons for using the 14 mm plug are given in detail on page 13 of reference (h).

229. Par. 3-18 to 3-20 incl. The gasoline engine does not start at low temperatures, as described in paragraph 211 of this report. The exact bearing of the carburetor and intake manifold design upon this condition cannot be ascertained since the lack of satisfactory starting characteristics may be due to a number of causes, including deficient ignition. As reported in paragraph 211 (g) it was found that carburetor adjustments failed to retain their efficacy under all conditions of operation and as further pointed out under paragraph 223(b) faulty assembly of the carburetor jet is likely to occur. A suitable choking device is provided so located as to be accessible to an operator using rope starting.

230. Par. 3-21. The carburetor intake is screened with a single sheet of metallic gauze. It is doubtful whether this strainer will be effective in eliminating extremely fine particles of foreign matter and dust. Evidence exists which demonstrates that Navy portable gasoline engines not equipped with efficient air cleaners have been subjected to serious damage. Hence, it is recommended that a more efficient air cleaner be provided.

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231. Par. 3-22. A priming cock has been provided on the gasoline engine as submitted. However, the use of this device failed to aid in starting the engine at low temperatures. See paragraph 211 above.

232. Par. 3-23 to 3-25 incl. A mechanical governor has been provided to automatically control the engine speed. In general, the operation of this device has been satisfactory as far as controlling engine speed is concerned, although at times the action of the governor caused "hunting". Then without any readjustment the governor would resume satisfactory control. The governor can be adjusted while the engine is in operation without dangor to personnel. Whenever the engine is stopped, the action of the governor causes the throttle to assume the wide open position. Information was obtained which indicates that this condition is detrimental to easy starting. As now arranged, the throttle remains wide open until the engine starts.

233. Par. 3-26. No hand throttle has been provided with the equipment as received, which is in agreement with the governing specifications.

234. Par. 3-27 to 3-31 incl. Forced draft ventilation has been provided by means of a blower and shrouds which direct the air over the cylinder. Gasoline feed is by the gravity method. As previously stated, straight vehicular gasoline and high test aviation gasoline were employed in the tests without any noticeable difference in operation.

235. Par. 3-32 and 3-33. The gasoline tank is constructed of aluminum alloy and is of rugged construction. It has a capacity of 7 quarts. The exterior of the gas tank is badly scratched by the engine case retaining screws. These screws scrape the gas tank when the cover is removed and replaced. Steps should be taken to remedy this condition. In order to assist in determining the amount of gasoline in the tank it is recommended that the bayonet gauge be plated or painted a dull black so that the gasoline level may be more readily determined. It is difficult to detect the gasoline line on the present plain metallic gauge.

236. Par. 3-35 to 3-40 incl. A sediment well or gasoline filter has been provided between the gasoline tank and the carburetor. A drain cock has not been provided for draining the gasoline. In place thereof a 1/8" pipe plug has been located in the lowest part of the tank. This affords an inconvenient method of draining the gasoline system and results in spillage. This condition should be remedied. A shut-off cock has been provided at the outlet from the gasoline tank, but this device cannot be employed for drainage. The gasoline and oil lines are provided with expansion loops to minimize the effects of vibration. Two of these lines show evidence of kinking apparently due to interference with the engine cover retaining screws. As originally submitted the gasoline line to the carburetor was equipped with a rubber hose insert. This connection showed signs of becoming permanently kinked and showed evidence of becoming porous. A representative of the contractor replaced this line with a metallic tube wrapped with asbestos. (See paragraphs 211(f) and 221 for discussion of "air-lock" phenomenon.) The gasoline filling cap is provided with a breather valve which can

DECLASSIFIED

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be closed when the equipment is in condition for transportation or storage. Due to lack of sufficient threads the filler cap leaks when the engine is turned over. (See comments under paragraph 207 above.)

237. Par. 3-41. The instructions accompanying the engine state that suitable timing marks for resetting spark and valve time have been provided. These timing marks are not visible without disassembly.

238. Par. 3-42. There is considerable vibration when the engine is operating, particularly when it is resting on a smooth hard surface. The action of the governor appears to contribute to this vibration. Without completely disassembling the engine it is impossible to determine whether all necessary and feasible steps have been taken to reduce vibration to a minimum, such as properly counterbalanced crankshaft. The fact that the engine is of the single cylinder design undoubtedly contributes to the vibration observed. A further discussion of the effect of this vibration upon the various component parts of the control panel will be found in the discussion under Section VI of these specifications (RE 13A 506).

239. Par. 3-43. The crankcase is provided with a 1/8" pipe plug for drainage purposes. However, this plug is practically inaccessible due to its proximity to the blower shroud. While this plug might be removed without too much difficulty it would be exceedingly difficult to replace the plug and this latter operation would undoubtedly require the use of special tools. A more suitable arrangement for crank case drainage should be supplied.

240. Par. 3-44 to 3-46 incl. The crank case breather takes the form of a small tube terminating at the carburetor intake where it is protected against falling rain. Due to the dry sump system of lubrication it is unnecessary to provide an oil-tight cover to prevent loss of lubricant.

241. Par. 3-47. The tests conducted to determine oil and gas tightness with engine suspended in an inverted position are discussed in paragraph 207 above.

242. Par. 3-48. The engine is provided with a muffler and exhaust system which incorporates the necessary degree of efficiency to make it satisfactory for the use intended. However, the positioning of the muffler and exhaust is such that it presents a fire hazard and steps should be taken to overcome this difficulty.

243. Par. 3-49 to 3-56 incl. The engine is provided with a rugged stainless steel cover for protecting it against mechanical and water damage during transportation and stowage. The cover is secured to the engine base by means of large non-detachable fillister head screws. The cover is fitted with two handles on opposite sides for carrying purposes. The handles fold flat against the cover when not in use and open to 90° when in usable position.

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Specifications RE 13A 506 (Section IV - Generator, Alternator, Exciter, Starting Motor.

244. Par. 4-1 to 4-14 incl. The general construction of the units which comprise the generator conform with the requirements of these paragraphs. The generator bearings are of such design and construction that the need for frequent lubrication is unnecessary and hence no fittings for lubrication are provided. Repacking of the bearings after two years' use is recommended. During the course of the tests the generator bearings function satisfactorily and no signs of overheating were observed.

245. Par. 4-15 to 4-29 incl. The generator wiring is brought out to a panel secured to the side of the generator on which are mounted five plug receptacles. This panel is provided with an adequate cover. The connectors between the generator and control panel are permanently secured on the control panel end. The cables and plugs are of the same general design as the other cables provided with the equipment and are color coded. The other general requirements of these paragraphs have been complied with where the parts covered are open to inspection. Certain aspects of the internal generator construction could not be ascertained without complete disassembly.

246. Par. 4-31 to 4-35 incl. The generator shaft end is equipped with a removable dome shaped aluminum alloy cover to serve as protection during transportation. The cover is of rugged construction but the securing chain by means of which it is fastened to the generator is very weak and was broken beyond repair early in the tests. A chain of more durable design should be provided. The generator is provided with two carrying handles of suitable strength and design.

Specifications RE 13A 506 (Section V - Performance)

247. Par. 5-4. The alternator was arranged for d.c. motor drive through medium of belt and pulleys and installed in the temperature control chamber. The temperature within the chamber was held constant at 45° C and the generator operated for two hours. The intermediate frequency transmitter, operating at full power output, was utilized to load the generator. Table 93 appended hereto illustrates the results of this test. The shell of the generator rose in temperature to 53° C, a total rise of 8° above ambient.

248. Par. 5-5. Tests conducted in accordance with this paragraph of the specifications are listed in Table 94 attached hereto. It will be noted that the percentage increase in exciter voltage as listed in column 1 is 8.2% for two different tests. The readings taken with precision meters connected external to the equipment result in percentage increases in excess of this figure and in excess of the specification requirement of 11%. An examination of the circuit reveals that the panel voltmeter and ammeter are connected on the generator side of the charging cut-out. Measurement of resistance between the coil of the cut-out and the positive battery charging terminal revealed a resistance of 0.018 ohm. With 20 amperes flowing in the circuit the drop across this resistance is

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0.36 volt which accounts for the difference in readings between external and internally connected voltmeters. Taking this fact into consideration, the equipment as supplied complies with the specification requirement of 11%.

249. Par. 5-6. Test conducted to determine conformity with this paragraph of the specifications is illustrated in Table 95. It will be noted that the change in alternator voltage is in agreement with the specification requirements. The change in exciter voltage exceeds the specification requirements. It is pointed out, however, that during the course of this test trouble was experienced with the exciter fuse which manifested itself in exciter voltage fluctuations. Subsequent to the test, removal of the exciter fuse revealed that the shell of the fuse receptacle had become loose and broken, apparently due to vibration and weak construction. A new shell was procured and installed and satisfactory operation was obtained thereafter. However, the construction of this fuse is not considered satisfactory since under the influence of vibration too much strain is imposed upon the receptacle shell. Steps should be taken to modify this design and eradicate the trouble. However, in view of the fact that this loose contact was undoubtedly responsible for the decrease in voltage observed and that the other features of operation were satisfactory, it is recommended that the operation of the exciter be considered as satisfactory in this respect when a suitable fuse is provided.

250. Par. 5-7. The alternator complies in all respects with the requirements of this paragraph, as is illustrated in Table 96 appended hereto.

251. Par. 5-8. The exciter characteristics were checked in accordance with the terms of this paragraph and found satisfactory. The exciter is capable of supplying 20 amperes for charging purposes at 7.5 volts in addition to the necessary excitation for the alternator field.

252. Par. 5-9 and 5-10. The starting motor as provided fails to rotate the power shaft of the engine at 180 r.p.m. at temperatures of -10° C and lower. This feature of the equipment is covered in paragraph 211 of this report. The efficiency of the starter motor was not obtained.

253. Par. 5-11. The gasoline and oil consumption of the gasoline engine under full load was determined at a temperature of approximately 25° C. With the carburetor adjusted to the leanest possible mixture for smooth running the gasoline consumption was found to be 1.4 quarts per hour. No measurable decrease in the oil level could be detected after one hour of operation. After approximately eight hours operation the oil consumption was measured as 1/4 pint. That the efficiency of the engine is largely dependent upon carburetor adjustment was revealed by a second test wherein a slightly different carburetor adjustment was employed. Fuel consumption with this adjustment was 2.14 quarts per hour.

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254. Par. 5-12. The speed characteristics of the engine under conditions of gradual load reduction are illustrated in Table 97. The specification requirements of this paragraph have been met since the increase in speed is less than that permitted under the terms of the governing contract.

255. Par. 5-13, 5-14, and 5-15. Table 98 appended hereto covers tests conducted in conformity with the terms of these paragraphs. In all cases the operation of the equipment complied with the requirements of the specifications.

Specifications RE 13A 506 (Section VI - Bed-Plate-Control Panel)

256. Par. 6-1 to 6-8 incl. The design and construction of the bed-plate-control panel is such as to comply with these paragraphs of the governing specifications.

257. Par. 6-9. The control panel housing is designed to protect the controls from the effects of falling rain. The cover can be extended and secured at right angles with the housing to form a protective cover and can be tightly closed for transportation purposes. The cables connecting between the control panel and the generator are permanently secured on the control panel end and are housed in the control panel for transportation. This space is rather restricted, although adequate for the purpose, but the design is such that the cables are permitted to bulge upward. This subjects the connections within the case to possible injury. It is recommended that a partition be inserted above the cable stowage space to avoid this condition.

258. Par. 6-14. The vibration to which the control panel is subjected caused the failure of the exciter fuse, as detailed in paragraph 249 above. Other items in the panel which required attention are as follows:

(a) The negative battery charging lead frequently worked out of the receptacle during the course of the test. Means should be provided for preventing this condition. Since both the low voltage connectors are of the same design, steps should be taken to insure that all leads are suitably anchored.

(b) Stud of Resistor 755 grounded to the frame, thus grounding the negative battery lead. This condition was remedied during the remainder of the tests by removing one retaining nut and shortening the screw. Steps should be taken to provide more clearance in the control panel case to correct this condition.

(c) Leads on bakelite terminal strips in control panel are dependent for contact on screw pressure against bakelite surface. It is recommended that studs or inserts be used so that metal to metal contact is assured.

259. Par. 6-18-13. The stud cords are secured in the control panel by means of split bakelite blocks. The blocks are fastened together by screws tapped into the bakelite. This design is considered unsatisfactory and metal inserts should be provided to take these screws.

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260. Par. 6-18-16. The construction of the battery cables is not entirely satisfactory.

(a) As pointed out in paragraph 258(a) above, these cables work out of their receptacles when the engine is in operation.

(b) It is recommended that the fiber insulating sleeves protecting the ends of the battery cables be lengthened to more adequately cover the junction between the bare copper and rubber insulation on the cable.

(c) At present the fiber insulating sleeves on the battery cables are held in place by a through pin. These pins ground on the receptacle shell and short the battery. Means should be provided to overcome this difficulty.

261. The appearance of the various units of the XTBR-1 equipment and the type of construction used are illustrated in the following photographs.

Plate 19. Front oblique view of intermediate frequency transmitter, in case.

Plate 20. Back oblique view of intermediate frequency transmitter, in case.

Plate 21. Right back view of intermediate frequency transmitter, case removed.

Plate 22. Left back view of intermediate frequency transmitter, case removed.

Plate 23. Front oblique view of high frequency transmitter, in case.

Plate 24. Back oblique view of high frequency transmitter, in case.

Plate 25. Right back view of high frequency transmitter, case removed.

Plate 26. Left back view of high frequency transmitter, case removed.

Plate 27. Front oblique view of rectifier unit, in case.

Plate 28. Back oblique view of rectifier unit, in case.

Plate 29. Right back view of rectifier unit, case removed.

Plate 30. Left back view of rectifier unit, case removed.

Plate 31. Front oblique view of engine-generator unit.

DECLASSIFIED

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Plate 32. Right back view of engine-generator unit.

Plate 33. Left back view of engine-generator unit.

Plate 34. View of transportation cart, assembled, without equipment in place.

Plate 35. View of combined antenna system erected on three masts.

262. Summary of the defects noted and such items as do not comply with the requirements of the governing specifications, together with such other items as require further consideration, are listed below. The numerals enclosed in parentheses refer to the paragraphs of this report under which these items are discussed in detail.

(a) (23) No special means are provided for securing major units of transmitting equipment to a deck or platform.

(b) (25,80) The weight of the equipment exceeds specification limits.

(c) (27) Certain items of resistors do not comply with Navy Specifications.

(d) (30) Certain items used in construction show evidence of corrosion.

(e) (31) Certain items are constructed of iron or steel (magnetic) where this material is not required for electro-magnetic purposes or extreme strength.

(f) (33a, 158a) Tuning dial of high frequency master oscillator circuit galled due to lack of sufficient clearances.

(g) (33b) Fuse clips in rectifier unit have insufficient clearance.

(h) (33c) Terminal panel on rear of rectifier unit is too small and restricted to provide safe and adequate connections for external leads.

(i) (33d) Possibility of interconnecting external power sources on rectifier unit.

(j) (33f, 44c, 44d) Rectifier tubes are subjected to over voltage.

(k) (33g) Filter capacitors in rectifier unit are marked with insufficient voltage rating.

(l) (33h) Insufficient clearances are provided between tube sockets and ground.

(m) (33i) Insufficient protection is afforded to safeguard transformer Item 682 against overloads.

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(n) (39) Phenolic insulation is used in plugs and receptacles of 500 and 1500 volt connecting cables.

(o) (44e, 44f, 44g, 44h, 44i) Various 38837 tubes failed during course of tests.

(p) (44j) One 38803 tube failed during tests.

(q) (48) Certain controls lack insulating bushings.

(r) (49) Intermediate frequency transmitter unit "Antenna Coupling Switch" decreases controlled effect with increase in numerical setting.

(s) (53) Visibility of intermediate frequency antenna ammeter is poor due to anti-glare glass cover; intermediate frequency antenna ammeter, high frequency antenna ammeter and rectifier line voltmeter became inoperative during tests.

(t) (60, 33e, 41) "Flamenol" insulated wire broke down in rectifier unit; improper clearance provided for certain leads and excessive solder used on some connections.

(u) (61, 216) Exterior surfaces of all units are not painted a uniform color.

(v) (66) Units are not proof against falling rain and moisture.

(w) Round rubber buffer pads are unsatisfactory and readily tear loose.

(x) (74) Diagrams secured to inner surfaces of covers of major units should be given maximum protection against moisture.

(y) (76) Difficulty is experienced by two men in handling the rectifier and transmitter units.

(z) (87) Interference exists between d.c. control cable (green and white) receptacle and knurled head securing screw on rectifier unit.

(aa) (91) Certain switches failed during vibration.

(bb) (92, 102) Gain control on high frequency transmitter is not wire wound resistor.

(cc) (94, 112b, 131) Antenna systems as submitted are unsuitable for use in region of 2000 kilocycles.

(dd) (99) Distortion characteristics of high frequency transmitter exceed specification limits of 10%.

(ee) (112c) Intermediate frequency transmitter master oscillator and I.P.A. plate circuits fail to meet specifications requirements of 5% overlap.

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(ff) (115) No stops are provided on master oscillator compensating condensers in the intermediate frequency and high frequency transmitters.

(gg) (133) Deformation of mast sections likely due to use of split aluminum reinforcing rings.

(hh) (135) Present method provided for anchoring antenna masts not suitable for use in rocky locations.

(ii) (136) Insulators provided in mast guys are unsatisfactory.

(jj) (139) Counterpoise spans are not marked to serve as measuring lines.

(kk) (144) No antenna accessory stowage means are provided with the preliminary model.

(ll) (151a) Modulation of 95% is not obtained with the high frequency transmitter unit.

(mm) (152) When operating into "Boat Antenna" constant overloading of the P.A. tubes occurs at frequencies between 1200 and 2000 kilocycles with full plate potential applied.

(nn) (155) Adjustment of equipment by means of calibration curves cannot be accomplished in one-man-minute.

(oo) (160b) Detuning of I.P.A. grid circuit of intermediate frequency transmitter causes frequency shift of 0.004%; specification limit shift to 0.003%.

(pp) (163a) Variation of supply line voltages causes frequency shift at 4500 kilocycles greater than permitted by specifications.

(qq) (169a) Frequency change of high frequency transmitter due to roll and pitch exceeds specification requirements.

(rr) (171b) Frequency change of intermediate frequency transmitter due to shock exceeds specification requirements.

(ss) (178) Rubber sleeves for waterproofing cable terminals are not sufficiently flexible.

(tt) (179) Need for accessories, in addition to those called for by specifications is indicated. Heavier and larger rawhide mallet should be provided.

(uu) (183) Method of obtaining microphone potential is likely to produce high voltage hazards.

(vv) (184) The need for a 6-volt trouble light is indicated.

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(ww) (187) Hinges on accessory box should be strengthened and modified; compartments not marked as to contents.

(xx) (188) Substitution of non-ferrous metals in place of ferrous materials should be considered wherever possible in construction of transportation carts.

(yy) (189, 190, 193, 195, 196, 197) Modification of certain items of construction used in transportation carts is indicated.

(zz) (192) Transportation cart overturns if tilted at angle of 35°.

(aaa) (200) Disassembled transportation cart exceeds specification tolerances.

(bbb) (207) Gasoline engine leaks oil and gasoline when suspended upside down in condition for transportation.

(ccc) (210, 211, 217, 223, 224, 225, 227, 229, 230, 232, 235, 236, 238, 239, 242) Starting and operational characteristics of gasoline engine are unsatisfactory and modification of transportation, storage and servicing means are necessary.

(ddd) (246) Chain securing protective cover to generator is too weak.

(eee) (249) Exciter fuse mounting in engine control panel is unsatisfactory.

(fff) (257) Cable stowage compartment in engine control panel should be improved.

(ggg) (258, 259, 260) The design and construction of certain parts of the engine control panel are unsatisfactory.

CONCLUSIONS

263. The physical appearance of the units is uniform and pleasing although the finish of certain units must be modified to correspond to the color used on the major items. Controls are arranged in an orderly and symmetrical manner to afford maximum ease in operation. The rear panel of each major unit is provided with interlocked access door to provide for ease in changing tubes and making minor adjustments. The units may be completely removed from their cases for more extensive adjustments or repairs. The rear panel of each major unit and in addition, the front panel of the rectifier, are provided with ventilating louvers. Outer cases and covers are of stainless steel, adequately braced by channels welded to the inner surface. Rubber bumpers are provided to protect the equipment against shock. The handles provided for carrying purposes are of good design, although the weight of the larger units is excessive for two men when the footing is unsatisfactory. In general, the weights of the equipment exceed the specification tolerances.

DECLASSIFIED

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264. The power output obtained at all frequencies exceeds the specification requirements. Difficulty is experienced in properly adjusting the output circuits of the high frequency transmitter when operating into the present high frequency antenna system in the region of 2000 kilocycles. The frequency stability of the equipment under varying temperatures and degrees of humidity is excellent considering the fact that no temperature control is employed. The compensating devices provided for this purpose perform very well.

265. The tubes used in the equipments, particularly the 38837 and to a lesser degree the 38266A, have not provided reliable performance with respect to tube life. This condition results from inherent tube weaknesses and the fact that the tubes are being operated too close to the safe limit.

266. Another serious defect in the operation of the equipment results from the poor starting characteristics of the gasoline engine, particularly at low temperatures. Starting difficulties seriously impair the usefulness of the remote start feature, except when the engine is warm.

267. The antenna system is so constructed that it may be set up readily by a trained crew and is of light but rugged construction. Complete transportation equipment was not provided with the preliminary model and hence definite conclusion as to the suitability of the equipment which will be supplied cannot be arrived at. The limited equipment provided performed satisfactorily although certain modifications are required to improve performance.

268. A number of changes, modifications and corrections are indicated in order to provide greater safety factors, effect greater ease in handling by operating personnel and in a small degree to improve frequency stability.

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Table 1

Model XTBR-1 Radio Equipment

LIST OF WEIGHTS

Test as per paragraphs 1-11 and 1-12 of Specifications RE 13A 518B

No. of Pieces	Description of Item	Wgt. per Unit Lbs.	Wgt. per Unit Ozs.	Total Weight Lbs.	Total Weight Ozs.
	(BASIC ANTENNA-COUNTERPOISE SYSTEM)				
1	Mast Base	2	9		
1	Base Stake	2	6.25		
1	Lower Mast Section	14	1		
2	Plain Mast Sections	11	12	23	8
1	Middle Mast Section	12	9.5		
1	Upper Mast Section	11	1.5		
3	Long Guys (60')	2	6.25	7	3.5
3	Short Guys (30')	1	3	3	8
6	Guy Stakes		15.75	5	15
1	Halyard (100')	5	13.25		
1	Antenna Span (85')	1	1.25		
1	10 ft. extension line	1	1		
3	Counterpoise spans (100')	1	0.5	3	1
2	Insulated downleads	0	7	0	14
11	Snap lines	1	1.5	12	4
1	Connector Plate	0	5.5		
6	Insulators	0	15	5	13.5
4	Hand Reels	0	8.75	2	3

Total of above: 115 lbs. 6.25 ounces

(BASIC EQUIPMENT)

(a)	Engine Driven Generator Unit		
	Generator	127	8
	Base and Control Panel	74	8
	Engine	141	4
	Total	343	4
(b)	Rectifier complete with tubes and covers and canvas cover	273	2
(c)	High Frequency Transmitter unit complete with tubes, covers, and canvas cover	214	12
(d)	Receiver Unit complete	77	
(e)	Receiver Power Unit	65	8

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Table 1 (continued)

		Wgt.per Unit		Total Weight	
(f)	Accessories	Lbs.	Ozs	Lbs.	Ozs.
	Accessory Case	21			
	Canvas Cover	2	13		
	Splicing Compound	0	8		
	Tape	0	8		
	Solder (rosin core)	1			
	Soldering Iron (electric)	1	1.5		
	Mallet (rawhide)	2	10.75		
	Tool Roll, containing:				
	6" diagonal pliers				
	6" long nose side cutters				
	Electricians knife				
	5" tweezers				
	4" flat file				
	6" gas pliers				
	7/16" spintite wrench				
	3" screw driver				
	(weight tool roll):	1	14.75		
	Hand Microphone ..		14.5		
	Breast Microphone	1	15.5		
	Portable lamp and cord	2	6.75		
	Hook up wire	1	1		
	Large Screw Driver	0	8		
	Cables				
	#1 - 50', a.c. power, blue and amber	15	4		
	#2 - 50' Control circuits	15	4		
	#3 - 50' Ext. for #1	15	4		
	#4 - 50' Ext. for #2	15	4		
	#5 - 10' Ext. for #1	3	3.5		
	#6 - 10' Ext. for #2	3	0.5		
	#7 - 7' Rect to Trans Control & a.c.	2	10.5		
	#8 - 7' Rect to Trans. Bias	2	10		
	#9 - 7' Rect to Trans (500 V.)	1	4		
	#10 - 7' Rect to Trans (1350)	1	5.5		
	#11 - Rect. to Receiver a.c.	1	14		
	#12 - Ant Connection to recr.		5.5		
	#13 - Rec Pr Unit to Recr.	2	8		
	#14 - 6 V. pr from Bat. to Pr Unit	2	0		
	Total in Accessory Case:	121	8		
(g)	100 ampere hour batteries (2)	80	4	160	8
(h)	Mobile Spares (not received) Manufacturer's weight:	94			
(i)	Station Spares(not received) Manufacturer's weight:	92			

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	Table 1 (continued)	Wgt. per Unit Lbs.	Wgt. per Unit Ozs.	Total Weight Lbs.	Total Weight Ozs.
(j)	Antenna materials box (not rec'd) Manufacturer's weight:	75			
(k)	1 Antenna Mast	61	4		
(l)	1 Five gallon gasoline can(filled) (Weight empty: 16 lbs)	46			
(m)	Transportation cart for Transmitting Equipment	260			
(n)	Transportation cart for Engine Equipment (est'd weight by contractor):	270			
	TOTAL WEIGHT OF BASIC EQUIPMENT:			2268 lbs.	12 oz.
	(SUPPLEMENTARY ANTENNA COUNTERPOISE SYSTEM)				
2	Mast Bases	5	3.5		
2	Base Stakes	4	12.25		
2	Lower Mast Sections	28	2		
4	Plain Mast Sections	47			
2	Middle Mast Sections	25	3		
2	Upper Mast Sections	22	3		
6	Long Guys	14	7		
6	Short Guys	7			
12	Guy Stakes	11	14		
3	Halyards	17	7.25		
3	Antenna Spans (100')	3	1		
2	Down leads (55')	1	3.5		
12	Snap Lines	13	2		
6	Connector Plates	2	1.5		
3	Insulators	2	13		
5	Hand Reels	2	11.75		
2	Insulated Leads	0	14		
	TOTAL OF SUPPLEMENTARY ANTENNA COUNTERPOISE SYSTEM	209	2.75		
	(TOTAL SUPPLEMENTARY EQUIPMENT)				
	Intermediate Frequency Transmitter, complete with metal and canvas covers	193	12		
	Supplementary antenna material as above	209	2.75		

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Table 1 (continued)

	Lbs.	Ozs.
Supplementary spares		
Mobile	4	
Station (Contractor's estimate)	13	
Transportation boxes:		
Supp. Antenna Material	41	
Mobile Spares	16	
Station Spares	21	
Canvas Covers for:		
Supp. Ant. Material Box	2	
Supp. Mobile Spares Box	2	8
Supp. Station Spares Box	3	12
TOTAL OF SUPPLEMENTARY EQUIPMENT:	506 lbs.	3 ozs.
Antenna Loading Coil	29	8
Cover	2	12
Grand Total of All Equipment (compiled from actual weights of equipment submitted and from contractor's estimated weights for equipment not submitted with preliminary model):	2807 lbs.	3 ozs.

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Table 2

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit
HUMIDITY TEST

Test as per paragraph 2-13 of Specifications RE 13A 518B

High Frequency Transmitter Unit, Rectifier unit and Alternator Unit placed in Temperature Control Room. Alternator belted to d-c motor. Equipment then operated for sufficient time to observe meter readings, output and frequency, after which it was shut down.

Ambient Temperature: 30° C
Relative Humidity: 26%

Alternator	Rectifier	H.F. Transmitter
Freq: 60 cycles	Line Tap: 2	Freq: 2000.452 kilocycles
Voltage: 118	Power Tap: 3	MO Ip: 19.5
	Main Rect. E: 1350	1st IPA Ip: 24
	Aux. Rect. E: 540	2nd IPA Ip: 56
		PA Ig: 50
		PA Ip: 305
		Ant I: 2.5
		Watts Out: 272

The equipment was allowed to remain idle for a period of one hour during which time the ambient temperature was held constant at 45° C., with a relative humidity of from 85 to 95%. At the end of this hour the equipment was started, with the following results:

Freq: 60 cycles	Line Tap: 2	Freq: 2002.850 kilocycles
Voltage: 117	Power Tap: 3	MO Ip: 21
	Main Rect. E: 1350	1st IPA Ip: 29
	Aux.Rect. E : 540	2nd IPA Ip: 55
		PA Ig: 48
		PA Ip: 300
		Ant I: 2.45
		Watts Out: 272

The equipment started readily and functioned normally. The only change of any importance observed was the difference in output frequency - 1398 cycles.

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Table 3

Model XBTR-1 Radio Equipment
Intermediate Frequency Transmitter Unit
HUMIDITY TEST

Test as per paragraph 2-13 of Specifications RE 13A 518B

Intermediate Frequency Transmitter Unit, Rectifier Unit and Alternator Unit placed in Temperature Control Room. Alternator belted to d-c motor. Equipment then operated for sufficient time to observe meter readings, output and frequency, after which it was shut down.

Ambient Temperature: 30° C
Relative Humidity : 26%

Alternator	Rectifier	I. F. Transmitter
Freq: 60 cyclos	Line Tap: 2	Freq: 1000.499 kilocycles
Voltage: 118	Power Tap: 3	IPA Ig: 4.4
	Main Rect. E: 1360	IPA Ip: 41
	Aux. Rect. E: 560	PA Ig: 39
		PA Ip: 305
		Ant I: 3.50
		Watts Out: 251

The equipment was allowed to remain idle for a period of approximately one hour during which time the ambient temperature was held constant at 45° C., with a relative humidity of from 85 to 95%. At the end of this hour the equipment was started, with the following results:

Freq:	60 cyclos	Line Tap: 2	Freq: 1000.570 kilocyclos
Voltage:	118	Power Tap: 3	IPA Ig: 5.0
		Main Rect.E: 1360	IPA Ip: 40
		Aux. Rect.E: 550	PA Ig: 39
			PA Ip: 305
			Ant I: 3.45
			Watts Out: 244

The equipment started readily and functioned normally. The only change of any importance observed was the slight difference in frequency, 71 cycles, and the small diminution in power output, 7 watts.

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Table 4

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit
LIST OF CONTROLS FOR OPERATION OF HIGH FREQUENCY UNIT

Test as per paragraph 2-29 of Specifications RE 13A 518B

Control Designation	Purpose
A	M.O. Band Change Switch, 4 point
B	M.O. Tuning Dial, 2500 divisions
C	1st IPA Plate Band Change Switch, 3 positions
D	1st IPA Tuning Dial, 100 divisions
E	PA Band Change Switch, 3 positions
F	2nd IPA Tuning Dial, 2200 divisions
G	PA Tuning Dial, 1700 divisions
H	Output Tuning Capacitor Dial, 100 divisions
J	Output Tuning Inductor Dial, 3600 divisions
K	Antenna Tuning Capacitor Dial, 100 divisions
L	Antenna Tuning Inductor Dial, 3600 divisions
	Calibration compensator adjustment
	Microphone jack
	Key extension jack
	Line input jack
	Test key
	Panel lights (2)
	Plate voltage indicator light
	Calibration chart
	Carrier adjustment
	Emission switch, 3-position
	Audio gain control
	Filament rheostat
	Filament tap switch, 4-position

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Table 5

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit
LIST OF CONTROLS FOR OPERATION OF INTERMEDIATE FREQUENCY UNIT

Test as per paragraph 2-29 of Specifications RE 13A 518B

Control Designation	Purpose
A	MO Band Change Switch, 6 positions
B	MO Tuning Dial, 2500 divisions
C	IPA Grid Band Change Switch, 4 positions
D	IPA Grid Tuning Dial, 100 divisions
E	IPA Plate Band Change Switch, 5 positions
F	IPA Plate Tuning Dial, 100 divisions
G	PA Band Change Switch, 6 positions
H	PA Tuning Dial, 100 divisions
J	Antenna Coupling Switch, 6 positions
K	Antenna Band Change Switch, 13 positions
L	Antenna Tuning Dial, 100 divisions
	Calibration compensator
	Key extension jack
	Filament tap switch, 4 positions
	Test key
	CW-MCW switch
	Filament rheostat
	Panel lights (2)
	Plate voltage indicator light
	Calibration chart

Table 6

Model XTBR-1 Radio Equipment
Rectifier Unit

LIST OF CONTROLS FOR OPERATION OF RECTIFIER UNIT
Test as per paragraph 2-29 of Specifications RE 13A 518B

Gasoline Engine Start Stop Switch, 2 button
Main Line Toggle Switch
Filament Rheostat
Voltmeter Transfer Switch, 2 positions
Line Tap Switch, 4 positions
Power Tap Switch, 3 positions
Transmitter Rectifier Start Stop Switch
Plate Voltage Toggle Switch
Plate Voltage Indicator
Panel Light

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Table 7

Model XTBR-1 Radio Equipment

LIST OF INDICATING INSTRUMENTS

Test as per paragraph 2-34 of Specifications RE 13A 518B

High Frequency Transmitter Unit

1 MO Plate Current Meter, 0-50 ma
2 1st IPA Plate Current Meter, 0-100 ma
3 Modulator Plate Current Meter, 0-50 ma
4 Modulation Indicator, 0-150
5 2nd IPA Plate Current Meter, 0-100 ma
6 PA Grid Current Meter, 0-100 ma
7 PA Plate Current Meter, 0-500 ma
8 Filament Voltmeter, 0-15 V. a.c.
9 Antenna Current, 0-5 amperes, r.f.

Intermediate Frequency Transmitter Unit

1 Filament Voltmeter, 0-15 V. a.c.
2 Audio Oscillator Plate Current, 0-50 ma
3 IPA Grid Current Meter, 0-10 ma
4 IPA Plate Current Meter, 0-100 ma
5 PA Grid Current Meter, 0-100 ma
6 PA Plate Current Meter, 0-500 ma
7 Antenna Current, 0-8 amperes, r.f.

Rectifier Unit

1 Plate Voltage, 0-2 kv, d.c.
2 Line Voltage, 0-150 V. a.c.
3 Filament Voltage, 0-10 V. a.c.

Engine Unit Control Panel

1 Alternator Voltage, 0-150 V. a.c.
2 Exciter Voltage-Current, 0-8 V. d.c.; 0-25 amperes, d.c.
3 Alternator Frequency, 57-63 cycles (Frahm)

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Table 8

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

OPERATION INTO ACTUAL ANTENNA

Test as per paragraph 4-3 of Specifications RE 13A 518B

Control or Meter	2000 kc	3000 kc	4000 kc	5000 kc	6000 kc	7000 kc
A	1	2	4	2	2	3
B	662	2143	1094	579	2142	1723
C	1	1	2	2	3	3
D	34	86	59	84	47	68
E	1	2	2	2	3	3
F	458	641	1179	1457	63	439
G	0*	538	0870	1168	59	4
H	14	78	78	65	0	85
J	0	2988	0016	0	614	650
K	0	100	100	0	100	63
L	0	467	1320	1525	2195	1686
P.A. Ip	340	300	260	260	275	260
Ant I ext	1.9	1.9	1.7	0.5	2.0	2.45
Line E	120	116	119	115	115	115
Rect. Ep	1000	1390	1440	1400	1370	1400

Note: * denotes that it was impossible to resonate the Power Amplifier Tank Circuit.

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Table 9

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

OPERATION INTO ACTUAL ANTENNA

Test as per paragraph 4-3 of Specifications RE 13A 518B

Control or Meter	8000 kc	10000 kc	12000 kc	14000 kc	16000 kc	18000 kc
A	4	2	2	3	4	4
B	1094	580	2140	1720	1091	2059
C	3	2	3	3	3	3
D	83	84	46	68	83	93
E	3	3	3	3	3	3
F	766	1162	1400	1561	1674	1763
G	514	695	723	1394	1444	1540
H	85	92	86	94	93	89
J	1899	1831	2500	1824	2302	2591
K	59	100	100	100	100	97
L	3107	1912	2540	2635	2389	3075
P.A. Ip	250	260	280	270	250	260
Ant I ext	1.6	0.9	2.1	1.0	2.0	1.7
Line E	118	118	120	120	120	120
Rect. Ep	1350	1350	1350	1350	1350	1350

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Table 10

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

OPERATION INTO ACTUAL ANTENNA

Test as per paragraph 4-3 of Specifications RE 13A 518B

Control or Meter	Column 1	Column 2	Column 3	Column 4
A	1	1	1	4
B	662	930	662	2059
C	1	1	1	3
D	32	38	32	93
E	1	1	1	3
F	474	629	470	1761
G	626	0	208	1511
H	47	28	21	87
J	2107	0	0	2608
K	100	0	100	97
L	0	0	0	3055
P.A. Ip	315	320	315	260
Ant I ext	2.0	2.1	2.7	2.1
Line E	120	118	118	118
Rect. Ep	1350	1300	1350	1350

EXPLANATION:

Column 1. High Frequency Transmitter adjusted to 2000 kilocycles operating into the Intermediate Frequency Antenna System.

Column 2. High Frequency Transmitter adjusted to the lowest frequency at which resonance of the Power Amplifier Tank Circuit could be obtained when operating on the High Frequency Antenna System (85 ft. long). This frequency was found to be 2056 kilocycles.

Column 3. High frequency transmitter, adjusted to 2000 kilocycles, operating into High Frequency Antenna System. Antenna lengthened to 100 feet.

Column 4. High frequency transmitter, adjusted to 18,000 kilocycles, operating into High Frequency Antenna System. Antenna lengthened to 100 feet.

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Table 11

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

OPERATION INTO ACTUAL ANTENNA

Test as per paragraph 4-3 of Specifications RE 13A 518B

Control or Meter	300 kc	400 kc	500 kc	600 kc	700 kc	800 kc
A	1	3	4	6	2	3
B	873	964	2014	385	1119	953
C	1	1	2	3	1	1
D	14	84	66	28	63	84
E	1	2	2	3	3	4
F	27	16	76	47	80	33
G	1	1	2	3	3	3
H	25	88	61	6	66	81
J	3	3	5	5	5	5
K	2	6	8	9	10	10
L	43	66	56	58	34	54
P.A. Ip	300	310	240	300	310	295
Ant I ext	4.8	5.4	5.4	6.0	6.2	6.4
Line E	112	112	112	111	112	111
Rect. Ep	1320	1320	1350	1320	1300	1310

Table 12

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

OPERATION INTO ACTUAL ANTENNA
Test as per paragraph 4-3 of Specifications RE 13A 518B

Control or Meter	1000 kc	1200 kc	1400 kc	1600 kc	1800 kc	2000 kc
A	4	6	4	5	6	6
B	2006	375	1114	864	819	1871
C	2	3	3	3	4	4
D	65	24	62	88	52	69
E	4	5	5	5	5	5
F	88	36	59	74	86	92
G	4	5	5	6	6	6
H	52	31	76	14	58	76
J	5	6	6	5	5	5
K	11	11	12	12	13	13
L	31	60	57	75	70	89
P.A. Ip	280	300	280	290	280	280
Ant I ext	5.7	5.4	4.7	4.2	3.3	2.9
Line E	112	111	112	120	120	119
Rect. Ep	1330	1310	1350	1400	1400	1380

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Table 13

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

AUDIO FREQUENCY CHARACTERISTIC FROM LINE INPUT TO CARRIER

Test as per paragraph 4-8 and 7-9 of Specs.RE 13A 518B

Input voltage constant at 0.7 volt
Phone carrier - 37.5 watts

Modulation Frequency Cycles	Percent Modulation	Modulation Indicator	Decibel Level	
	(Output Frequency 4500 kilocycles)			
100	49.5	34	-5.4	
200	72.8	65	-0.6	Spec limit
300	82.2	80	+0.6	
500	85.0	89	+1.5	
700	86.7	91	+1.5	
1000	87.0	89	+1.4	
1500	84.5	82	+0.6	
2000	79.8	76	-0.1	
2500	77.3	68	-0.6	
3000	72.0	61	-1.6	Spec limit
3500	67.5	54	-2.6	
4000	66.7	50	-3.6	
	(Output Frequency 2000 kilocycles)			
100	54.5	36	-7.0	
200	75.2	66	-1.5	Spec limit
300	84.0	81	0	
500	89.0	93	+1.3	
700	90.0	94	+1.5	
1000	89.0	92	+1.5	
1500	86.3	86	+0.5	
2000	83.9	78	-0.4	
2500	80.0	69	-1.4	
3000	77.3	63	-2.0	Spec limit
3500	74.2	56	-3.2	
4000	71.5	51	-4.3	

Specifications require ± 2 decibels over frequency range 100 to 3000 cycles.

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Table 14

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

SIGNAL TO NOISE RATIO AND PERCENT DISTORTION

Test as per paragraphs 4-8 and 7-9 of Specifications RE 13A 518B

Modulation Frequency - 400 cycles
Carrier Power - 37.5 watts

Percent Modulation	Percent Distortion	Noise Level db down	Modulation Indicator	Power Output
(Transmitter Output Frequency: 2000 kilocycles)				
86.5	13.5	40	80	70
80.0	12.6	39	70	61
71.0	11.1	36	55	50
60.0	9.6	34	41	42.5
50.0	6.7	31	32	39.0
40.0	5.0	27.5	22	38.0
30.0	5.1	24.5	16	37.5
22.0	6.0	22.0	11	37.5
12.0	9.4		6	37.5
(Transmitter Output Frequency: 4500 kilocycles)				
100.0	18.0	35.0	127	77.0
91.0	14.4	34.0	107	72.0
80.0	11.7	32.0	78	58.0
70.0	10.2	30.0	59	47.5
60.0	9.2	28.3	48	43.0
50.0	6.6	26.0	36	39.0
40.0	5.3	24.0	27	37.5
30.0	4.4	21.0	19	37.5
20.0	4.6		12	37.5

Specification Requirements:
Distortion: 10% at 90% modulation
Noise: 40 db down at full modulation

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Table 15

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

RANGE OF AUDIO GAIN CONTROL

Test as per paragraph 4-11 of Specifications RE 13A 518B

Line Input - 500 ohms
Zero Level - 6 milliwatts
Modulating Frequency - 1000 cycles

Audio Input Volts	DB Level	Percent Modulation	Modulation Indicator	Audio Gain Position	Mod. Power Output
	(Output Frequency - 4500 kilocycles)				
5.49	+10	85	90	30%	75
3.08	+5	85	90	40	75
1.73	0	85	90	50	75
0.97	-5	85	90	60	75
0.547	-10	85	90	85	75
0.308	-15	68	62	100	62
	(Output Frequency - 2000 kilocycles)				
5.49	+10	87	97	30%	82
3.08	+5	87	97	40	82
1.73	0	87	97	50	82
0.97	-5	87	97	60	82
0.547	-10	87	97	85	82
0.308	-15	79	79	100	67

Specification Requirements: Adjustment of gain in steps of 2 decibels or less for input levels from 10 decibels below 6 milliwatts to 5 decibels above.

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Table 16

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

DETERMINATION OF LIMITING FREQUENCIES AND OVERLAP OF M.O. CIRCUIT

Test as per paragraph 4-33 of Specifications RE 13A 518B

Control	1	2	3	4	5	6	7	8
A	1	1	2	2	3	3	4	4
B	0	2500	0	2500	0	2500	0	2500
C	2	1	1	1	1	2	2	2
D	50	67	60	90	84	54	42	80
E	2	1	1	2	2	2	2	2
F	1089	1599	1346	747	586	1132	1013	1402
G	0742	0504	0161	389	268	853	725	1131
H	67	60	65	68	73	74	73	84
J	324	637	637	965	965	388	521	3426
K	0	100	100	100	100	100	100	100
L	3305	2146	2204	2303	2305	2231	2236	1897
LD Coil	10	11	11	12	12	13	12	13
LD Cond	994	1199	860	1077	590	635	2183	2054
Freq Kc	942.3	1248.0	1187.7	1569.6	1464.3	1936.1	1800.8	2380.0
KC Overlap	57.7		60.3		105.3		135.3	117.4
Mean Freq.	971.1		1217.8		1516.9		1868.4	2321.2
% Overlap	6.00		4.95		6.95		7.25	5.05
Output Freq.	4xMO	2xMO	2xMO	2xMO	2xMO	2xMO	2xMO	2xMO

Specification Requirements: 5%

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Table 17

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

DETERMINATION OF OVERLAP OF 1st I.P.A. CIRCUIT

Test as per paragraph 4-33 of Specifications RE 13A 518B

Control	1	2	3	4	5	6
A	1	3	3	3	1	4
B	0	1722	0122	193	2187	2500
C	1	1	2	2	3	3
D	20	100	0	100	0	97
E	2*	2	2	2	2	3
F	1089	958	603	1613	1411	1088
G	945	820	603	1232	1007	625
H	51	55	52	47	47	96
J	3218	3500	1907	1512	753	1923
K	100	100	100	100	100	100
L	1735	1614	430	2446	1810	1098
LD Coil	13	15	14	14	16	16
LD Cond	464	1257.5	1871	1922	2020	1952
Freq.KC	1884.5	3500	2945.4	5930.8**	4801.2	9524.4**
KC Overlap	115.5		554.6		1129.6	474.4
Mean Freq.	1942.2		3222.7		5366.0	9287.2
% Overlap	5.9		17.2		21.0	5.1

Note: * Output frequency 2 x 1st IPA
** LD-2 frequency at 1/2 output frequency

Specification requirements: 5%

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Table 18

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

DETERMINATION OF OVERLAP OF 2nd IPA AND PA CIRCUITS

Test as per paragraph 4-33 of Specifications RE 13A 518B

Control	1	2	3	4	5	6
A	1	2	2	4	2	4
B	0	1264	0412	1241	2491	.2500
C	1	1	1	3	3	3
D	20	76	65	84	52	96
E	1	1	2	2	3	3
F	0137	2193	0120	1835	0121	1798
G	0062	877	0	1495	0027	1569
H	31	79	41.5	92	100	61
J	2508	1885	0	0700	2038	2612
K	0	100	100	100	82	94
L	0	1505	1450	2541	3543	3110
LD Coil	13	14	14	16	14	16
LD Cond	469	1207	620	776	2301	1944
Freq.KC	1886.0	2685.7	2455.9	8118*	6212.9*	19030.8**
KC Overlap	114		229.8		1905.1	930.8
Mean Freq.	1943		2570.8		7165.4	18565.4
% Overlap	5.87		8.9		26.6	5.06

* LD-2 at 1/2 output frequency
** LD-2 at 1/4 output frequency

Permitted by Specifications: 5%

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Table 19
Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit
DETERMINATION OF LIMITING FREQUENCIES AND OVERLAP OF M.O. CIRCUIT
Test as per paragraph 4-33 of Specifications RE 13A 518B

Control	1	2	3	4	5	6	7	8	9	10	11	12
A	1	1	2	2	3	3	4	4	5	5	6	6
B	0000	2500	0000	2500	0000	2500	0000	2500	0000	2500	0000	2500
C	1	1	1	1	1	2	2	2	2	3	3	3
D	0	51	41	80	74	42	33	74	69	28	20	65
E	1	1	1	2	1	2	2	2	2	3	3	3
F	6	60	49	11	82	53	42	86	79	47	41	81
G	1	1	1	1	1	2	2	2	2	3	3	3
H	2	45	41	73	71	32	24	67	60	23	22	66
J	1	1	1	1	1	2	2	2	2	2	2	2
K	1	5	4	6	6	8	7	8	8	9	9	10
L	76	37	62	69	52	23	71	76	66	61	55	30
LD Coil	2	3	2	3	3	4	4	4	4	5	5	5
LD Cond	638	222	1589	1162	939	428	196	1531	1322	1120	940	2223
Freq.KC	142.8	170.4	163.6	195.3	189.3	225.9	218.5	260.7	254.2	302.8	294.7	351.2
KC Overlap	7.2		6.8		6.0		7.4		6.5		8.1	17.9
Mean Freq.	146.4		167.0		192.3		222.2		257.4		298.7	360.1
% Overlap	4.9		4.06		3.14		3.32		2.52		2.71	4.97

Specification Requirements: 5%

Note: Output frequency double MO Frequency.

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Table 20

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

DETERMINATION OF OVERLAP OF I.P.A. GRID CIRCUIT

Test as per paragraph 4-33 of Specifications RE 13A 518B

Control	1	2	3	4	5	6	7	8
A	1	3	3	6	5	5	5	6
B	0123	2019	0719	0345	1427	1758	0336	2500
C	1	1	2	2	3	3	4	4
D	0*	100*	0*	100*	0*	100**	0	78
E	1	2	2	3	3	5	5	5
F	7	45	12	47	25	81	73	95
G	1	2	2	3	3	6	6	6
H	5	13	2	21	3	45	13	90
J	1	2	2	2	2	6	6	6
K	2	7	7	9	9	11	11	12
L	38	70	18	59	41	79	70	81
LD Coil	5	6	6	8	7	10	9	10
LD Cond	773	1908	1175	769	1995	359	1289	1760
Freq KC	287.4	435.6	395.1	601.3	563.7	854.3	774.2	1051.2
KC Overlap	12.6		40.5		37.6		80.1	51.2
Mean Freq.	293.7		415.4		582.5		814.3	1025.6
% Overlap	4.29		9.75		6.46		9.85	4.99

Specification Requirements: 5%

Note: * Output frequency double oscillator frequency
** Output frequency 6 times oscillator frequency

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Table 21
Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit
DETERMINATION OF OVERLAP OF I.P.A. PLATE CIRCUIT
Test as per paragraph 4-33 of Specifications RE 13A 518B

Control	1	2	3	4	5	6	7	8	9	10
A	1	3	2	5	5	2	2	5	4	6
B	0000	0954	2138	1452	0505	2243	1489	582	2122	2500
C	1	1	1	2	2	1	1	2	2	4
D	0	85	75	86	75	77	64	76	68	80
E	1	1	2	2	3	3	4	4	5	5
F	9	95	01	97	2	97	2	98	2	95
G	1	1	1	2	2	3	3	4	4	6
H	5	85	81	88	73	83	75	79	78	89
J	1	1	1	1	2	2	2	5	5	5
K	2	7	6	9	9	10	10	10	10	12
L	35	33	53	43	20	45	35	74	68	81
LD Coil	5	6	6	7	7	9	9	10	10	13
LD Cond	735	1281	908	1894	1362	1213	810	1756	1470	1167
Freq KC	285.7	401.7	380.1	557.3	522.3	765.5	719.8	1050.6	1010.3	2102.2
KC Overlap	14.3		21.6		35.0		45.7		40.3	102.2
Mean Freq.	292.9		390.9		539.8		742.6		1030.5	2051.1
% Overlap	4.89		5.53		6.49		6.15		3.91	5.00

Specification Requirements: 5%

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Table 22
Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit
DETERMINATION OF OVERLAP OF POWER AMPLIFIER PLATE CIRCUIT
Test as per paragraph 4-33 of Specifications RE 13A 518B

Control	1	2	3	4	5	6	7	8	9	10	11	12
A	5	3	3	6	5	3	2	5	5	5	4	6
B	1798	1856	1015	0250	1046	1294	1816	2100	0450	1630	1744	2500
C	1	2	1	3	2	2	1	2	2	3	3	4
D	0	24	85	24	81	15	70	94	74	97	73	80
E	1	2	2	3	3	4	3	5	5	5	5	5
F	11	42	18	42	12	42	90	34	8	82	64	96
G	1	1	2	2	3	3	4	4	5	5	6	6
H	2	96	2	96	1	98	2	98	2	95	3	85
J	1	1	2	2	2	4	5	5	5	5	6	6
K	2	7	8	9	9	10	10	11	11	11	11	12
L	37	63	32	58	31	51	39	45	30	78	67	80
LD Coil	5	6	6	8	7	9	9	11	10	12	12	13
LD Cond	746	1789	1313	710	1647	1692	977	770.5	1674	1652	615	1167
Freq Kc	286.18	429.1	402.9	596.7	540.7	820.0	738.6	1172.1	1039.1	1692.3	1469.4	2102.2
KC Overlap	13.82		26.2		56.0		81.4		133.0		222.9	102.2
Mean Freq.	293.1		416.0		568.7		779.3		1105.6		1580.8	2051.2
% Overlap	4.7		6.3		9.9		10.4		12.0		14.0	4.98

Specification Requirements: 5%

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Table 23

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit
FREQUENCY RANGE OF MASTER OSCILLATOR COMPENSATING CONDENSER
Test as per paragraph 4-36 of Specifications RE 13A 518B

	Frequency kilocycles	Frequency kilocycles
Normal setting:	1999.100	4500.000
Compensating condenser minimum:	1999.550	4500.300
Compensating condenser maximum:	1967.660	4462.425
Range (Output Frequency):	31.440	37.570
Range (Oscillator Frequency):	15.720	18.780
Frequency of Oscillator:	999.500	2250.000

The compensating condenser has no stop to prevent shorting. However, shorting does not damage the equipment, merely stops the oscillator.

Table 24

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit
FREQUENCY RANGE OF MASTER OSCILLATOR COMPENSATING CONDENSER
Test as per paragraph 4-36 of Specifications RE 13A 518B

	Frequency kilocycles	Frequency kilocycles
Normal setting:	300.975	2002.500
Compensating condenser minimum:	300.995	2001.250
Compensating condenser maximum:	298.995	1991.200
Range (Output Frequency):	1.980	11.300
Range (Oscillator Frequency):	.990	1.883
Frequency of Oscillator:	150.487	333.540

The compensating condenser has no stop to prevent shorting. However, shorting does not damage the equipment, merely stops the oscillator.

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Table 25

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

EFFECT OF M.O. DIAL LOCK UPON FREQUENCY

Test as per paragraph 4-38 of Specifications RE 13A 518B

Master Oscillator Control	Frequency kilocycles	Frequency Change Cycles	Per cent
"B" set counterclock	2000.540		
Locked	.440	100	0.005
"B" set clockwise	.530		
Locked	.440	90	0.0045
"B" set counterclock	4500.573		
Locked	.670	97	0.0021
"B" set clockwise	.603		
Locked	.669	66	0.0014

Table 26

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

EFFECT OF M.O. DIAL LOCK UPON FREQUENCY

Test as per paragraph 4-38 of Specifications RE 13A 518B

Master Oscillator Control	Frequency kilocycles	Frequency Change Cycles	Per cent
"B" set counterclock	300.520		
Locked	.509	11	0.0036
"B" set clockwise	300.520		
Locked	.511	9	0.003
"B" set counterclock	1000.503		
Locked	.460	43	0.0043
"B" set clockwise	1000.540		
Locked	.503	37	0.0037

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Table 27

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

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

Test as per paragraph 4-41 of Specifications RE 13A 518B

Control "A"	Control "B"	Frequency kc	Change in Freq. kc	Kilocycle per Div.	Per cent per div.
1	0000	942.3			
1	0500	983.4	41.1	0.082	0.00834
1	1000	1035.6	52.2	0.096	0.00927
1	1500	1096.0	60.4	0.122	0.0113
1	2000	1168.6	72.6	0.145	0.0124
1	2500	1248.2	78.6	0.157	0.0126
2	0000	1187.6			
2	0500	1239.1	51.5	0.103	0.00832
2	1000	1304.4	65.3	0.130	0.0100
2	1500	1380.0	75.6	0.151	0.0109
2	2000	1470.9	90.9	0.182	0.0124
2	2500	1569.1	98.2	0.196	0.0125
3	0000	1463.8			
3	0500	1527.4	63.6	0.127	0.00833
3	1000	1608.3	80.9	0.162	0.0101
3	1500	1701.7	93.4	0.187	0.0110
3	2000	1813.9	112.2	0.224	0.0123
3	2500	1937.9	124.0	0.248	0.0128
4	0000	1800.3			
4	0500	1881.2	80.9	0.162	0.0086
4	1000	1980.6	99.4	0.198	0.0100
4	1500	2095.3	114.7	0.229	0.0109
4	2000	2232.4	137.1	0.274	0.0123
4	2500	2382.7	150.3	0.300	0.0126

Specification Requirements: Not to exceed 0.02%

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Table 28

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

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

Test as per paragraph 4-41 of Specifications RE 13A 518B

Control "A"	Control "B"	Frequency kc	Change in Freq.Kc	Kilocycle per Div.	Percent per Div.
1	0000	142.74			
1	0500	146.63	3.89	0.008	0.005
1	1000	151.53	4.90	0.0098	0.006
1	1500	157.16	5.63	0.011	0.007
1	2000	163.60	6.44	0.013	0.008
1	2500	170.36	6.76	0.014	0.008
2	0000	163.57			
2	0500	168.00	5.43	0.011	0.007
2	1000	173.64	5.64	0.011	0.006
2	1500	180.19	6.55	0.013	0.007
2	2000	187.57	7.38	0.015	0.008
2	2500	195.16	7.59	0.015	0.008
3	0000	189.23			
3	0500	194.45	5.22	0.010	0.005
3	1000	200.95	6.50	0.013	0.006
3	1500	208.48	7.53	0.015	0.007
3	2000	217.03	8.55	0.017	0.008
3	2500	225.81	8.78	0.018	0.008
4	0000	218.49			
4	0500	224.49	6.00	0.012	0.005
4	1000	231.93	7.44	0.015	0.006
4	1500	240.57	8.64	0.017	0.007
4	2000	250.44	9.87	0.020	0.008
4	2500	260.73	10.29	0.021	0.008
5	0000	254.17			
5	0500	261.24	7.07	0.014	0.005
5	1000	269.81	8.57	0.017	0.006
5	1500	279.53	9.72	0.019	0.007
5	2000	290.93	11.40	0.023	0.008
5	2500	302.82	11.89	0.024	0.008
6	0000	294.69			
6	0500	303.00	8.31	0.017	0.006
6	1000	312.79	9.79	0.020	0.006
6	1500	324.28	11.49	0.023	0.007
6	2000	337.16	12.88	0.026	0.008
6	2500	350.29	13.13	0.026	0.007

Specification Requirements: Not to exceed 0.02%

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Table 29

Model XTBR-1 Radio Equipment
Rectifier Unit

MEASUREMENT OF RIPPLE VOLTAGES

Test as per paragraph 5-6 of Specifications RE 13A 518B

Rectifier	D.C. Voltage	Ripple voltage at (cycles) 60	90	120	240	Key Position
Main	1430	0.42	-	3.1	0.21	Key down
Main	1430	0.09	-	2.4	0.12	Key up
Auxiliary	560	0.13	-	0.95	-	Key down
Auxiliary	560	0.07	-	0.85	-	Key up

SUMMARY: The total ripple voltage is obtained by taking the square root of the sum of the squares at the various frequencies measured.

Rectifier	D.C. Voltage	Total Ripple %	Total Ripple Volts	Key Position
Main	1430	0.21	3.1	Down
Main	1430	0.16	2.38	Up
Auxiliary	560	0.25	1.4	Down
Auxiliary	560	0.23	1.3	Up

Permitted by Specifications: 1.0%

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Table 30

Model XTBR-1 Radio Equipment
Rectifier Unit

REGULATION OF RECTIFIERS

Test as per paragraph 5-7 of Specifications RE 13A 518B

Full Load Operating Conditions

Line Volts	Rectifier Output Volts	P.A. Ip	Regulation Volts	%
	Main Rectifier with H.F. Transmitter			
115	1455 key up	0		
115	1325 key down	320	130	9.8
	Main Rectifier with I. F. Transmitter			
115	1460 key up	0		
115	1325 key down	320	135	10.2
	Auxiliary Rectifier with H.F. Transmitter			
115	582 key up	-		
115	520 key down Normal Load		62	11.9
	Auxiliary Rectifier with I.F. Transmitter			
115	587 key up			
115	540 key down Normal Load		47	8.7
	Bias Rectifier with H. F. Transmitter			
115	62.0 key up			
115	59.0 key down Normal Load		3	5.1
	Bias Rectifier with I.F. Transmitter			
115	63.0 key up			
115	59.3 key down Normal Load		3.7	6.25

(Power Supply: A.C. Line)

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Table 31

Model XTBR-1 Radio Equipment
Rectifier Unit

POWER REQUIRED FROM SUPPLY LINES

Test as per paragraph 5-24 of Specifications RE 13A 518B

	Watts	Line Volts	Line Amps	Volt Amps
(H.F. Unit, 2000 kilocycles with Rectifier)				
Starting Power	530	110.5	7.3	806
Stand-by	530	110.5	7.3	806
Key down, CW (290 watts)	1210	110	12.9	1418
Key down, MCW (90 watts)	940	109	10.5	1145
Key down, phone (90 watts)	940	109	10.5	1145
Receiver	200			
Total Maximum:	1410			
(I.F. Unit, with Rectifier)				
Starting Power	530	111	7.5	830
Stand-by	530	111	7.5	830
Key down, CW (180 watts)	1030	109.5	11.5	1260
Key down, MCW	850	109.5	9.8	1080
Receiver	200			
Total Maximum:	1230			

Permitted by specifications: 1400 watts

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Table 32

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

EFFECT OF LINE VOLTAGE VARIATION ON RECTIFIER AND HIGH FREQUENCY TRANSMITTER UNITS

Test as per paragraph 7-4 of Specifications RE 13A 518B

Line Volts	Frequency kc	Frequency Change Cycles	Per cent	Power Output	Filament volts	Plate Volts
104.5	2000.572			232	9.0	1250
115.0	.558			288	10.0	1380
126.5	.532	40	0.002	362	11.0	1500

In the above test the line voltage was varied between the limits of -10% and +10% for a period of one minute without readjustment of any voltage controls. Equipment functioned normally.

Line Volts	Frequency kc	Frequency Change Cycles	Per cent	Power Output	Line Tap	Fil. Tap	Plate Volts
97.7	2000.590			292	4	4	1350
115.0	.590			289	2	2	1350
126.5	.600	10	0.0005	300	1	1	1370

In the above test the line voltage was varied from -15% to +10% in five minutes. Controls were readjusted for normal operation. It was possible to adjust all filaments to normal potential for all line voltages.

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Table 33

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

EFFECT OF LINE VOLTAGE VARIATION ON RECTIFIER
AND INTERMEDIATE FREQUENCY TRANSMITTER UNITS

Test as per paragraph 7-4 of Specifications RE 13A 518B

Line Volts	Plate Volts	Filament Volts	Power Output	Frequency kcs	Frequency Change Cycles	Per cent
104.5	1250	9.0	144	300.492		
115.0	1380	9.9	168	.503		
126.5	1500	10.9	190	.517	25	0.0083

In the above test the line voltage was varied between the limits of -10% and +10% in a period of one minute without readjusting any voltage controls. Equipment functioned normally.

97.7	1420	10.0	168	300.505		
115.0	1500	10.0	186	.517		
126.5	1400	10.0	168	.511	6	0.002

In the above test the line voltage was varied from -15% to +10% in five minutes. Controls were readjusted for normal operation. It was possible to adjust all filaments to normal potential for all line voltages.

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Table 34

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

DETERMINATION OF POWER OUTPUT

Test as per paragraph 7-7 of Specifications RE 13A 518B

Control or Meter	2000 kc	3000 kc
A	1	2
B	0662	2143
C	1	1
D	34	86
E	1	2
F	0458	0640
G	0030	0482
H	35	61
J	0	2522
K	100	100
L	0768	1259

	CW	Phone Unmod	MCW	Phone Mod	CW	Phone Unmod	MCW	Phone Mod
MO Ip	19	19	19.5	19	19.5	19	19	19
1st IPA Ip	30	25	26	28	26	24	25	25
2nd IPA Ip	65	60	56	63	46	40	41	42
PA Ig	54	56	50	50	38	40	36	36
PA Ip	300	85	105	105	300	100	115	120
Watts Out	288	37.5	73	71	263	37.5	72	72
Spec Req.	150		37.5	37.5	150		37.5	37.5
Mod Ip		40	32	40		42	34	42
Ind		0	78	78		0	78	78
Emiss Sw	CW	PH	MCW	PH	CW	PH	MCW	PH
% of CW Pr			25.4	24.6			27.4	27.4
Percent Mod			82.7	82.8			79.9	80.0
Gain Control				180				180
Plate E	1370	1480	1480	1460	1420	1500	1500	1500
Aux E	530	500	520	520	550	550	550	550
Line E	106	108	108	107	109	109	109	109

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Table 35

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

DETERMINATION OF POWER OUTPUT

Test as per paragraph 7-7 of Specifications RE 13A 518B

Control or Meter	4000 kc	5000 kc
A	4	2
B	1094	0579
C	2	2
D	59	84
E	2	2
F	1179	1454
G	0870	1117
H	62	52
J	190	0073
K	100	14
L	2828	2600

	CW	Phone Unmod	MCW	Phone Mod	CW	Phone Unmod	MCW	Phone Mod
MO Ip	20.5	20	20	20	21	20	20.5	20.5
1st IPA Ip	30	29	33	29	21	20	20	20
2nd IPA Ip	36	37	38	33	42	41	39	39
PA Ig	32	34	29	28	28	30	28	28
PA Ip	250	95	125	125	260	110	120	120
Watts Out	243	34.5	68	69	204	37.5	66	66
Spec Req	150		37.5	37.5	148		37	37
Mod Ip		43	34	42		41	32.5	41
Mod Ind		0	80	80		0	80	80
Emiss Sw	CW	PH	MCW	PH	CW	PH	MCW	PH
% of CW Pr			28	28.4			32.3	32.3
Percent Mod			79.3	80.5			79.5	82.1
Gain Control				180				180
Plate E	1450	1500	1500	1490	1380	1450	1440	1440
Aux E	550	550	550	550	550	540	550	550
Line E	109	109	109	109	104	105	105	104

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Table 36

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

DETERMINATION OF POWER OUTPUT

Test as per paragraph 7-7 of Specifications RE 13A 518B

Control or Meter	6000 kc	7000 kc
A	2	3
B	2142	1723
C	3	3
D	47	69
E	3	3
F	0061	0448
G	0000	0378
H	48	89
J	0613	0621
K	100	0
L	3500	1496

	CW	Phone Unmod	MCW	Phone Mod	CW	Phone Unmod	MCW	Phone Mod
MO Ip	20	20	20	20	23	22.5	22.5	22.5
1st IPA Ip	34	32	33	33	43	44	42	41
2nd IPA Ip	22	22	22	22	30	24	30	32
PA Ig	30	32	30	31	30	32	30	30
PA Ip	255	117	120	120	260	80	100	100
Watts Out	280	37.5	70	70	265	35	65	63
Spec Req	144		36	36	141		35.5	35.5
Mod Ip		43.5	34.5	43.5		43	34	42.5
Mod Ind			82	82			75	75
Emiss Sw	CW	PH	MCW	PH	CW	PH	MCW	PH
% of CW Pr			25	25			24.5	24
Percent Mod			86.7	86.3			80.8	81.0
Gain Control				200				200
Plate E	1460	1510	1510	1500	1450	1520	1520	1520
Aux E	570	560	560	560	560	550	560	550
Line E	109	109	110	109	109	109	109	109

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Table 37

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

DETERMINATION OF POWER OUTPUT

Test as per paragraph 7-7 of Specifications RE 13A 518B

Control or Meter	8000 kc	10000 kc
A	4	2
B	1094	0580
C	3	2
D	82.5	84
E	3	3
F	0772	1167
G	0332	0966
H	70	97
J	1919	1798
K	67	100
L	3500	1933

	CW	Phone Unmod	MCW	Phone Mod	CW	Phone Unmod	MCW	Phone Mod
MO Ip	20.5	20	20.5	20.5	22	21	21	21
1st IPA Ip	51	46	44	44	22	20	20	20
2nd IPA Ip	43	24	22	20	33	34	36	38
PA Ig	30	30	28	27	30	32	31	30
PA Ip	250	80	100	100	270	90	105	105
Watts Out	255	35	68	68	292	35	70	70
Spec.Req.	137		34	34	130		32.5	32.5
Mod Ip		42.5	34.0	42.0		43	34	42
Mod Ind			80	80			82	82
Emiss Sw	CW	PH	MCW	PH	CW	PH	MCW	PH
% of CW Pr			26.6	26.6			24.8	24.8
Percent Mod			80.4	83.5			85.7	86.1
Gain Control				200				200
Plate E	1450	1510	1510	1510	1450	1520	1520	1500
Aux E	560	550	550	550	570	550	550	550
Line E	109	109	109	110	109	109	109	108

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Table 38

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

DETERMINATION OF POWER OUTPUT

Test as per paragraph 7-7 of Specifications RE 13A 518B

Control or Meter	12000 kc	14000 kc
A	2	3
B	2140	1720
C	3	3
D	46	68.5
E	3	3
F	1402	1561
G	1179	1408
H	90	99
J	2492	1745
K	100	100
L	2489	2407

	CW	Phone Unmod	MCW	Phone Mod	CW	Phone Unmod	MCW	Phone Mod
MO Ip	19.5	19	19	19	23	23	23	23
1st IPA Ip	34	34	34	33	46	45	46	46
2nd IPA Ip	34	33	36	37	33	33	32	32
PA Ig	28	31	30	29	27	30	27	27
PA Ip	260	100	110	115	265	110	120	120
Watts Out	259	35	70	70	254	35	63	63
Spec Req	122		30.5	30.5	115		29	29
Mod Ip		43	34	42		44	35	44
Mod Ind			80	80			82	82
Emiss Sw	CW	PH	MCW	PH	CW	PH	MCW	PH
% of CW Pr			27	27			24.8	24.8
Percent Mod			84	83.5			83.8	85.8
Gain Control				200				200
Plate E	1420	1500	1500	1500	1440	1520	1510	1520
Aux E	560	550	550	550	570	560	560	570
Line E	107	108	108	108	109	110	110	111

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Table 39

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

DETERMINATION OF POWER OUTPUT

Test as per paragraph 7-7 of Specifications RE 13A 518B

Control or Meter	16000 kc	18000 kc
A	4	4
B	1092	2058
C	3	3
D	82.5	92
E	3	3
F	1675	1761
G	1490	1531
H	94	60
J	2325	2598
K	100	94
L	2783	3039

	CW	Phone Unmod	MCW	Phone Mod	CW	Phone Unmod	MCW	Phone Mod
MO Ip	22	21	21	21	26	25	25	25
1st IPA Ip	43	42	43	43	27	26	26	26
2nd IPA Ip	32	33	30	30	38	39	37	37
PA Ig	26	30	26	26	26	29	28	27
PA Ip	270	100	115	115	275	110	120	125
Watts Out	243	35	64	64	225	35	61	64
Spec. Req.	108		27	27	100		25	25
Mod Ip		44	35	43		43	34	43
Mod Ind			82	82			82	82
Emiss Sw	CW	PH	MCW	PH	CW	PH	MCW	PH
% of CW Pr			26.3	26.3			27.0	28.5
Percent Mod			82.3	82.6			87.5	86.2
Gain Control				200				200
Plate E	1450	1520	1510	1510	1420	1490	1480	1480
Aux E	580	560	560	560	550	550	550	550
Line E	110	110	110	110	107	108	108	108

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Table 40

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

DETERMINATION OF POWER OUTPUT

Test as per paragraph 7-7 of Specifications RE 13A 518B

Control or Meter	300 kc	400 kc
A	1	3
B	0872	0964
C	1	1
D	22	90
E	1	2
F	21	19
G	1	1
H	5.5	80
J	1	2
K	3	7
L	32	28

	CW	MCW	CW	MCW
IPA Ig	4.6	4.5	4.6	4.5
IPA Ip	33	33	36	36
PA Ig	48	50	48	50
PA Ip	325	140	270	120
Ant I int*	5.0	2.7	4.9	2.9
Ant I ext**	4.63	2.57	4.65	2.70
Ant Res	8.1	8.1	8.1	8.1
Ant Cap	378	378	378	378
Watts Output	173	53.5	173	59
Watts Required	100	25	100	25
Audio Ip		19		19.5
% Modulation		100		100
% MCW/CW		31		34
Line E	110	111	111	111
Ep Main	1440	1520	1480	1530
Ep Aux	570	560	570	560

Note: "Ant I int" denotes antenna ammeter incorporated in transmitter. "Ant I ext" denotes precision type instrument connected into circuit between base of dummy antenna resistor and counterpoise terminal.

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Table 41

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

DETERMINATION OF POWER OUTPUT

Test as per paragraph 7-7 of Specifications RE 13A 518B

Control or Meter	500 kc		600 kc	
A	4		6	
B	2014		0385	
C	2		3	
D	61		28	
E	2		3	
F	77		47	
G	2		3	
H	53		11	
J	3		4	
K	8		9	
L	60		56	
	CW	MCW	CW	MCW
IPA Ig	4.8	4.7	4.8	4.8
IPA Ip	36	36	40	40
PA Ig	48	50	49	50
PA Ip	320	135	320	140
Ant I int*	5.5	3.1	5.2	2.9
Ant I ext**	5.05	3.10	4.75	2.85
Ant Resistance	8.1	8.1	10.42	10.42
Ant Capacity	378	378	378	378
Watts Output	206	78	235	84.6
Watts Required	100	25	110	27.5
Audio Ip		19.5		19.5
% Modulation		100		100
% MCW/CW		37.8		36
Line E	111	111	110	111
Ep Main	1450	1510	1430	1510
Ep Aux	570	560	560	550

Note: "Ant I int" denotes antenna ammeter incorporated in transmitter. "Ant I ext" denotes precision type instrument connected into circuit between base of dummy antenna resistor and counterpoise terminal.

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Table 42

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit
DETERMINATION OF POWER OUTPUT
Test as per paragraph 7-7 of Specifications RE 13A 518B

Control or Meter	700 kc	800 kc
A	2	3
B	1118	0952
C	1	1
D	62	88
E	3	4
F	81	34
G	3	3
H	59	89
J	4	4
K	10	10
L	27	47

	CW	MCW	CW	MCW
IPA Ig	4.9	4.8	5.2	5.1
IPA Ip	40	40	41	42
PA Ig	42	44	41	42
PA Ip	320	145	320	150
Ant I int*	4.9	2.7	4.9	2.9
Ant I ext**	4.35	2.70	4.65	2.76
Ant Resistance	12.24	12.24	12.24	12.24
Ant Capacity	378	378	378	378
Watts Output	231.5	89.4	265	90
Watts Required	120	30	130	32.5
Audio Ip		19.5		19.5
% Modulation		100		100
% MCW/CW		38.7		34.0
Line E	109	110	109	110
Ep Main	1430	1500	1430	1500
Ep Aux	560	560	560	560

Note: "Ant I int" denotes antenna ammeter incorporated in transmitter. "Ant I ext" denotes precision type instrument connected into circuit between base of dummy antenna resistor and counterpoise terminal.

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Table 43

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

DETERMINATION OF POWER OUTPUT

Test as per paragraph 7-7 of Specifications RE 13A 518B

Control or Meter	1000 kc	1200 kc
A	4	6
B	2006	0375
C	2	3
D	63	22
E	4	5
F	76	38
G	4	5
H	70	42
J	5	6
K	11	11
L	15	48

	CW	MCW	CW	MCW
IPA Ig	5.4	5.4	4.9	4.8
IPA Ip	41	42	43	43.5
PA Ig	41	43	42	43.5
PA Ip	310	140	265	125
Ant I int*	3.7	2.2	3.3	2.0
Ant I ext**	3.64	2.15	3.11	1.95
Ant Resistance	20.41	20.41	24.28	24.28
Ant Capacity	378	378	378	378
Watts Output	271	94.5	234	92.5
Watts Required	150	37.5	150	37.5
Audio Ip		19		19
% Modulation		100		100
% MCW/CW		34.9		39.5
Line E	108	108	109	109
Ep Main	1410	1480	1430	1490
Ep Aux	560	550	560	550

Note: "Ant I int" denotes antenna ammater incorporated in transmitter. "Ant I ext" denotes precision type instrument connected into circuit between base of dummy antenna resistor and counterpoise terminal.

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Table 44

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

DETERMINATION OF POWER OUTPUT

Test as per paragraph 7-7 of Specifications RE 13A 518B

Control or Meter	1400 kc	1600 kc
A	4	5
B	1114	0864
C	3	3
D	63	88
E	5	5
F	60	74
G	5	6
H	65	37
J	5	5
K	12	12
L	42	60

	CW	MCW	CW	MCW
IPA Ig	2.6	2.5	2.2	2.2
IPA Ip	38	38	36	37
PA Ig	34	36	31.5	34
PA Ip	295	145	285	145
Ant I int*	3.3		2.6	
Ant I ext**	2.96	1.85	2.66	1.70
Ant Resistance	30.4	30.4	36.65	36.65
Ant Capacity	378	378	378	378
Watts Output	266	104	259	106
Watts Required	150	37.5	150	37.5
Audio Ip		19.5		19.5
% Modulation		100		94 pos. 100 neg.
% MCW/CW		39		42.5
Line E	109	109	109	109
Ep Main	1440	1500	1440	1500
Ep Aux	580	570	570	570

Note: "Ant I int" denotes antenna ammeter incorporated in transmitter. "Ant I ext" denotes precision type instrument connected into circuit between base of dummy antenna resistor and counterpoise terminal.

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Table 45

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

DETERMINATION OF POWER OUTPUT

Test as per paragraph 7-7 of Specifications RE 13A 518B

Control or Meter	1800 kc	2000 kc
A	6	6
B	0819	1871
C	4	4
D	52	70
E	5	5
F	88	91
G	6	6
H	60	76
J	5	5
K	12	12
L	70	79

	CW	MCW	CW	MCW
IPA Ig	1.4	1.4	1.4	1.4
IPA Ip	32	33	32	33
PA Ig	29	31	28	30
PA Ip	270	135	280	145
Ant I int*	2.3		2.4	
Ant I ext**	2.43	1.55	2.16	1.40
Ant Resistance	42.81	42.81	50.92	50.92
Ant Capacity	378	378	378	378
Watts Output	253	103	238	99.7
Watts Required	150	37.5	150	37.5
Audio Ip		19.5		19.5
% Modulation		90 pos.		91 pos.
		100 neg.		100 neg.
% MCW/CW		40.6		41.9
Line E	109	109	109	109
Ep Main	1450	1500	1440	1500
Ep Aux	580	570	580	570

Note: "Ant I int" denotes antenna ammeter incorporated in transmitter. "Ant I ext" denotes precision type instrument connected into circuit between base of dummy antenna resistor and counterpoise terminal.

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Table 46

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

DETERMINATION OF POWER OUTPUT
(BOAT ANTENNA)
Test as per paragraph 7-8 of Specifications RE 13A 518B

Control or Meter	300 kc		400 kc	
A	1		3	
B	0972		0964	
C	1		1	
D	15		84	
E	1		2	
F	23.5		21	
G	1		1	
H	2		76	
J	1		2	
K	5		5	
L	30		17	
Load Coil Tap (M)	2		10	
	CW	MCW	CW	MCW
IPA Ig	6.4	6.4	7.9	6.8
IPA Ip	34	34	38	38
PA Ig	50	51	49	50
PA Ip	320	140	320	140
Ant I int	4.8	2.7	5.1	2.8
Ant I ext	3.77	2.05	4.06	2.10
Ant Res	10.3	10.3	10.3	10.3
Ant Cap	222	222	222	222
Watts Output	146	43.4	170	45.4
Audio Ip		19		19
% MCW/CW		29.7		28.0
Line E	111	112	112	112
Ep Main	1470	1550	1460	1540
Ep Aux	580	580	590	580

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Table 47

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

DETERMINATION OF POWER OUTPUT
(BOAT ANTENNA)

Test as per paragraph 7-8 of Specifications RE 13A 518B

Control or Meter	500 kc	600 kc
A	4	6
B	2014	0385
C	2	3
D	61	26
E	2	3
F	77	45
G	2	3
H	75	25
J	4	5
K	7	8
L	48	60
Load Coil Tap (M)	10	10

	CW	MCW	CW	MCW
IPA Ig	4.2	4.1	5.8	5.8
IPA Ip	37	38	41	41
PA Ig	50	51	50	52
PA Ip	320	142	295	130
Ant I int	5.6	3.2	5.4	3.1
Ant I ext	4.35	2.44	4.61	2.52
Ant Res	10.3	10.3	10.3	10.3
Ant Cap	222	222	222	222
Watts Output	195	61.3	219	65.3
Audio Ip		19		18.5
% MCW/CW		31.4		29.8
Line E	112	112	112	112
Ep Main	1460	1540	1460	1540
Ep Aux	590	580	580	570

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Table 48

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

DETERMINATION OF POWER OUTPUT
(BOAT ANTENNA)

Test as per paragraph 7-8 of Specifications RE 13A 518B

Control or Meter	700 kc		800 kc	
A	2		3	
B	1118		0952	
C	1		1	
D	58		84	
E	3		4	
F	82		39	
G	3		3	
H	65		90	
J	5		5	
K	9		10	
L	51		7	
Load Coil Tap (M)	10		10	
	CW	MCW	CW	MCW
IPA Ig	6.5	6.4	6.7	6.5
IPA Ip	42	42	45	45
PA Ig	4	46	41	44
PA Ip	310	140	315	145
Ant I int	5.4	3.2	5.8	3.5
Ant I ext	4.60	2.60	4.67	2.89
Ant Res	10.3	10.3	10.3	10.3
Ant Cap	222	222	222	222
Watts Output	218	69.6	225	86
Audio Ip		19		19
% MCW/CW		31.9		38.2
Line E	112	112	112	112
Ep Main	1460	1530	1460	1530
Ep Aux	590	580	590	580

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Table 49

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

DETERMINATION OF POWER OUTPUT
(BOAT ANTENNA)

Test as per paragraph 7-8 of Specifications RE 13A 518B

Control or Meter	1000 kc		1200 kc	
A	4		6	
B	2006		0375	
C	2		3	
D	66		26	
E	4		5	
F	87		37	
G	4		5	
H	81		32	
J	6		6	
K	10		11	
L	50		36	
Load Coil Tap (M)	10		10	
	CW	MCW	CW	MCW
IPA Ig	6.3	6.3	6.0	5.7
IPA Ip	44	44	47	48
PA Ig	45	46	45	47
PA Ip	315	150	310	120
Ant I int	5.8	3.9	4.6	2.4
Ant I ext	4.69	2.87	3.87	2.10
Ant Res	10.3	10.3	10.3	10.3
Ant Cap	222	222	222	222
Watts Output	225	84.8	154	45.5
Audio Ip		19		19
% MCW/CW		37.7		29.6
Line E	111	112	113	113
Ep Main	1450	1540	990*	1060
Ep Aux	590	580	600	590

Note: (*) reduced Ep Main used because of inability to reduce coupling to a low enough value to avoid overloading of the power amplifier stage with full voltage applied.

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Table 50

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

DETERMINATION OF POWER OUTPUT
(BOAT ANTENNA)

Test as per paragraph 7-8 of Specifications RE 13A 518B

Control or Meter	1400 kc	1600 kc
A	4	5
B	1114	0864
C	3	3
D	64	88
E	5	5
F	59	75
G	5	6
H	73	22
J	6	6
K	11	12
L	52	50
Load Coil Tap (M)	10	10

	CW	MCW	CW	MCW
IPA Ig	2.6	2.6	2.3	2.2
IPA Ip	41	42	40	40
PA Ig	36	38	36	38
PA Ip	315	135	315	135
Ant I int	4.3	2.4	4.1	2.3
Ant I ext	3.79	2.20	3.77	2.15
Ant Res	10.3	10.3	10.3	10.3
Ant Cap	222	222	222	222
Watts Output	148	49.8	146.5	47.6
Audio Ip		19.5		19.5
% MCW/CW		33.7		32.5
Line E	112	112	114	114
Ep Main	980*	1050	990*	1060
Ep Aux	600	590	600	600

Note: (*) reduced Ep Main used because of inability to reduce coupling to a low enough value to avoid overloading of the power amplifier stage with full voltage applied.

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Table 51

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit
DETERMINATION OF POWER OUTPUT (BOAT ANTENNA)

Test as per paragraph 7-8 of Specifications RE 13A 518B

Control or Meter	1800 kc	2000 kc
A	6	6
B	0819	1871
C	4	4
D	53	70
E	5	5
F	86	90
G	6	6
H	57	77
J	6	6
K	12	12
L	63	69
Load coil tap (M)	10	10

	CW	MCW	CW	MCW
IPA Ig	1.5	1.5	1.45	1.5
IPA Ip	37	37	38	38
PA Ig	32	34	30	31
PA Ip	300	130	300	135
Ant I int.	4.1	2.3	3.7	2.2
Ant I ext.	3.70	2.17	3.35	2.00
Ant Res	10.3	10.3	10.3	10.3
Ant Cap	222	222	222	222
Watts output	141	48.5	116	41.2
Audio Ip		19.5		19.5
% MCW/CW		34.4		35.5
Line E	113	114	112	113
Ep main	990*	1050	990*	1050
Ep aux	600	600	600	600

Note: * Reduced Ep main used because of inability to reduce coupling to a low enough value to avoid overloading of the power amplifier stage with full voltage applied.

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Table 52

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit
ACCURACY OF FREQUENCY ADJUSTMENT USING CALIBRATION CURVES

Test as per paragraph 7-11 of Specifications RE 13A 518B

Time Seconds	Calibration Frequency	LK-1 Beat Frequency	Transmitter Frequency	Difference	
				Cycles	Per Cent
27	2000.000	800	2000.800	800	0.04
34	4500.000	1370	4498.630	1370	0.03

Specification Requirements: 0.2%.

Note: In conducting this test the necessary settings were first derived from the calibration charts. After the settings were obtained the time required to adjust the transmitter was noted. It would not be possible to determine all settings for one frequency from the calibration charts in one minute.

Dial Readings as taken from Calibration Charts.

Control	2000 kc	4500 kc
A	1	4
B	0664	2057
C	1	2
D	35	73.5
E	1	2
F	0535	1338
G	0230	1063
H	31	88
J	1290	2805
K	94	100
L	0420	1645

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Table 53

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

ACCURACY OF FREQUENCY ADJUSTMENT USING CALIBRATION CURVES

Test as per paragraph 7-11 of Specifications RE 13A 518B

Time Seconds	Calibration Frequency	LK-1 Beat Frequency	Transmitter Frequency	Difference	
				Cycles	Per Cent
43	2000.000	700	1999.300	700	0.035
32	1000.000	737	999.263	737	0.074
23	300.000	175	299.825	175	0.058

Specification Requirements: 0.2%

Note: In conducting this test the necessary settings were first derived from the calibration charts. After the settings were obtained the time required to adjust the transmitter was noted. It would not be possible to determine all settings for one frequency from the calibration charts in one minute.

Dial Readings as taken from Calibration Charts.

Control	2000 kc	1000 kc	300 kc
A	6	4	1
B	1867	1993	0846
C	4	2	1
D	69.1	65.2	34
E	5	4	1
F	94.5	90.0	32
G	6	4	1
H	81	71.1	19.5
J	6	5	1
K	13	11	3
L	59	15.3	34

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Table 54

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit
ACCURACY OF RESET TO PREVIOUSLY CALIBRATED FREQUENCIES

Test as per paragraph 7-13-1 of Specifications RE 13A 518B

Trial No.	Frequency kc	Time Seconds	Deviation in Frequency Cycles	Per Cent
Original	2000.603			
1	520	42	83	0.004
2	559	42	44	0.002
3	570	43	33	0.002
4	650	40	47	0.002
5	570	45	33	0.002
	(Power: 300 watts)		Average:	0.0024%
Original	4500.560			
1	551	57	9	0.0002
2	540	53	20	0.0004
3	695	55	135	0.003
4	680	42	120	0.0027
5	699	55	139	0.003
	(Power: 225 watts)		Average:	0.0018%

Required by Specifications: 0.08%
All tuning controls were misadjusted previous to re-set test.

Note: Paragraph 7-10 of Specifications RE 13A 518B requires that the high frequency unit be capable of adjustment, when using a suitable frequency standard, to within 0.001% of the standard in one minute.

Test as per paragraph 7-10

Original frequency	2000.603
Adjusted frequency	2000.590
Time	54 seconds
Cycles deviation	13
Per cent deviation	0.0006%
Specification requirements	0.001%

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Table 55

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit
ACCURACY OF RESET TO PREVIOUSLY CALIBRATED FREQUENCIES

Test as per paragraph 7-13-1 of Specifications RE 13A 518B

Trial No.	Frequency kc	Time Seconds	Deviation in Frequency Cycles	Deviation in Frequency Per Cent
Original	300.545			
1	547	36	2	0.00066
2	546	31	1	0.00033
3	552	27	7	0.00233
4	552	27	7	0.00233
5	552	27	7	0.00233
	(Power: 205 watts)		Average:	0.0016%
Original	1000.555			
1	564	32	9	0.0009
2	561	31	6	0.0006
3	560	31	5	0.0005
4	566	30	11	0.0011
5	560	32	5	0.0005
	(Power: 265 watts)		Average:	0.00072%
Original	2000.588			
1	655	35	67	0.0033
2	710	33	122	0.0061
3	727	32	139	0.0069
4	723	33	135	0.0067
5	657	34	69	0.0034
	(Power: 234 watts)		Average:	0.0052%

Required by specifications: Average 0.08%
All tuning controls were misadjusted previous to reset, i.e., controls A, B, C, D, E, F, G, H, J, K and L.

Note: Paragraph 7-10 of Specifications RE 13A 518B requires that the IF unit be capable of adjustment, when using a suitable frequency standard, to within 0.005% of the standard in a period of one minute. The foregoing data reveal that an accuracy of 0.005% may be obtained without the use of a standard. When a standard is employed the equipment is capable of an accuracy in excess of that required by paragraph 7-10.

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Table 56

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit
TEST FOR LOST MOTION, BACK LASH AND TORQUE LASH

Test as per paragraph 7-13-2 of Specifications RE 13A 518B

Trial No.	Frequency when approached from Counter Clockwise Direction	Clockwise Direction	Backlash Cycles	Backlash Per Cent
1	2000.640	2000.460	180	0.009
2	606	396	210	0.010
3	607	435	172	0.008
4	628	402	226	0.011
5	623	416	207	0.010
			Average:	0.0096%
1	4500.799	4500.400	399	0.009
2	809	356	453	0.010
3	903	412	491	0.011
4	759	427	332	0.007
5	812	413	399	0.009
			Average:	0.0092%

Subsequent to the above test the master oscillator dial control became inoperative due to galling. This condition was remedied by a representative of the contractor, after which backlash tests were repeated. The results of this retest are listed below.

1	2000.548	2000.390	158	0.008
2	638	382	256	0.013
3	616	410	206	0.010
4	621	415	206	0.010
5	704	410	294	0.015
			Average:	0.011%
1	4500.677	4500.296	381	0.008
2	631	311	320	0.007
3	637	311	326	0.007
4	643	332	311	0.007
5	650	350	300	0.007
			Average:	0.007%

Specification requirements: 0.03%

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Table 57

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit
TEST FOR LOST MOTION, BACK LASH AND TORQUE LASH

Test as per paragraph 7-13-2 of Specifications RE 13A 518B

Trial No.	Frequency when approached from Counter Clockwise Direction	Clockwise Direction	Back Lash Cycles	Back Lash Per Cent
1	300.657	300.600	57	0.019
2	660	600	60	0.020
3	660	600	60	0.020
4	660	640	20	0.0066
5	662	600	62	0.0206
			Average:	0.0172%
1	1000.640	1000.440	200	0.020
2	645	448	197	0.0197
3	643	438	205	0.0205
4	635	420	215	0.0215
5	633	415	218	0.0218
			Average:	0.0207%
1	2000.625	2000.268	357	0.0178
2	702	245	457	0.0285
3	650	258	392	0.019[illegible]
4	645	280	365	0.018[illegible]
5	755	330	425	0.021[illegible]
			Average:	0.0198

Permitted by specifications: Average - 0.05%

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Table 58

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit
VARIATION OF FREQUENCY WITH DETUNING OF CIRCUITS

Test as per paragraph 7-13-4 of Specifications RE 13A 518B

Circuit Detuned	Frequency kc	Per Cent Change of Current	Frequency Difference Cycles	Frequency Difference Per Cent
Normal	2000.500			
1st IPA cc	501	25	1	0.00005
1st IPA c	498	25	2	0.0001
2nd IPA cc	495	25	5	0.00025
2nd IPA c	495	25	5	0.00025
PA cc	500	-	0	0
PA c	498	25	2	0.0001
Ant "H" cc	500	25		
Ant "H" c	500	25		
Normal	4500.500			
1st IPA cc	489	25	11	0.0003
1st IPA c	470	25	30	0.0007
2nd IPA cc	500	25		
2nd IPA c	500	25		
PA cc	500	25		
PA c	500	25		
Ant "H" cc	500	25		
Ant "H" c	500	25		

Note: cc denotes detuned in counter clockwise direction.
c denotes detuned in clockwise direction.

Permitted by specifications: 0.002%.

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Table 59

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit
VARIATION OF FREQUENCY WITH DETUNING OF CIRCUITS

Test as per paragraph 7-13-4 of Specifications RE 13A 518B.

Circuit Detuned	Frequency kc	Per Cent Change of Current	Frequency Difference Cycles	Frequency Difference Per Cent
Normal	300.593			
IPA "D" cc	605	25	12	0.004
"D" c	582	25	11	0.0037
IPA "F" cc	589	25	4	0.0013
"F" c	583	25	10	0.003
PA "H" cc	593	*	0	0
"H" c	590	25	3	0.001
Ant "L" cc	593	25	0	0
"L" c	599	25	6	0.002
Normal	1000.550			
IPA "D" cc	585	25	35	0.0035
"D" c	505	25	45	0.0045
IPA "F" cc	552	25	2	0.0002
"F" c	549	16*	1	0.0001
PA "H" cc	550	25	0	0
"H" c	553	25	3	0.0003
Ant "L" cc	549	25	1	0.0001
"L" c	552	25	2	0.0002
Normal	2000.590			
IPA "D" cc	555	25	35	0.0017
"D" c	612	25	22	0.0011
IPA "F" cc	594	14*	4	0.0002
"F" c	590	12*	0	0
PA "H" cc	590	12*	0	0
"H" c	590	12*	0	0
Ant "L" cc	575	25	15	0.0007
"L" c	590	25	0	0

Note: * denotes current change limited by control.
cc denotes detuned in counter clockwise direction.
c denotes detuned in clockwise direction.

Permitted by specifications: 0.003%.

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Table 60

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit
CONTROL OF POWER OUTPUT

Test as per paragraph 7-13-5 of Specifications RE 13A 518B.

Power Tap	Frequency kc	Frequency Change Cycles	Frequency Change Per Cent	Watts Output	Per Cent Power	Ep	% Ep
1	2000.495	-	-	52.5	18	620	44.5
2	495	-	-	153.8	52.5	960	69.0
3	496	1	0.00005	292.5	100.0	1390	100.0
1	4500.439	-	-	37.5	16.5	630	44.7
2	438	1	0.00002	121	53.4	990	68.7
3	438	1	0.00002	226.5	100.0	1440	100.0

Specification requirements: 0.005%.

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Table 61

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit
CONTROL OF POWER OUTPUT

Test as per paragraph 7-13-5 of Specifications RE 13A 518B

Power Tap	Frequency kc	Frequency Change Cycles	Frequency Change Per Cent	Watts Output	Per Cent Power	Ep	% Ep
1	300.603			35.4	21.0	600	43.0
2	603	0	0	85.0	49.7	960	68.5
3	600	1	0.0003	171.0	100.0	1400	100.0
	Antenna resistance: 8.2 ohms; capacity: 378 uuf.						
1	1000.608			66	23.9	600	43.0
2	609	1	0.0001	152	55.0	960	68.5
3	608	0	0	276	100.0	1400	100.0
	Antenna resistance: 20.4 ohms; capacity: 378 uuf.						
1	2000.597			62	27.5	600	42.5
2	595	2	0.0001	150	66.5	950	67.0
3	598	1	-	225	100.0	1420	100.0
	Antenna resistance: 51.15 ohms; capacity: 378 uuf.						

Ambient temperature: 26 degrees Centigrade.

Permitted by specifications: 0.01% frequency change.

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Table 62

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit
CHANGE OF TUBES
MASTER OSCILLATOR CIRCUIT

Test as per paragraph 7-13-6 of Specifications RE 13A 518B.

Tube No.	Frequency kc	Deviation from Average Frequency
1	2003.110	170
7	2003.520	580
9	2003.450	510
16	2001.750	1190
17	2002.195	745
18	2001.300	1640
19	2002.560	380
20	2003.515	575
21	2002.300	640
22	2002.240	700
Mean	2002.940	713 cycles 0.036%
1	4503.350	1836
7	4503.750	1236
9	4503.500	986
16	4501.650	964
17	4502.000	514
18	4500.950	1564
19	4502.510	4
20	4503.710	1196
21	4502.660	146
22	4502.060	454
Mean	4502.514	890 cycles 0.0197%

Permitted by specifications: 0.2%.

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Table 63

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit
CHANGE OF TUBES
FIRST I.P.A. CIRCUIT

Test as per paragraph 7-13-6 of Specifications RE 13A 518B.

Tube No.	Frequency kc	Deviation from Average Frequency
1	2000.364	64
7	396	32
9	420	8
16	433	5
17	430	2
18	435	7
19	443	15
20	436	8
21	436	8
22	444	16
Mean	428	16.5 cycles 0.00082%
1	4500.326	62
7	300	36
9	286	22
16	260	4
17	245	19
18	275	11
19	261	3
20	241	23
21	239	25
22	228	36
Mean	264	24 cycles 0.0005%

Permitted by specifications: 0.001%.

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Table 64
Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit
CHANGE OF TUBES
MASTER OSCILLATOR CIRCUIT

Test as per paragraph 7-13-6 of Specifications RE 13A 518B.

Tube No.	Frequency kc	Deviation from Average Frequency
1	300.482	61
8	519	98
19	367	54
20	482	61
21	475	54
22	343	78
23	335	86
24	462	41
25	360	61
26	389	32
Mean	300.421	63 cycles 0.021%
1	1000.890	222
3	839	171
19	596	72
20	914	246
21	780	112
22	500	168
23	418	250
24	802	134
25	445	223
26	499	169
Mean	1000.668	177 cycles 0.0177%

Permitted by specifications: 0.1%.

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Table 65

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit
CHANGE OF TUBES
INTERMEDIATE POWER AMPLIFIER CIRCUIT

Test as per paragraph 7-13-6 of Specifications RE 13A 518B

Tube No.	Frequency kc	Deviation from Average Frequency
1	300.479	1
8	477	3
19	473	7
20	474	6
21	476	4
22	479	1
23	480	0
24	486	6
25	486	6
26	488	8
Mean	300.480	4 cycles 0.0013%
1	1000.625	13
3	620	18
19	628	10
20	637	1
21	638	0
22	638	0
23	644	6
24	645	7
25	650	12
26	650	12
Mean	1000.638	8 cycles 0.0008%

Permitted by specifications: 0.002%.

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Table 66

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit
VARIATION OF SUPPLY LINE VOLTAGE

Test as per paragraph 7-13-7 of Specifications RE 13A 518B

Line Voltage	Plate Voltage	Filament Voltage	Power Output	Frequency kc	Frequency Change Cycles	Frequency Change Per Cent
		(Minus 5% to plus 5% in one minute)				
109	1290	9.3	262	2000.530		
115	1360	9.9	305	2000.510		
121	1440	10.5	330	2000.510	20	0.001
109	1300	9.3	173	4500.590		
115	1380	9.9	199	4500.490		
121	1450	10.5	225	4500.438	152	0.0034
		(Minus 5% to plus 5% in five minutes)				
109	1290	9.4	262	2000.538		
115	1350	9.9	290	2000.526		
121	1420	10.4	323	2000.510	28	0.0014
109	1300	9.3	173	4500.593		
115	1390	9.9	199	4500.518		
121	1450	10.5	223	4500.442	151*	0.0034
109	1300	9.3	193	8000.503		
115	1380	9.9	223	8000.530		
121	1450	10.5	258	8000.528	27	0.00034

Note: * This test re-checked with similar results to first test. Total change 159 cycles; 0.0035%.

Permitted by specifications: 0.0025%.

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Table 67

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit
VARIATION OF SUPPLY LINE VOLTAGE

Test as per paragraph 7-13-7 of Specifications RE 13A 518B

Line Voltage	Plate Voltage	Filament Voltage	Power Output	Frequency kc	Frequency Change Cycles	Frequency Change Per Cent
	(Minus 5% to plus 5% in one minute)					
109	1300	9.3	146	300.487		
115	1390	10.0	168	.492		
121	1450	10.5	180	.499	12	0.004
109	1310	9.3	188	1000.505		
115	1380	10.0	219	.523		
121	1450	10.5	243	.530	25	0.0025
109	1320	9.3	145	2001.172		
115	1400	10.0	175	.212		
121	1460	10.5	200	.240	68	0.0034
	(Minus 5% to plus 5% in five minutes)					
109	1300	9.3	146	300.488		
115	1390	10.0	168	.497		
121	1450	10.5	186	.501	13	0.0043
109	1300	9.3	182	1000.510		
115	1390	10.0	213	.527		
121	1450	10.5	243	.538	28	0.0028
109	1320	9.3	146	2001.200		
115	1400	10.0	172	.256		
121	1450	10.5	200	.286	86	0.0044

Permitted by specifications: 0.005%.

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Table 68

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

VARIATIONS IN TEMPERATURE

Test as per paragraph 7-13-8 of Specifications RE 13A 518B

Time	Temp °C	Rel Hum	Frequency kc	MO Ip	1st IPA Ip	2nd IPA Ip	PA Ig	P.A. Ip	Watts Out	P.A. Ep	Line E
0810	52	17	2002.650	20	26	58	51	300	265	1400	117
0825	52	10	2.710	20	26	58	51	300	262	1400	117
0840	50	11	2.745	20	25	56	50	300	258	1400	116.5
0855	51	10	2.810	20	25	56	50	300	252	1400	116.5
0859	39	21	2.835	20	25	56	50	300	258	1400	116.5
0914	40	15	2.895	20	25	56	50	295	257	1390	116
0929	40	13	2.930	20	25	56	50	295	255	1400	116.5
0944	40	15	2.945	20	25	56	50	290	254	1400	116
0950	29	25	2.970	20	25	56	50	290	258	1390	116
1005	30	20	3.040	20	25	56	50	290	258	1390	116
1020	30	20	3.060	20	25	56	50	290	258	1380	116
1035	30	19	3.065	20	25	56	50	290	258	1380	116
1048	21	24	3.110	20	25	56	50	290	261	1390	116
1103	20	21	3.150	20	25	56	50	290	262	1380	116
1118	20	16	3.160	20	25	56	50	295	261	1380	116
1133	19	17	3.155	20	25	56	50	295	261	1390	116
1140	10	19	3.150	20	25	56	50	295	262	1390	116
1155	10	21	3.165	20	25	56	50	300	263	1380	116
1210	10	23	3.160	20	25	56	50	295	262	1390	116
1225	10	19	3.150	20	25	56	50	300	261	1390	116
1240	0	-	3.190	20	25	57	50	300	262	1400	116
1255	-8	-	3.230	20	26	57	51	300	263	1400	115.5
1310	-11	-	3.250	20	26	58	51	300	265	1400	116
1325	-14	-	3.250	20	26	58	52	300	263	1400	115.5
1340	-16	-	3.250	20	26	58	52	300	263	1400	115.5
1355	-17	-	3.235	20	26	58	52	300	262	1400	115.5
1410	-19	-	3.230	20	26	58	52	300	262	1400	115.5
1425	-20	-	3.230	20	26	60	53	310	263	1400	115.5
1440	-20	-	3.215	20	26	60	53	310	262	1400	115.5
1455	-21.2	-	3.210	20	26	60	53	305	258	1400	115.5
1510	-20.6	-	3.215	20	26	60	53	310	258	1400	115.5
1525	-20	-	3.200	20	26	60	53	310	258	1400	115
1540	-21.2	-	3.200	20	26	61	54	310	259	1400	115.5
1555	-21.5	-	3.200	20	26	59	53	310	258	1400	115

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Table 68 (continued)

Summary

Temperature °C	Cycles Change	Percent Change per 1° C.
50 to 40	135	0.00067
40 to 30	120	0.00060
30 to 20	90	0.00045
20 to 10	5	0.00002
10 to -11	100	0.00024
-11 to -20	20	0.00011

Permitted by specifications: 0.005% per degree change in ambient temperature.

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Table 69

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

VARIATIONS IN TEMPERATURE

Test as per paragraph 7-13-8 of Specifications RE 13A 518B

Time	Temp °C	Rel Hum	Frequency Kc	MO Ip	1st IPA Ip	2nd IPA Ip	PA Ig	P.A. Ip	Watts Out	P.A. Ep	Line E
0835	53	12	4502.400	26	24	39	30	255	197	1410	116
0850	51	13	2.755	26	23	39	29	255	192	1410	116
0905	51	11	2.755	26	23	40	29	250	192	1400	115.5
0920	51	11	2.915	26	24	41	29	255	194	1420	117
0935	41	12	3.195	26	24	41	29	250	197	1410	117
0950	40	11	3.300	26	24	42	28	250	199	1420	117
1005	41	11	3.365	26	24	42	28	250	197	1410	117
1020	40	11	3.410	26	24	43	28	250	197	1410	117
1035	31.5	11	3.515	26	24	41	28	250	199	1410	117
1050	30	15	3.620	26	24	42	28	250	199	1400	116.5
1110	30	17	3.630	26	24	41	29	250	199	1410	116.5
1125	30	16	3.665	26	24	41	29	250	199	1400	116.5
1140	23	11	3.780	26	24	42	29	250	200	1410	116.5
1145	20	10	3.875	26	24	42	29	250	201	1410	116.5
1200	19.5	14	3.970	26	24	42	29	250	203	1410	116.5
1215	20	15	4.020	26	24	42	29	255	203	1410	116.5
1230	20.0	15	4.050	26	24	42	29	255	202	1400	116.5
1245	15	11	4.110	26	24	41	30	255	203	1410	116.5
1300	12.5	12	4.230	26	24	42	30	255	203	1410	116.5
1315	9.5	16	4.230	26	24	41	30	260	204	1410	116.5
1330	10	28	4.480	26	24	41	30	260	204	1410	116.5
1345	10	35	4.455	26	24	42	30	260	204	1410	116.5
1400	8	-	4.400	26	24	42	30	260	204	1410	116.5
1415	0	-	4.480	26	24	42	30	260	204	1410	116.5
1430	-4.5	-	4.560	26	24	42	30	260	204	1410	116
1445	-6.7	-	4.625	26	25	42	30	260	207	1420	116
1500	-8.9	-	4.635	26	25	42	30	260	206	1420	116
1515	-10.5	-	4.640	26	25	42	30	260	204	1420	116
1530	-11.7	-	4.640	26	25	42	30	260	206	1420	116
1545	-12.8	-	4.630	26	26	43	30	260	208	1420	116.5
1600	-13.3	-	4.620	26	26	43	30	260	209	1430	116.5
1615	-13.9	-	4.615	26	26	43	30	265	207	1430	116.5
1630	-14.5	-	4.605	26	26	43	30	265	207	1420	116.5

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Table 69 (continued)

Summary

Temperature °C	Cycles Change	Percent Change per 1° C
50 to 40	495	0.0011
40 to 30	255	0.00056
30 to 20	385	0.00085
20 to 10	405	0.0009
10 to 0	35	0.00007
0 to -10	160	0.00035
-10 to -14.5	35	0.00015

Permitted by specifications: 0.006% per degree change in ambient temperature.

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Table 70

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

VARIATIONS IN TEMPERATURE

Test as per paragraph 7-13-8 of Specifications RE 13A 518B

Time	Temp °C	Rel Hum	Frequency kc	IPA Ig	IPA Ip	PA Ig	P.A. Ip	Plate E	Watts Out	Line E
0830	51	10	300.751	4.3	32	48	250	1440	185	117
0845	51	11	.796	4.3	32	48	245	1430	181	117
0900	50.5	9	.831	4.3	32	47	245	1420	179	117
0915	51	13	.859	4.3	31	47	240	1420	176	116.5
0930	41	9	.882	4.3	31	48	240	1430	179	118
0945	40	10	.898	4.3	32	47	245	1440	179	118
1000	40	10	.910	4.3	31	47	240	1430	179	117.5
1015	40	12	.920	4.3	31	47	240	1430	177	117.5
1030	36	12	.923	4.3	31	47	240	1420	176	117.5
1035	30	15	.924	4.3	31	47	240	1430	176	117.5
1050	30	15	.926	4.3	31	47	240	1420	175	117.5
1105	30	15	.925	4.3	32	47	245	1430	177	117.5
1120	30	15	.921	4.3	32	48	245	1430	177	117.5
1130	18	33	.914	4.3	32	48	245	1430	179	117.5
1145	20	33	.904	4.3	32	48	245	1420	177	117.5
1200	20	33	.895	4.3	32	48	250	1430	177	117.5
1215	19	39	.884	4.3	32	48	250	1420	177	117
1230	11	50	.875	4.2	32	48	250	1420	175	117
1245	11	45	.865	4.2	32	48	250	1420	177	117
1300	10	29	.854	4.2	32	48	250	1420	179	117
1315	10	34	.845	4.2	32	48	250	1430	179	117
1330	0	-	.836	4.2	32	49	250	1430	176	117
1345	-5	-	.825	4.2	32	50	250	1440	177	117
1400	-7.2	-	.803	4.2	33	50	255	1440	179	117
1415	-8.9	-	.779	4.2	33	50	260	1450	179	117
1430	-10	-	.761	4.2	34	50	260	1450	179	117.5
1445	-11.1	-	.741	4.2	34	50	260	1450	180	117.5
1500	-12.2	-	.725	4.2	34	50	260	1450	180	117.5
1515	-13.3	-	.711	4.2	34	50	260	1450	180	117.5
1530	-13.9	-	.700	3.9	34	50	260	1450	180	117.5
1545	-14.3	-	.690	3.9	34	50	260	1450	181	117.5
1600	-15.0	-	.680	3.9	34	50	260	1450	180	117.5
1615	-15.5	-	.671	3.8	34	50	260	1450	180	117

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Table 70 (continued)

Summary

Temperature ° C	Cycles Change	Percent Change per 1° C
50 to 40	61	0.002
40 to 30	1	-
30 to 20	37	0.0012
20 to 10	39	0.0013
10 to 0	9	0.0003
0 to -10	75	0.0025
-10 to -15	81	0.0054

Permitted by Specifications: 0.008% per degree change in ambient temperature.

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Table 71

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

VARIATIONS IN TEMPERATURE

Test as per paragraph 7-13-8 of Specifications RE 13A 518B

Time	Temp °C	Rel Hum	Frequency kc	IPA Ig	IPA Ip	PA Ig	P.A. Ip	Plate E	Watts Out	Line E
0830	51	24	1002.990	4.3	41	40	300	1390	261	115
0845	50	25	2.815	4.2	41	40	300	1400	261	116
0900	51	15	3.260	4.1	40	39	295	1390	254	116
0915	49	12	3.325	4.1	41	39	300	1400	263	117
0930	51	11	3.355	4.0	41	39	245	1400	262	117
0940	40	15	3.380	4.0	40	39	295	1400	261	117
0955	40	13	3.410	4.0	40	39	295	1400	261	117
1010	40	13	3.445	4.0	40	39	295	1400	260	117
1025	40	13	3.475	4.1	40	39	295	1400	258	117
1040	40	13	3.490	4.1	40	38	295	1390	257	116
1055	31	16	3.500	4.1	40	38	295	1390	257	116
1110	30	17	3.510	4.1	40	39	295	1390	257	116
1125	30	17	3.520	4.2	40	39	295	1390	258	116.5
1140	30	17	3.525	4.2	40	39	300	1390	258	116
1155	30	17	3.530	4.2	40	39	300	1390	258	116
1210	23	19	3.525	4.2	39	39	295	1390	255	116
1220	20	21	3.525	4.2	40	39	295	1390	256	116
1235	20	21	3.520	4.2	40	39	295	1390	256	116
1250	20	21	3.510	4.2	41	40	300	1390	256	116
1310	19	21	3.510	4.2	41	40	300	1390	256	116
1325	20	20	3.510	4.2	41	40	300	1400	258	116
1340	10	31	3.490	4.2	42	40	300	1400	256	116
1355	10	27	3.490	4.3	42	40	300	1400	260	116
1410	10	27	3.480	4.3	42	40	300	1400	260	116
1425	10	27	3.470	4.3	42	40	305	1400	261	116
1440	10	27	3.465	4.3	42	40	310	1400	262	116
1455	0	-	3.450	4.4	42	40	310	1400	262	116
1510	-5	-	3.425	4.4	42	40	310	1400	261	116
1525	-8.3	-	3.400	4.4	42	40	315	1400	261	116
1540	-10.6	-	3.370	4.4	43	41	320	1400	262	116
1555	-12.5	-	3.350	4.4	43	41	320	1400	266	116
1610	-14.2	-	3.325	4.5	44	42	320	1400	267	116
1625	-15.0	-	3.300	4.5	44	42	320	1400	266	116

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Table 71 (continued)

Temperature ° C	Cycles Change	Percent Change per 1° C
50 to 40	135	0.0013
40 to 30	35	0.0003
30 to 20	15	0.0001
20 to 10	45	0.0004
10 to 0	15	0.0001
0 to -10	80	0.0008
-10 to -15	70	0.0014

Permitted by specifications: 0.008%
per degree change in ambient temperature.

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Table 72

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

VARIATION IN HUMIDITY

Test as per paragraph 7-13-9 of Specifications RE 13A 518B

Time	Temp °C	Rel Hum	Frequency kc	MO Ip	1st IPA Ip	2nd IPA Ip	PA Ig	P.A. Ip	Plate E	Line E	Watts Out
1330	46.0	33	2003.990	20	25	56	50	310	1400	118	277
1345	45.5	33	3.875	20	25	56	50	305	1390	118	275
1400	46.0	31	3.875	20	25	56	50	305	1390	117	273
1415	45.0	58	3.550	20	25	56	50	300	1390	117	272
1430	46.0	76	3.375	20	25	56	50	300	1390	117	270
1445	45.5	71	3.325	20	25	55	50	300	1390	117	270
1500	46.0	82	3.160	20	25	55	50	300	1380	117	270
1515	46.0	82	3.100	20	25	56	50	300	1390	117	271
1530	45.0	92	2.850	20	25	56	50	300	1390	118	274
1545	44.5	94	2.855	20	25	55	50	300	1390	118	274
1555	45.0	90	2.890	20	25	55	50	300	1390	118	274
1600	46.0	63	3.340	20	25	56	50	300	1400	118	274
1615	45.5	31	3.675	20	25	56	50	300	1390	118	271
1630	46.5	39	3.675	20	25	56	50	300	1390	118	270

Frequency at end of 1st test: 2003.875 kc
Frequency at maximum change in 2nd and 3rd tests: 2002.850 kc
Frequency change: 1025 cycles
0.051%
Permitted by specifications: 0.2%

Maximum power reduction: 1.1%
Permitted by specifications: 25%

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Table 73

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

VARIATIONS IN HUMIDITY

Test as per paragraph 7-13-9 of Specifications RE 13A 518B

Time	Temp °C	Rel Hum	Frequency kc	MO Ip	1st IPA Ip	2nd IPA Ip	PA Ig	P.A. Ip	Plate E	Line E	Watts Out
0930	46.0	33	4502.860	26	24	40	30	255	1440	119	221
0945	45.5	33	3.140	26	24	40	30	250	1440	119	217
1000	46.0	31	3.990	26	24	40	30	250	1430	118	216
1015	46.0	49	3.510	26	24	40	29	250	1420	118	217
1030	45.5	58	3.270	26	24	40	29	250	1420	118	211
1045	46.0	68	2.560	26	24	41	29	250	1420	118	211
1100	45.0	90	2.060	26	24	41	29	250	1420	118	211
1115	46.0	94	1.610	26	23	40	28	250	1420	118	211
1130	45.5	97	1.620	26	23	40	29	250	1420	118	211
1145	46.0	94	1.790	26	23	40	28	250	1420	118	211
1200	46.0	94	1.890	26	23	40	29	245	1420	118	211
1215	46.5	43	3.630	26	24	40	28	245	1420	118	211
1230	46.0	33	4.250	26	24	40	28	245	1420	118	210
1245	46.0	33	4.455	26	24	40	28	250	1420	118	210
1300	46.0	31	4.600	26	24	40	29	250	1420	118	210
1315	45.5	33	4.640	26	24	40	29	245	1420	118	210
1330	46.0	31	4.700	26	24	40	29	250	1420	118	210

Frequency at end of 1st test: 4503.990 kc
Frequency at maximum change in 2nd and 3rd tests: 4501.610
Frequency change: 2380 cycles
0.053%
Permitted by specifications: 0.2%

Maximum power reduction: 3%
Permitted by specifications: 25%

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Table 74

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

VARIATION IN HUMIDITY
(Power Source: XTBR-1 Alternator belted to D.C. Driving Motor)

Test as per paragraph 7-13-9 of Specifications RE 13A 518B

Time	Temp °C	Rel Hum	Frequency kc	IPA Ig	IPA Ip	PA Ig	P.A. Ip	Plate E	Alt E	Watts Out	Alt f
0930	46.0	31	1003.650	4.3	40	39	295	1370	117	242	60
0945	46.5	32	3.700	4.3	40	38	290	1360	117	237	60
1000	44.5	34	3.760	4.3	40	38	290	1360	116	236	60
1015	46.0	76	3.400	4.3	40	38	290	1350	117	229	60
1030	45.0	94	3.070	4.3	40	38	290	1350	116	228	60
1045	46.0	94	3.040	4.2	40	38	290	1350	117	227	60
1100	46.0	94	3.050	4.2	40	38	290	1350	116	224	60
1115	46.0	94	3.060	4.2	39	38	290	1350	116	224	60
1130	45.5	97	3.105	4.2	38	38	285	1350	116	224	60
1145	45.5	41	3.510	4.2	40	38	290	1350	116	229	60
1200	46.0	32	3.700	4.2	40	38	290	1360	117	234	60
1215	45.5	31	3.800	4.2	40	38	290	1350	117	230	60
1230	45.5	31	3.850	4.3	40	38	290	1350	116	230	60
1245	45.5	31	3.890	4.2	39	38	280	1350	116	227	60
1300	46.0	32	3.920	4.3	40	38	290	1350	116	232	60

Frequency at end of 1st test: 1003.760 kilocycles
Frequency at maximum change in 2nd and 3rd tests: 1003.040
Frequency change: 720 cycles
0.072%
Permitted by specifications: 0.2%

Maximum power reduction: 5%
Permitted by specifications: 25%

Alternator Temperature, start of test: 46°C
end of test: 58°C

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Table 75

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

VARIATIONS IN HUMIDITY

Test as per paragraph 7-13-9 of Specifications RE 13A 518B

Time	Temp °C	Rel Hum	Frequency kc	Watts Out	IPA Ig	IPA Ip	P.A. Ig	P.A. Ip	Plate E	Line E
0845	46.0	33	300.490	178	4.4	32	48	250	1410	116
0900	46.0	31	.573	178	4.3	31	48	245	1410	115
0915	46.0	31	.633	175	4.3	31	48	245	1410	116
0930	46.0	31	.680	173	4.3	31	48	245	1410	116
0945	46.0	31	.711	175	4.3	31	48	245	1410	116
1000	46.0	71	.676	168	4.3	31	47	240	1400	116
1015	46.0	88	.574	161	4.3	31	47	235	1400	115.5
1030	46.0	94	.550	161	4.3	31	47	230	1400	116
1045	46.0	97	.562	157	4.2	31	47	230	1400	116
1100	46.0	97	.565	157	4.1	31	47	230	1400	116
1115	46.0	95	.570	157	4.1	31	47	230	1400	116
1130	46.0	94	.575	157	4.1	31	47	230	1400	116
1145	48.0	35	.685	168	4.1	31	47	240	1400	116
1200	45.5	33	.742	168	4.0	31	47	240	1400	116
1215	45.5	35	.764	169	4.0	31	47	240	1400	116

Frequency at end of 1st test: 300.711 kilocycles
Minimum frequency during 2nd and 3rd tests: 300.550

Frequency change: 161 cycles
0.052%

Specification requirements: 0.2%

Maximum power reduction: 10%
Specification Requirements: 25%

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Table 76

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

LOCKED KEY OPERATION FOR TWO HOURS

Test as per paragraph 7-13-10 of Specifications RE 13A 518B

Time	Temp °C	Frequency kc	Power Out	MO Ip	1st IPA Ip	2nd IPA Ip	PA Ip	Line E	Plate E	P.A. Ig
1300	45.5	2000.630	280	19.5	24	56	305	113	1350	50
1310	46.0	.515	277	19.5	24	56	300	114	1350	50
1320	45.5	.480	270	20.0	24	56	305	114	1350	50
1330	46.0	.463	276	19.5	24	56	300	114	1350	50
1340	45.5	.455	268	19.5	24	56	300	114	1330	50
1350	45.5	.465	253	18.5	22	54	285	109	1300	48
1400	45.5	.450	273	19.0	24	56	300	113	1350	50
1410	46.0	.448	268	19.0	24	56	300	113	1350	50
1420	46.0	.442	268	19.0	24	56	300	113	1350	50
1430	45.5	.442	265	19.0	24	56	300	113	1350	49
1440	46.0	.458	257	18.5	22	54	290	109	1300	48
1450	46.0	.443	257	18.5	23	54	290	111	1300	48
1500	46.0	.440	257	18.5	22	54	290	110	1300	48

Maximum change in frequency during run from frequency at end of first 20 minutes - 40 cycles
0.002%

Permitted by specifications: 0.005%

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Table 77

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

LOCKED KEY OPERATION FOR TWO HOURS

Test as per paragraph 7-13-10 of Specifications RE 13A 518B

Time	Temp °C	Frequency kc	Power Out	MO Ip	1st IPA Ip	2nd IPA Ip	PA Ip	Line E	Plate E	P.A. Ig
0900	45.5	4500.850	254	27	23	41	290	112	1470	31
0910	45.5	.638	248	27	23	40	290	112	1470	30
0920	46.0	.555	245	27	22	41	280	111	1450	30
0930	45.5	.528	243	27	23	42	280	111	1480	30
0940	46.0	.538	240	27	22	44	280	111	1480	30
0950	46.0	.535	245	27	23	46	280	112	1470	30
1000	45.5	.541	248	27	23	46	285	113	1490	30
1010	45.5	.565	240	27	22	46	280	112	1460	30
1020	45.5	.611	230	27	22	44	275	110	1450	30
1040	45,5	.711	232	27	22	44	270	110	1450	30
1050	45.5	.721	230	27	22	45	275	108	1450	30
1100	46.0	.730	238	27	22	45	275	111	1450	30
1105	46.0	.725	240	27	22	46	280	113	1470	30

Maximum change in frequency during run from frequency at end of first 20 minutes - 175 cycles
0.0039%

Permitted by specifications: 0.005%

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Table 78

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

LOCKED KEY OPERATION FOR TWO HOURS

Test as per paragraph 7-13-10 of Specifications RE 13A 518B

Time	Temp °C	Frequency kc	Power Out	IPA Ig	IPA Ip	P.A. Ig	P.A. Ip	Plate E	Line E
1300	45.5	300.667	188	4.3	34	44	265	1470	111.5
1310	46.0	.665	184	4.2	34	44	260	1460	111.5
1320	45.5	.655	186	4.2	34	44	265	1470	112.0
1330	45.5	.655	185	4.2	34	44	265	1470	112.0
1340	45.5	.655	184	4.2	34	43	260	1470	111.5
1350	45.5	.656	181	4.2	34	43	260	1450	111.5
1400	46.0	.658	183	4.2	33	43	260	1450	111.0
1410	45.5	.660	184	4.2	34	43	260	1450	112.0
1420	45.5	.660	180	4.2	34	43	260	1460	111.5
1430	45.5	.663	184	4.2	34	44	260	1460	112.0
1440	45.5	.665	184	4.2	34	43	260	1460	112.0
1450	45.5	.667	182	4.2	34	43	260	1460	112.0
1500	45.5	.667	181	4.2	34	43	260	1460	111.5

Maximum change in frequency during run from frequency at end of first 20 minutes - 12 cycles
0.004%

Permitted by Specifications: 0.025%

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Table 79

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

LOCKED KEY OPERATION FOR TWO HOURS

Test as per paragraph 7-13-10 of Specifications RE 13A 518B

Time	Temp °C	Frequency kc	Power Out	IPA Ig	IPA Ip	P.A. Ig	P.A. Ip	Plate E	Line E
0940	45.0	1000.760	217	4.0	42	38	250	1480	110
0950	45.5	.752	217	3.8	42	38	250	1480	110.5
1000	45.5	.761	217	3.8	42	38	250	1480	110.5
1010	45.5	.770	217	3.8	42	38	250	1480	111
1020	46.0	.780	217	3.8	42	38	245	1480	111
1030	46.0	.785	210	3.8	42	37	240	1450	110
1040	45.5	.796	214	3.8	42	37	240	1480	110.5
1050	46.5	.807	213	3.8	42	37	240	1480	110.5
1100	46.0	.820	212	3.8	42	37	240	1480	111.5
1110	46.0	.830	211	3.7	42	37	240	1470	111
1120	46.5	.838	210	3.8	42	37	240	1460	109
1130	46.0	.851	211	3.8	42	37	240	1470	111
1140	46.0	.860	211	3.7	42	37	240	1480	111

Maximum change in frequency during run from frequency at end of first 20 minutes - 99 cycles
0.01%

Permitted by specifications: 0.025%

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Table 80

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

CHANGE FROM KEY LOCKED TO INTERMITTENTLY KEYED CONDITION

Test as per paragraph 7-13-11 of Specifications RE 13A 518B

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	Percent
Fil lighted	2000.700	2000.780	80	0.004
Fil not lighted	2000.624	2000.819	195	0.0097
Fil lighted	4500.435	4500.542	107	0.0024
Fil not lighted	4500.292	4500.768	476	0.0106

Permitted by Specifications:
Filament lighted: 0.01%
Filament not lighted: 0.05%

Table 81

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

CHANGE FROM KEY LOCKED TO INTERMITTENTLY KEYED CONDITION

Test as per paragraph 7-13-11 of Specifications RE 13A 518B

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	Percent
Fil lighted	2000.598	2000.665	67	0.0033
Fil not lighted	2000.619	2000.782	163	0.0081
Fil lighted	300.607	300.613	6	0.002
Fil not lighted	300.611	300.630	19	0.0065

Permitted by Specifications:
Filaments lighted: 0.02%
Filaments not lighted: 0.05%

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Table 82

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

CHANGE FROM CONTINUOUSLY KEYED CONDITION
TO INTERMITTENTLY KEYED CONDITION

Test as per paragraph 7-13-12 of Specifications RE 13A 518B

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
2000.703	2000.738	35	0.0017
4500.827	4500.928	101	0.0022

Permitted by specifications: 0.005%

Table 83

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

CHANGE FROM CONTINUOUSLY KEYED CONDITION TO
INTERMITTENTLY KEYED CONDITION

Test as per paragraph 7-13-12 of Specifications RE 13A 518B

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
300.628	300.633	5	0.0016
2000.675	2000.715	40	0.002

Permitted by specifications: 0.01%

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Table 84

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

INCLINATION DUE TO ROLL AND PITCH OF SHIP

Test as per paragraph 7-13-13 of Specifications RE 13A 518B

Time	Frequency kilocycles Max.	Min.	
0905	2000.419	2000.419	Vertical
0910	.418	.450	Inclination
0915	.420	.455	"
0920	.425	.458	"
0925	.428	.462	"
0930	.432	.468	"
0935	.436	.470	"
0935	.442	.442	Vertical
0940	.445	.445	"
0945	.446	.446	"

Frequency when vertical (start): 2000.419
Frequency at maximum change: 2000.470
Change in frequency: 51 cycles
0.0025%

Frequency when vertical (end): 2000.446
Frequency at maximum change: 2000.470
Change in frequency: 24 cycles
0.0012%

Permitted by specifications: 0.001%

Note: Transmitter was operated key locked until the major portion of the drift had ceased, before test was started.

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Table 85

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

INCLINATION DUE TO ROLL AND PITCH OF SHIP

Test as per paragraph 7-13-13 of Specifications RE 13A 518B

Time	Frequency kilocycles Max.	Min.	
1020	4500.642	4500.642	Vertical
1025	.618	.668	Inclination
1030	.623	.673	"
1035	.628	.678	"
1040	.633	.683	"
1045	.639	.690	"
1050	.643	.694	"
1050	.663	.663	Vertical
1055	.672	.672	"
1100	.677	.677	"

Frequency when vertical (start): 4500.642
Frequency at maximum change: 4500.694
Change in Frequency: 52 cycles
0.0011%

Frequency when vertical (end): 4500.677
Frequency at maximum change: 4500.694
Change in frequency: 17 cycles
0.00034%

Permitted by specifications: 0.001%

Note: Transmitter was operated key locked until the major portion of the drift had ceased, before test was started.

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Table 86

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

INCLINATION DUE TO ROLL AND PITCH OF SHIP

Test as per paragraph 7-13-13 of Specifications RE 13A 518B

Time	Frequency kilocycles Max.	Min.	Condition
0915	300.661	300.661	Vertical
0920	.660	.667	Inclination
0925	.660	.669	"
0930	.661	.670	"
0935	.664	.674	"
0940	.667	.677	"
0945	.670	.679	"
0945	.680	.680	"

Frequency when vertical (start): 300.661
Frequency at maximum change: 300.679
Change in frequency: 18 cycles
0.006%

Frequency when vertical (end): 300.680
Frequency at maximum change: 300.660
Change in frequency: 20 cycles
0.0066%

Permitted by specifications: 0.05%

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Table 87

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

INCLINATION DUE TO ROLL AND PITCH OF SHIP

Test as per paragraph 7-13-13 of Specifications RE 13A 518B

Time	Frequency kilocycles Max.	Min.	Condition
1555	1000.747	1000.747	Vertical
1600	.746	.729	Inclination
1605	.744	.725	"
1610	.745	.728	"
1615	.746	.727	"
1620	.748	.726	"
1625	.745	.730	"
1625	.741	.741	Vertical

Frequency when vertical (start): 1000.747
Frequency at maximum change: 1000.725
Change in frequency: 22 cycles
0.0022%

Frequency when vertical (end): 1000.741
Frequency at maximum change: 1000.725
Change in frequency: 16 cycles
0.0016%

Permitted by specifications: 0.05%

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Table 88

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

VIBRATION TEST

Test as per paragraph 7-13-14 of Specifications RE 13A 518B

Time	Frequency kc	Antenna I	P.A. Ip	P.A. Ep	Line E	Condition
1120	4502.500	2.2	240	1400	117	No vibration
1125	2.425	2.2	245	1400	117	Vibrating
1130	2.375	2.2	245	1400	117	Vibrating
1135	2.400	2.2	245	1400	117	Vibrating
1140	2.450	2.2	245	1400	117	Vibrating
1145	2.400	2.2	245	1400	117	Vibrating
1150	2.375	2.2	245	1400	117	Vibrating
1200	2.430	2.2	245	1400	117	No vibration

Maximum set in frequency - 70 cycles
0.0015%
Permitted by specifications - 0.01%

1400	2000.482	2.5	300	1370	116	No vibration
1405	.470	2.5	300	1370	116	Vibrating
1410	.450	2.5	300	1370	116	Vibrating
1415	.455	2.5	300	1370	116	Vibrating
1420	.460	2.4	300	1360	116	Vibrating
1425	.460	2.4	300	1360	116	Vibrating
1430	.480	2.4	300	1360	116	Vibrating
1440	.467	2.5	300	1360	116	No vibration

Maximum set in frequency - 15 cycles
0.0007%
Permitted by specifications - 0.01%

DETERMINATION OF CARRIER NOISE - PHONE OPERATION

	Mod. Ind.	% Mod.	Noise - DB	PA Ip	Ant I
		(4500 kc)			
No vibration:	90	86	33	130	1.00
Vibrating:	88	86	32	130	1.00
		(2000 kc)			
No vibration:	80	86	50	140	1.00
Vibrating:	80	86	45	140	1.00

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Table 89

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

VIBRATION TEST

Test as per paragraph 7-13-14 of Specifications RE 13A 518B

Time	Frequency kc	Antenna I	P.A. Ip	P.A. Ep	Line E	Condition
0900	300.770	3.0	250	1410	116	No vibration
0905	.812	3.0	250	1410	116	Vibrating
0910	.840	3.0	250	1410	116	"
0915	.830	3.0	250	1410	117	"
0920	.822	3.0	250	1410	117	"
0925	.822	3.0	250	1410	117	"
0930	.835	3.0	250	1410	117	"
0930	.838	3.0	250	1410	117	No vibration

Maximum set in frequency: 68 cycles
0.022%
Permitted by specifications: 0.02%

1425	1000.666	3.5	295	1370	115	No vibration
1430	.678	3.5	295	1370	115	Vibrating
1435	.675	3.5	295	1360	115	"
1440	.700	3.5	295	1360	115	"
1445	.711	3.5	295	1370	116	"
1450	.708	3.5	295	1370	116	"
1455	.710	3.5	295	1370	116	"
1455	.720	3.5	295	1370	116	No vibration

Maximum set in frequency: 54 cycles
0.0054%
Permitted by specifications: 0.02%

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Table 90

Model XTBR-1 Radio Equipment
High Frequency Transmitter Unit

SHOCK TEST

Test as per paragraph 7-13-15 of Specifications RE 13A 518B

	Frequency kc 1 minute before shock	Frequency kc 2 minutes after shock	Frequency Change Cycles	Frequency Change Percent
1	4500.575	4500.629	54	0.0012
2	.629	.620	9	0.0002
3	.619	.628	9	0.0002
4	.628	.630	2	0.00004
1	2000.722	2000.699	23	0.00115
2	.698	.700	2	0.0001
3	.700	.703	3	0.00015
4	.703	.715	12	0.0006

Permitted by specifications: 0.002%

Table 91

Model XTBR-1 Radio Equipment
Intermediate Frequency Transmitter Unit

SHOCK TEST

Test as per paragraph 7-13-15 of Specifications RE 13A 518B

	Frequency kc 1 minute before shock	Frequency kc 2 minutes after shock	Frequency Change Cycles	Frequency Change Percent
1	300.695	300.670	25	0.008
2	.670	.652	18	0.006
3	.652	.651	1	0.0003
4	.651	.649	3	0.001
1	1000.645	1000.607	38	0.0038
2	.608	.593	15	0.0015
3	.593	.575	18	0.0018
4	.576	.573	3	0.0003

Permitted by specifications: 0.002%

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Table 92

Model XTBR-1 Radio Equipment
Rectifier Unit

SHOCK TEST

Test as per paragraph 7-13-15 of Specifications RE 13A 518B

	Line E	Main Rectifier Before	Main Rectifier After	Aux. Rectifier Before	Aux. Rectifier After	I.F. Transmitter Unit P. A. Ip Before	P. A. Ip After	Frequency Before (1000 kc)	Frequency After (1000 kc)
1	116	1390	1390	560	560	295	295	501	500
2	116	1390	1390	560	560	295	295	500	500
3	116	1390	1390	560	560	295	295	500	500
4	116	1390	1390	560	560	295	295	500	500

No change in operation of rectifier unit or transmitter noted during or after completion of test.

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Table 93

Model XTBR-1 Radio Equipment
Alternator Unit

ENDURANCE TEST

Test as per paragraph 5-4 of Specifications RE 13A 506B

Time	Alternator Output Volts	Alternator Frequency	I. F. Transmitter Plate E	P.A. Ip	Amb. Temp.°C
1415	115	60	1350	290	45.0
1425	115	60	1350	280	46.5
1435	115	60	1350	280	46.0
1445	113	60	1330	280	43.0
1455	114	60	1330	280	47.0
1505	113	60	1320	280	47.5
1515	113	60	1310	280	45.0
1525	113	60	1320	280	45.0
1535	113	60	1320	280	45.0
1545	113	60	1320	280	45.0
1555	113	60	1320	275	45.0
1605	112	60	1300	275	45.0
1615	113	60	1320	275	45.0

Note: Alternator was placed within Temperature Test Room and used to energize the Intermediate Frequency Transmitter Unit at full power output. Alternator was driven by D.C. Motor through medium of belt and pulleys.

Temperature of Alternator Shell at start: 45.0° C
" " " " " 2nd of two hour test period: 53.0° C.
Temperature rise: 8° C.

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Table 94

Model XTBR-1 Radio Equipment
Generator Unit

CHARACTERISTICS OF GENERATOR UNIT

Test as per paragraph 5-5 of Specifications RE 13A 506B

Specifications state that with the exciter excitation so adjusted that with a battery counter e.m.f. of 6.45 volts a current of 20 amperes is flowing, opening of the (charging) circuit shall not result in an increase of the alternator excitation voltage in excess of 11%. (Contract Note, page 4, permits increase from 10% to 11%).

Regulator relay energized at full load condition; regulator relay open in no load condition.

	1	2	3
Engine r.p.m. (Exciter loaded)	1870	1870	1875
Exciter load (into battery) amps.	20	20	20
Exciter voltage*	7.3	6.8	6.7
Alternator voltage, No Load	115	115	115
Engine r.p.m. - Exciter load removed	1875	1875	1880
Exciter voltage - Load removed*	7.9	7.9	7.9
Alternator Voltage - Exciter load off	120	120	120
Increase in exciter voltage	8.2%	16%	19%
Engine r.p.m. (Exciter loaded)	1815	1775	1790
Exciter load (into battery) amps.	20	20	20
Exciter voltage*	7.3	6.8	6.7
Alternator voltage, Full Load	115	115	115
Engine r.p.m. - Exciter load removed	1830	1800	1800
Exciter voltage - Exciter load removed*	7.9	7.7	7.8
Alternator voltage - Exciter load off	119	119	119
Increase in exciter voltage.	8.2%	13%	16%

Note: *Exciter voltages tabulated in column 1 were measured with the panel voltmeter supplied with equipment. Exciter voltages tabulated in columns 2 and 3 were measured with precision meter connected across ends of battery cables.

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Table 95

Model XTBR-1 Radio Equipment
Generator Unit

CHARACTERISTICS OF GENERATOR UNIT

Test as per paragraph 5-6 of Specifications RE 13A 506B

Specifications state that with full load applied to both alternator and exciter and with the exciter voltage initially adjusted to 7.5 and the alternator to 115 at 25°C; both excitations being thereafter left intact, the decrease in voltage upon continuous operation until maximum temperature has been reached, shall not exceed 14%, nor shall the change in the alternator exciter voltage exceed 7% (Contract Notes, Page 4, permit the values of 14% and 7%).

	Amb	Gen	Alternator			Exciter			
Time	°C	Temp	E	I	W	E	I	W	RPM
1300	23.0	30.0	115	13.5	1555	7.3	18.2	133	1805
1315	23.5	34.0	111	13.1	1454	6.9	17.8	123	1800
1330	24.0	38.0	112	13.1	1468	7.1	18.2	128	1800
1345	24.0	41.0	111	13.0	1442	7.0	18.1	127	1800
1400	24.0	43.0	110	12.8	1410	6.9	17.8	123	1800
1415	24.5	44.0	109	12.7	1385	6.8	17.6	120	1800
1430	24.5	44.0	108	12.6	1360	6.7	17.2	115	1800
1445	25.0	44.5	107	12.5	1340	6.6	17.0	112	1800
1500	25.5	45.0	105	12.3	1290	6.4	16.6	106	1800
1515	25.5	45.5	104	12.2	1270	6.3	16.3	103	1810
1530	26.0	45.0	107	12.5	1338	6.6	16.6	109	1800
1545	26.5	46.0	105	12.4	1304	6.6	16.4	108	1810

Maximum change in alternator voltage: 11 volts
9.5 per cent

Maximum change in exciter voltage: 1 volt
13.7 per cent

Note: Engine ran 20 seconds after shut-down due to pre-ignition.

Just before the readings were taken at 1530 it was noticed that the exciter voltage was fluctuating badly. Investigation revealed that exciter fuse was heating badly. The fuse was securely tightened and the exciter voltage increased from 6.3 to 6.6

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Table 96

Model XTBR-1 Radio Equipment
Alternator Unit

CHARACTERISTICS OF ALTERNATOR UNIT

Test as per paragraph 5-7 of Specifications RE 13A 506B

Conditions of Test:
R.P.M. - 1800
Alternator load resistance - 8.52 ohms
Alternator current - 13.4 amperes
Alternator voltage - 115.0 volts
Alternator output - 1530 watts
Ambient temperature - 24.0° C

D.C. Exciter load resistance - 0.37 ohm
D.C. Exciter current - 18.2 amperes
D.C. Exciter voltage - 7.0 volts
D.C. Exciter output - 123 watts

(1) Specifications require that alternator output voltage shall not exceed 124 volts or be less than 114 volts.

Alternator output volts - 115 volts

(2) Specifications require that the inherent regulation shall be such that when the alternator load is removed the voltage shall not increase beyond 145 volts.

Removal of the A.C. load (exciter loaded to 123 watts output) caused the alternator voltage to surge to 142 volts and then steady down at 132 volts.

Removal of the A.C. load (exciter unloaded) caused the alternator voltage to surge to 140 volts and steady down at 131 volts.

(3) Specifications require that with the "key up" voltage adjusted to 115 volts with a fixed load of any amount from 300 to 700 watts applied to the alternator, an additional keyed load of any value from 300 to 700 watts shall not cause an increase or decrease in voltage in excess of 5 volts.

Fixed alternator load - 494 watts at 112 volts
Additional keyed load - 598.5 watts

	Voltage	Current
Key up	112	4.5
Key down	115	9.5

Voltage difference: 3 volts

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Table 96 (continued)

(4) Specifications require that the wave form at full load shall be such that no harmonic voltage of the fundamental frequency (60 cycles) or any slot ripple, shall exceed 10% of the fundamental.

	Full Load		No Load	
	Volts	Percent	Volts	Percent
Fundamental	120		120	
2nd Harmonic	-	-	-	-
3rd Harmonic	10.2	8.5	2.1	1.75
4th Harmonic	-	-	-	-
5th Harmonic	4.2	3.5	3.3	2.75
6th Harmonic	-	-	-	-

Table 97

Model XTBR-1 Radio Equipment
Engine Driven Equipment

REGULATION OF ENGINE EQUIPMENT

Test as per paragraph 5-12 of Specifications RE 13A 506B

Specifications state that with the engine governor adjusted so that a speed of 1750 r.p.m. is obtained with a battery charging current of 20 amperes and an alternator load of 1.6 kva (90% P.F.) at 115 volts, gradual removal of charging load and alternator load shall not result in an engine speed in excess of 1925 r.p.m.

Alternator Load I	Exciter Load I	R.P.M.
12.3	18.6	1750
10.0	15.0	1755
8.0	10.0	1762
6.0	5.0	1785
4.0	2.0	1795
2.0	1.7	1810
0	0	1820

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Table 98

Model XTBR-1 Radio Equipment
Engine Driven Equipment

REGULATION OF ENGINE EQUIPMENT

Tests as per pars. 5-13, 5-14, and 5-15 of Specifications RE 13A 506B

(1) Par. 5-13

Specifications state that with engine governor adjusted so that a speed of 1750 r.p.m. is obtained, with a battery charging load of 20 amperes and an alternator load of 500 watts, a gradual increase in alternator load to 1200 watts shall not cause a decrease in engine speed in excess of 4 per cent.

Exciter load 7.5 volts at 20 amperes
Alternator load 115 volts at 4.35 amperes
R.P.M. - 1750

Load of alternator gradually increased to 1200 watts
I - 11 amperes; E - 106 volts
R.P.M. - 1705

Decrease in speed 45 r.p.m. or 2.5 per cent

(2) Par. 5-14

Specifications state that under same conditions as 5-13 above, but with the 700 watt load increase keyed on and off at a speed of 3 applications per second, the speed shall not decrease more than 2 per cent.

Exciter load 7.5 volts, 20 amperes
Alternator load, "key open" - 500 watts
Alternator load, "key closed" - 1200 watts

R.P.M. under "key open" condition - 1750
R.P.M. under "key closed" condition at rate of
3 applications per second - 1730

Decrease in speed - 20 r.p.m.; or 1.1 per cent

(3) Par. 5-15

Specifications state that under the conditions of 5-14 above but with the 700 watt load applied and removed suddenly, no "hunting" of the engine speed shall exceed 50 r.p.m. above or below the resultant steady speed.

	1	2	3
500 watt load, r.p.m.	1750	1750	1750
1200 watt load, r.p.m.	1705	1710	1710
Difference in r.p.m.	45	40	40

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Table 99

Model XTBR-1 Radio Equipment

DIMENSIONS OF UNITS

Data as per paragraph 2-52 of Specifications RE 13A 518B

(1) Transportation Box for Accessories
Depth: 18"
Width: 13"
Height: 23-1/4"

(2) Gasoline Engine with Cover (Dismounted)
Length: 19-1/4"
Width: 16-1/4"
Height: 22-5/8"

(3) Engine-Alternator Base
Length: 44-5/8"
Width: 17"
Height: 4-1/8"

(4) Control Panel
Height: 7-7/8"
Length: 18-1/4"
Width: 17"

(5) Engine-Alternator Base with control panel (stowage condition)
Length: 44-5/8"
Width: 17"
Height: 12"

(6) Intermediate Frequency Transmitter Unit
Depth: 18-1/8"
Width: 20"
Height: 35-7/8"

(7) High Frequency Transmitter Unit
Depth: 18-1/8"
Width: 20-1/8"
Height: 36"

(8) Rectifier Unit
Depth: 14-1/4"
Width: 20"
Height: 36"

(9) Loading Coil
Height: 12-1/2"
Width: 16"
Depth: 15-3/4"

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Table 99 (continued)

(10) Gasoline Container
Diameter: 10-5/8"
Diameter (handle down): 11-1/2"
Height: 20-7/8"

(11) Transportation Cart - Assembled
Overall length, handle attached: 10 ft. 10-1/2 in.
Overall width: 47-3/4"
Body length: 70-3/4"

(12) Transportation Cart - Disassembled for storage
Overall length: 6 ft. 4-3/8 in.
Overall width: 37-1/2"
Depth: 19-1/2"

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Table 100

Model XTBR-1 Radio Equipment

CABLES FOR OPERATION OF EQUIPMENT

Data as per paragraphs 8-8 and 8-9 of Specifications RE 13A 518B

Cable No.	Color Code	Length ft.	No. of Cond.	Purpose
1	Blue and amber	50 ft.	8	A.C. supply from Engine Unit to rectifier. 1-cond. and shield grounded 4-cond. and 3-cond. in parallel
2	Green and white	50 ft.	8	Start-stop control of engine. Keying compensation circuit 1-cond. and shield grounded.
3	Blue and amber	50 ft.	8	Extension for cable no. 1; fitted with plug and socket.
4	Green and white	50 ft.	8	Extension for cable no. 2; fitted with plug and socket.
5	Blue and amber	10 ft.	8	Extension for cable no. 1; fitted with 1 plug.
6	Green and white	10 ft.	8	Extension for cable no. 2; fitted with 1 plug.
7	Blue and green	7 ft.	8	Control circuits between Rectifier and transmitters; and a.c. filament supply.
8	Blue and red	7 ft.	8	Bias circuits between rectifier and transmitters.
9	Red and white	7 ft.	1	Auxiliary plate potential between rectifier and transmitters.
10	Red and amber	7 ft.	1	Main plate potential between rectifier and transmitters.
11	Amber and white	8 ft.	3	A.C. supply between rectifier and receiver (1 cond. grounded)
12	Black and white	8 ft.	1	Antenna connection between receiver and transmitter.

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Table 100 (continued)

Cable No.	Color Code	Length ft.	No. of Cond.	Purpose
13	None	8 ft.	5	Connections between receiver and receiver power unit.
14	None	10 ft.	2	6 volt supply from battery to receiver power unit.
15	None	25 ft.	2	115 volt trouble light.
16	Red	3 ft.	1	Plus connection from battery to control panel.
17	White	3 ft.	1	Minus connection from battery to engine control panel.
18	Green and amber	30 in.	8	A.C. line from alternator to control panel (fixed on one end)
19	Blue and white	30 in.	8	Field supply from control panel to generators (one end fixed)
20	Red and green	42 in.	2	Ignition shorting cable between control panel and magneto (one end fixed)
21	Green	30 in.	1	Starting circuit between generator and control panel (one end fixed)
22	Amber	30 in.	1	Starting and charging circuits between generator and control panel (one end fixed)
23	Blue	30 in.	1	Charging circuit between generator and control panel (one end fixed)

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